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## 2 Résumé



Pour des raisons de commodité discursive, la forme masculine est utilisée dans ce travail. Toutefois, il est entendu que tout ce qui est amené à la forme masculine s'entend également au féminin.

## **2.1 Problématique**

A l'aube du 21<sup>ème</sup> siècle (2015), la Suisse compte plus de 8 millions d'habitants (Office fédéral de la statistique OFS, 2015). Selon une statistique de 2012, plus de 40% de la population a consommé au moins un médicament quelconque au cours des 7 derniers jours (Office fédéral de la statistique OFS, 2015). Depuis un siècle la pharmacologie s'est fortement développée. Dès lors, le médicament est devenu un produit central pour soigner, voire guérir les maladies et améliorer la santé de la population. Cependant, les médicaments ont également des effets néfastes et des coûts importants.

Par notre expérience, une revue exploratoire et en interrogeant des professionnels de la santé, nous avons conscience que l'infirmier a un rôle important dans la gestion de la médication de la population soignée. Cette même population qui consomme parfois un nombre de médicaments important (polymédication), entraînant des effets indésirables.

Nous cherchons dans ce travail à démontrer cela et apporter des pistes de réflexions et d'intervention afin de diminuer les risques liés à la polymédication.

## **2.2 Concepts abordés**

Les concepts de polymédication en lien avec celui des personnes âgées y seront abordés. L'ancrage disciplinaire est présenté afin de démontrer l'intérêt pour la discipline infirmière. Nous aborderons aussi les concepts de prévention et de rôle infirmier.

## **2.3 Méthode**

Pour parvenir à réaliser ce travail, nous nous sommes interrogés sur la thématique. Celle-ci, nous a conduits à partager nos expériences et de nos réflexions en découle une question générale. Par la suite, nous avons fait une recherche de littérature afin d'approfondir nos connaissances et démontrer la pertinence du sujet. Pour démontrer cette pertinence, ce travail présente comment cette question s'intègre dans la discipline infirmière. Dès lors, nous avons posé des concepts principaux qui nous ont permis de formuler une question PICOT (Population, Intervention, Comparison, Outcomes, Time). Répondre à cette question en amenant des éléments issus de recherches d'articles scientifiques en explorant des bases de données (CINHAL, PubMed, Cochrane Library, PsycInfo, Medline) constitue un élément essentiel dans la construction de ce travail. L'analyse et le traitement de ces études au travers de grilles de Fortin (2010), nous ont permis d'y trouver des résultats et des recommandations pour la pratique.

## **2.4 Résultats**

Les résultats obtenus sont divers et variés, c'est la combinaison de plusieurs interventions qui permettra de prévenir les risques liés à la polymédication : l'éducation thérapeutique, l'approche multidisciplinaire, les connaissances et la formation du personnel de santé, les logiciels et outils d'aide à la décision.

## **2.5 Conclusion**

Cette démarche nous a permis d'accroître nos connaissances de la discipline infirmière et de développer un perfectionnement du rôle propre de l'infirmier. Elle nous permet donc de faire un pas supplémentaire sur le chemin de la professionnalisation. Toutefois, nos interventions sont limitées par leur manque de preuve. Des recherches supplémentaires sont nécessaires. De plus, la décision finale du changement de la médication revient au médecin ; cela pose les limites du rôle médico-délégué.

## **2.6 Mots-clés**

Personne âgée, polymédication, prévention, rôle infirmier

# 3 Introduction

### **3.1 Nature du travail réalisé dans le cadre du Travail de Bachelor**

Dans le cadre de notre formation HES en Soins Infirmiers, nous devons réaliser un travail de Bachelor comprenant plusieurs thématiques proposées majoritairement par des institutions de soins. Notre travail aborde la thématique des approches médicamenteuses dans l'accompagnement des personnes âgées. Plusieurs raisons nous ont incités à traiter ce sujet.

Premièrement, bien qu'il s'agisse d'un acte médico-délégué, l'infirmier a un rôle important dans la gestion et la relation aux médicaments. Quant au patient, il est l'élément central à qui la médication est destinée. Cette médication, qui avec l'évolution de la médecine, évolue fortement et devient indispensable pour améliorer et maintenir la santé du patient. Mais à quel prix ? Nous ne sommes pas sans savoir que des interactions médicamenteuses peuvent se produire lorsque nous additionnons des médicaments et cela s'amplifie avec la quantité de traitements différents consommés. De même, cela peut augmenter l'apparition « d'effets indésirables médicamenteux (EIM) qui peuvent représenter plus de 15% des causes d'hospitalisation des personnes âgées » (Rollason, Bonnabry & Vogt, 2000). Enfin, l'Office fédéral de la santé publique OFSP (2013) met la priorité sur une diminution des médicaments.

Cette consommation « importante » de médicaments nous heurte par sa complexité et les ravages que cela peut provoquer. C'est pourquoi nous avons

choisi d'approfondir davantage l'aspect de la polymédication chez les personnes âgées.

De plus, nous sommes conscients que le pourcentage de la population âgée va continuer de croître, pour atteindre plus de 26% de la population Suisse en 2035 (Office fédéral de la statistique OFS, 2011). Par ailleurs, la Suisse est un pays centré sur les soins curatifs. Il n'y a pas suffisamment d'investissement dans la prévention des maladies (Office fédéral de la santé publique OFSP, 2013). Cela n'est pas de bon augure car nous sommes conscients qu'il serait bénéfique d'entreprendre un travail dans la prévention. Cela aurait pour conséquence de réduire l'incidence, la mortalité et les coûts de la santé. L'infirmier est au cœur de ce problème et son rôle est d'apporter l'attention nécessaire afin de prévenir ou réduire la polymédication. D'où notre objectif qui est le suivant :

définir la polymédication et déterminer des interventions pouvant la diminuer.

### **3.2 Plan du Travail de Bachelor**

Pour ce faire, nous avons fait une revue de littérature. Soit, une recherche exploratoire et, par la suite, nous avons interrogé différentes bases de données afin de démontrer comment l'infirmier peut agir sur la diminution de ces risques et quel est son rôle dans la gestion de la médication. En d'autres

termes, comment peut-il réduire l'incidence de complications résultant de la polymédication ?

Cela sera réalisé à l'aide de recherches approfondies d'études scientifiques et par l'analyse de celles-ci.

Nous finaliserons ce travail en présentant les éléments facilitants et contraignants à la réalisation de ce dossier, les limites ainsi que les perspectives pour la recherche.

# 4 Problématique



#### **4.1 Comment la question de départ est survenue ?**

Suite à l'attribution du sujet cadre de ce travail (Les approches médicamenteuses dans l'accompagnement des personnes âgées), plusieurs questions sont survenues : quel est le rôle infirmier dans la réduction des effets secondaires des médicaments, quelles sont les alternatives à l'approche médicamenteuse chez la personne âgée, quelles sont les limites du rôle infirmier dans la prise en charge médicamenteuse, etc.

Plusieurs éléments nous ont permis de poser une question de départ. Premièrement, nous avons partagé nos expériences personnelles et professionnelles.

Ensuite, nous avons effectué une recherche exploratoire afin de renforcer nos arguments. Ceci a permis de poser la question suivante :

*Quel est le rôle infirmier dans la prévention, l'éducation et les alternatives actuelles de la polymédication chez les personnes âgées en home médicalisé en ville?*

Le contexte du home a été retenu car les constats sont les suivants : le nombre de médicaments consommés varie de la campagne à la ville dans le sens d'une consommation plus importante dans le second contexte ; encore plus marquée en maisons de soins (Stoehr, 2005) ; les personnes âgées ayant également plus de pathologies multiples, leurs comorbidités et un état cognitif ne leur permettant pas toujours d'être acteurs dans leur traitement, le home semble être un lieu de recherche également adéquat. (Merck Sharp & Dohme Corp, 2015).

En effet, nous avons constaté lors de nos expériences professionnelles, que des traitements médicamenteux étaient souvent la réponse « première » à une problématique de santé. Par exemple, une réserve d'anxiolytique est systématiquement donnée à la moindre angoisse ressentie par la personne ou un traitement de laxatif est donné dès qu'il y a un problème de transit intestinal.

Nous nous sommes alors posé la question de l'efficacité du traitement thérapeutique au vu du nombre parfois impressionnant de comprimés avalés en même temps par les personnes soignées. De même, cela pose aussi le problème des interactions entre les médicaments et des effets secondaires.

Pour conclure, un étudiant du groupe a assisté à la mise en place d'une fenêtre thérapeutique. Le nouveau médecin de la personne concernée a décidé une telle action car il ne voyait plus clair dans la liste des médicaments prescrits par d'autres médecins avant lui, le nombre en étant très conséquent.

Ces éléments ont suscité notre intérêt pour effectuer des recherches et apporter des éléments sur le sujet de la polymédication. Cela dans le but de développer nos connaissances et notre expertise professionnelle.

## **4.2 Pertinence pour les soins infirmiers**

Afin d'apporter de la valeur à notre question de départ, nous verrons dans ce chapitre comment celle-ci s'inscrit dans la discipline infirmière. Pour ce faire, nous exposerons le lien avec les 4 concepts du métaparadigme des soins infirmiers (environnement, soins, santé, personne), ainsi qu'un lien avec les 4

modes de savoirs qui le caractérisent (empirique, personnel, esthétique, éthique).

#### **4.2.1 Liens avec les 4 concepts du métaparadigme**

Le métaparadigme est un ensemble de concepts et propositions qui énoncent les phénomènes dont une discipline est concernée. Pour les soins infirmiers, il s'agit de l'environnement, des soins, de la santé et de la personne (Fawcett, 2005).

##### *4.2.1.1 Environnement*

Selon Fawcett (2005), le concept du métaparadigme de l'environnement se réfère à l'entourage significatif pour la personne ainsi qu'à son environnement physique. Cela inclut également les lieux où sont prodigués des soins infirmiers, de sa propre maison aux centres hospitaliers, voire à la société elle-même.

Ce concept se réfère également à toutes les conditions culturelles, sociales, politiques et économiques en lien avec la santé des êtres humains à tous les niveaux géographiques, que le niveau soit mondial, national, régional ou local (Fawcett, 2005).

Dans le cadre de notre problématique, la polymédication peut se retrouver dans chaque environnement de la personne soignée. En effet, qu'elle soit à domicile ou dans un hôpital, elle est susceptible de consommer des médicaments si elle a un problème de santé. Ainsi, la pertinence de tenir compte de l'environnement dans cette problématique est non négligeable

puisque dans chaque système, l'infirmier est amené à donner des médicaments. De plus, comprendre le fonctionnement du système dans lequel se trouve la personne soignée et son influence possible sur la prise des médicaments peut permettre de réduire la polymédication.

On peut noter une influence culturelle puisque chaque personne aura un regard différent sur les médicaments. Par exemple, grâce aux nouvelles technologies, la jeune génération actuelle accède facilement et rapidement à l'information. Elle fera peut-être preuve d'un esprit plus critique vis-à-vis d'un nouveau médicament puisqu'elle aura pris connaissance de la notice d'emballage avant de l'avoir acheté. Pour autant qu'elle prenne le temps de le consulter ; le flot d'informations devient tellement important qu'il entrave finalement ce libre accès.

On peut également noter l'impact des relations sociales. Les relations que la personne développe avec son entourage peuvent influencer sur ce phénomène dans le cadre de la problématique sur la polymédication. En effet, si un ami proche ou le conjoint de la personne soignée la convainc que sans de nombreux médicaments elle ne va pas guérir, il est permis de douter de la réussite d'une action visant à réduire la consommation des médicaments chez cette dernière.

En Suisse, la fabrication et la commercialisation des médicaments génèrent un grand revenu et permettent d'assurer de nombreux emplois (Interpharma, 2014). En ce sens, on peut supposer une certaine forme d'influence des conditions économiques sur la polymédication.

Le nombre de pharmacies a augmenté au cours de ces dernières années (Office fédéral de la statistique OFS, 2005). Cette augmentation facilite l'achat de médicaments et par là, le risque de polymédication.

La division européenne de l'Organisation mondiale de la Santé (OMS) dispose d'un programme appelé « Health Technologies and Pharmaceutical Programme (HTP) » avec une politique ainsi qu'une stratégie particulière dans l'utilisation rationnelle des médicaments. Il traite du développement, de l'approvisionnement et de l'utilisation des médicaments au sein d'un système de santé. Il s'inscrit dans le cadre politique « Health 2020 » de l'OMS qui a pour but de donner une vision, une stratégie, des priorités et des suggestions aux décideurs politiques afin d'améliorer la santé de la population (World Health Organization Europe, 2014).

Il existe également un groupe européen en faveur d'une utilisation rationnelle des médicaments. Ce groupe partage une vision commune d'amélioration de la santé au travers d'échanges d'idées et de coopération dans l'optique d'une utilisation rationnelle des médicaments. Il met l'accent sur une introduction contrôlée des médicaments, se repose sur les connaissances acquises et l'expérience de ses membres tout en utilisant des méthodes de recherche basées sur des preuves (Piperska Group, 2012).

#### *4.2.1.2 Soins*

Ce concept de soins du métaparadigme, selon Fawcett (2005), est défini comme représentant l'ensemble des actions infirmières entreprises pour et

avec la personne ainsi que leurs résultats. La définition donnée aux soins est également incluse dans ce concept.

La problématique de la polymédication concerne directement les infirmiers puisque ce sont eux qui sont amenés à donner les médicaments. Ils ont donc un rôle à jouer dans la prévention de la polymédication. En effet, grâce à leurs connaissances en pharmacologie sur les effets secondaires, les interactions et les surveillances d'un médicament, ils sont à même d'argumenter en faveur d'une réduction de la posologie. Et ainsi mettre en discussion l'introduction d'un autre produit ayant comme objectif de réduire les effets secondaires du premier.

L'infirmier peut être amené à intervenir auprès d'une personne à domicile devant prendre plusieurs médicaments. Il devra par exemple donner des explications à la personne et à son entourage sur la gestion de son traitement médicamenteux.

La « personne » est un être unique et devrait être considérée ainsi. Pour nous, la personne n'est pas vue en tant qu'un objet qui a besoin de soins. Cette appellation pourrait désigner un individu ou un groupe, comme par exemple la famille ou une communauté d'individus qui se trouvent dans une situation de besoin par rapport aux soins infirmiers. Nous devons souligner le fait que pour nous il existe toujours la notion d'une collaboration entre le soignant et le soigné, l'alliance thérapeutique permettant au soigné de prendre sa part de responsabilité et d'être acteur de sa santé. Ainsi nous apportons de

la reconnaissance, du respect et reconnaissons le droit pour l'individu de participer au processus de soin.

Avec notre thématique nous voudrions voir ce que nous, en tant que futurs professionnels, pouvons faire pour réduire ou informer le public concerné de ce problème de polymédication chez la personne âgée.

Nous regardons la personne dans une perspective qui se veut résolument holistique. Si la personne arrive avec une jambe cassée, certes ce problème a une priorité médicale toutefois nous ne devons pas uniquement nous centrer sur le membre mais également sur la personne. Notre rôle est d'informer la personne de ce qui se passe par rapport au traitement ciblé, mais aussi de répondre à d'autres questions concernant sa santé.

Dans notre cas c'est notre devoir de fournir des éléments de réponse afin d'aider la personne soignée à comprendre sa situation et les traitements autour. Par exemple, selon De Rubeis, Siegle & Hollon (2008), les études montrent que la psychothérapie cognitivo-comportementale est aussi efficace que des antidépresseurs pour traiter la dépression.

#### *4.2.1.3 Santé*

L'état de bien-être prend en compte l'interaction harmonieuse des parties physiques, psychiques, sociales et spirituelles de l'individu y compris la corrélation avec son entourage direct et indirect. Néanmoins, l'objectif des soins infirmiers reste toujours la santé de la personne.

La santé est un terme général qui ne cible pas vraiment le côté clinique. Ce terme peut être modifié selon la personne et son ressenti. Par exemple quelqu'un qui souffre d'une maladie chronique aura des jours où il se sent en bonne santé et d'autres où ce sera le contraire.

L'infirmier est maintenant considéré en tant que professionnel de la santé et non comme étant simplement l'exécutant du médecin. Nous pouvons questionner les ordres médicaux et donner nos opinions par rapport à ce que le médecin propose dans le traitement d'un patient. Cela fait partie de notre responsabilité professionnelle.

Nous sommes souvent vus comme des « garde-fous » entre médecin et patient. Notre rôle comprend la bienfaisance et la non malfaisance. Nous faisons ce qui est en notre pouvoir pour aider la personne nécessitant des soins à bénéficier de la meilleure santé possible. Dans le cas de la pharmacologie, nous sommes censés avoir des connaissances qui nous permettent non seulement de connaître les effets désirés et non désirés, mais aussi les réactions entre certains médicaments afin de réduire les effets secondaires (Fawcett, 2005).

#### *4.2.1.4 Personne*

Plusieurs auteurs des théories de soins infirmiers donnent leur définition propre de cette partie du métaparadigme infirmier. En traversant l'histoire de notre profession nous commençons avec Florence Nightingale qui dit à propos de la personne « c'est le récipient des soins infirmiers » (Nightingale, 1969 ;



dans Masters, 2011, p.49). Plus tard, Virginia Henderson complète les propos de Nightingale en disant que « le récipient est composé des aspects biologique, psychologique, sociologique et spirituel » (Henderson, 1966 ; dans Masters, 2011, p. 52). Jean Watson dans sa théorie du Caring décrit la personne en la décrivant comme « une unification de l'âme, du corps, de l'esprit et de la nature » (Watson, 1996 ; dans Masters, 2011, p. 52). Dorothea Orem parle « d'un être avec des besoins universels et développementaux et capable des auto-soins » (Orem, 1985 ; dans Masters, 2011, p. 60).

La théorie de Rosemarie Rizzo Parse, qui est celle de l'Humain-devenant, nous propose cette définition « un être ouvert plus que et différent que la somme de ses parties qui est en même temps en interaction mutuelle et simultanée avec l'environnement et qui choisit ses options et porte la responsabilité pour ses choix » (Parse, 1987 ; dans Masters, 2011, p. 68).

Pour nous, nous pouvons dire que de Nightingale jusqu'à Parse, nous aurons devant nous une personne qui non seulement a besoin de notre aide sur le plan physique mais aussi sur un plan psychologique et qu'elle peut être partenaire dans la façon dont nos soins sont prodigués.

#### **4.2.2 Liens avec les modes de savoirs infirmiers**

Le concept de polymédication est pertinent dans le domaine des soins infirmiers car l'infirmier est amené à démontrer des aptitudes dans l'accompagnement et le suivi des individus en ce qui concerne les traitements médicamenteux. Il est important de bien comprendre que l'infirmier travaille

au travers de 4 modes de savoirs qui sont les clés de la discipline infirmière. Il s'agit des savoirs : empirique, esthétique, personnel et éthique et qui représentent l'ensemble des connaissances que l'infirmier développe constamment dans sa discipline.

#### *4.2.2.1 Savoir empirique*

Selon Pepin, Kérouak et Ducharme (2010), le savoir empirique est la dimension scientifique de la discipline. Il comprend la recherche scientifique (quantitative ou qualitative), l'observation, l'exploration, la description et l'explication des phénomènes. Il s'agit d'intégrer des connaissances issues de la recherche et de l'habileté qu'a un infirmier à remettre en question ses interventions.

Ci-après, les différents aspects du savoir empirique rattachés à la polymédication.

Les traitements évoluent, de nouvelles molécules sont découvertes. Cela implique de nouveaux effets sur l'homéostasie du corps humain que l'infirmier se doit de connaître si il veut jouer un rôle dans la prise en charge d'un patient « polymédiqué » ou non.

Il s'agit de connaître les traitements, leurs interactions et les problèmes liés à la polymédication.

L'infirmier est au cœur de la prise en charge, il est celui qui prépare et administre les traitements, qui en fait les surveillances et qui joue un rôle important dans l'évolution de la santé de la personne soignée.

L'infirmier connaît les traitements et leurs effets, il ne s'agit pas que d'un acte médico-délégué où l'infirmier donne un comprimé. Il doit être capable de connaître le médicament, les effets secondaires, les interactions.

#### *4.2.2.2 Savoir éthique*

Selon Carper (1978), le savoir éthique comprend les jugements que nous devons effectuer ou les décisions que nous devons prendre : ce qui est bon, juste, correct et responsable. Cette connaissance est certes difficile surtout lorsque nous devons prendre une décision par rapport à un dilemme éthique faisant appel à notre propre morale.

Un code d'éthique pour l'infirmier est un outil qui le guide dans son jugement professionnel mais il va rarement pouvoir éliminer complètement un dilemme moral. Il peut nous arriver de faire quelque chose qui est en conflit avec nos valeurs et nous devons faire un choix ou un compromis afin de continuer de prodiguer des soins aux patients. En général nos actions sont planifiées, mais dans certaines situations nous pouvons être en face d'un problème où nous devons réagir rapidement selon nos valeurs.

A travers nos recherches, nous avons constaté qu'il existe beaucoup de littérature sur ce problème de la polymédication et les dilemmes de nature éthique auxquels l'infirmier doit faire face.

Concernant des soins et/ou des traitements, les choix que nous faisons en tant que professionnels de la santé sont souvent basés sur nos propres valeurs personnelles et surtout professionnelles et sur les principes éthiques qui

régissent la profession. Nous nous trouvons dans l'obligation d'administrer un certain traitement car nous voulons aider la personne et respecter son droit de vivre. Notre rôle comprend des actions délibérées faites pour accomplir un objectif. Malheureusement la connaissance des codes éthiques ne donne souvent pas de réponse claire aux questions morales posées dans les soins infirmiers. Un exemple de dilemme serait de savoir que faire lorsque quelqu'une personne a besoin d'une transfusion de sang pour survivre mais qu'elle est témoin de Jehova ? Nous savons que le refus va probablement entraîner le décès de la personne mais en même temps nous sommes censés respecter le choix de chaque individu.

Il ne faut pas oublier que nous travaillons avec des collègues qui pourraient ne pas partager nos propres valeurs. Ces conflits ne doivent pas entraver notre jugement professionnel ni porter atteinte à notre objectif principal, le bien-être du patient. Cette profession se développe continuellement, cela veut dire que les décisions éthiques que nous devons affronter vont elles-mêmes se développer.

Dans le cas de la polymédication, notre rôle doit être celui d'informer le patient des risques potentiels de son traitement, des façons de les réduire et aussi des éventuelles alternatives envisageables. Nous devons informer les autres professionnels de la santé impliqués dans ces traitements afin de prévenir ce qui est devenu un problème de santé publique.

#### 4.2.2.3 *Savoir esthétique*

Également selon Pepin et al. (2010), le savoir esthétique est la dimension de l'art infirmier. Cela signifie que l'infirmier dans sa discipline apporte à l'individu une expérience de soins, qui peut être vécue par le patient comme une expérience agréable ou désagréable. Le but du rôle infirmier est d'apporter à cet individu une expérience adéquate au travers de : l'intensité d'une interaction, la beauté d'un geste ou encore la qualité d'un soin (technique ou relationnel) par exemple. Le savoir esthétique comprend également la manière d'envisager la relation, la manière d'apporter de l'aide ou de reconnaître les besoins d'un individu.

Dans ce travail, le savoir esthétique intervient dans la façon dont l'infirmier va prendre en charge l'individu et son traitement. Il ne s'agit pas « seulement » de donner des comprimés aux personnes soignées mais aussi les renseigner afin d'apporter une qualité dans le soin. Ce n'est pas non plus donner un médicament pour calmer un patient agité mais bien de commencer par comprendre d'où vient cette agitation, comment nous pouvons la soulager autrement qu'avec une solution « facile » que représente le médicament. Ces soins apportés entrent dans la dimension du savoir esthétique et ce travail tente de démontrer qu'il y a un enjeu important pour les infirmiers face à la polymédication.

#### *4.2.2.4 Savoir personnel*

Pour conclure, le savoir personnel est selon Pepin et al. (2010), la dimension qui met en jeu la compréhension de soi, de l'autre et de la relation entre les deux. Ce savoir s'appuie sur l'expérience de l'infirmier à devenir un être unitaire, conscient et authentique et s'exprime par la congruence, l'authenticité entre le corps, l'âme et l'esprit.

Dans le cadre de notre problématique liée à la polymédication, il s'agit de l'expérience de l'infirmier face à la médication (aux effets secondaires, aux interactions). Par exemple, l'infirmier qui lui-même prend des médicaments et en connaît les bénéfices ou les inconvénients, sera capable de trouver les outils pour apporter les meilleurs conseils au patient dans sa relation à la (poly)médication.

Notre questionnement sur la polymédication et ce qui nous a amené à traiter ce sujet, entre dans le savoir personnel, en ce sens où il fait appel à des situations de notre expérience personnelle et/ou professionnelle et aura des incidences sur notre avenir professionnel.

### **4.3 Scoping Review (Revue exploratoire)**

Nous avons montré dans le chapitre précédent, comment la question de départ s'ancrait dans la discipline infirmière. Dans ce chapitre, il sera question de présenter la manière dont notre question s'intègre dans la pratique professionnelle et ce qu'elle suscite en termes d'intérêt. Pour ce faire, un

« scoping review » sera présenté, ainsi qu'un recueil de « questions réponses » d'experts (gériatre, infirmière et patiente) Cela nous permettra d'identifier différents concepts et de les développer dans le chapitre suivant. Un scoping review (aussi l'étude exploratoire) se réfère à un rassemblement rapide de la littérature dans une politique ou d'une zone clinique où les objectifs sont d'accumuler autant de preuves que possible et de cartographier les résultats.

Dans un premier temps, examinons quelques articles de lois :

#### **4.3.1 Articles de lois**

Les médicaments sont tous :

Les produits d'origine chimique ou biologique destinés à agir médicalement sur l'organisme humain ou animal, ou présentés comme tels, et servant notamment à diagnostiquer, à prévenir ou à traiter des maladies, des blessures et des handicaps; le sang et les produits sanguins sont considérés comme des médicaments (Chancellerie fédérale, 2015, art. 4 LPTh).

En Suisse, la publicité pour les médicaments est légale. Tous les types de médicaments peuvent faire l'objet d'une publicité si elle s'adresse uniquement aux personnes qui les prescrivent ou qui les remettent (Chancellerie fédérale, 2015, art. 31 LPTh, alinéa 1). Si le public est visé, ce seront uniquement des médicaments non soumis à ordonnance qui pourront faire l'objet d'une publicité (Chancellerie fédérale, 2015, art. 31 LPTh, alinéa 2).

Le lien avec notre problématique est que, si une personne décide d'aller acheter un médicament pour soulager ses maux de têtes après en avoir vu la

publicité, le contrôle sera sans doute moindre de la part de la personne qui remet le médicament.

En effet, si la personne achète un médicament prescrit par un médecin, ce dernier l'aura vue au préalable, il connaît son traitement et par là, les interactions possibles entre les différents médicaments. Ce n'est pas forcément le cas du pharmacien qui remet le médicament non soumis à ordonnance à la personne. Le Dulcolax® est un exemple typique de médicament non soumis à ordonnance qui, si il est mal utilisé ou trop fréquemment, aura des effets indésirables voire très néfastes : le Dulcolax® est un laxatif qui peut réduire le péristaltisme intestinal et donc augmenter la constipation de la personne, voire amener à une atrophie de l'intestin pouvant nécessiter une résection chirurgicale (Enhanced Medical Decisions, 2009).

Pour prévenir la polymédication, il existe différents moyens légaux.

Le premier est l'article 32 de la LPT<sub>h</sub> condamnant « la publicité pouvant inciter à un usage excessif, abusif ou inapproprié de médicaments » (Chancellerie fédérale, 2015, art. 32 LPT<sub>h</sub>, alinéa 2).

Le second est l'interdiction « d'octroyer, d'offrir ou de promettre des avantages matériels aux personnes qui prescrivent ou remettent des médicaments ». Les personnes qui prescrivent ou remettent des médicaments ont l'interdiction de solliciter ou d'accepter des avantages matériels (Chancellerie fédérale, 2015, art. 33 LPT<sub>h</sub>).



Cela signifie qu'une entreprise pharmaceutique X n'a pas le droit de promettre des avantages matériels à un médecin s'il prescrit le médicament produit par l'entreprise X plutôt que le médicament produit par l'entreprise Y.

La barrière dans ce cas est double puisque celui qui accepte est puni au même titre que celui qui propose.

Toujours selon cet article, seuls les avantages matériels de valeur modeste ayant un rapport avec la pratique sont acceptés. Cela peut consister en des petits objets publicitaires tels que bloc-notes, stylos, tapis de souris, etc.

#### **4.3.2 Interrogation d'experts**

Afin de développer notre problématique, nous avons choisi d'interpeller deux professionnels de santé, une infirmière aux soins à domicile et un médecin gériatre travaillant en home et milieu hospitalier, susceptibles de faire régulièrement face au phénomène de polymédication. Nous avons également questionné une personne âgée vivant seule à domicile et ayant un traitement médicamenteux. Au travers de ces entretiens, nous avons pu acquérir des informations qui renforcent l'idée initiale que la polymédication est un problème en plein essor mais pouvant être mieux contrôlé grâce à des interventions ciblées des professionnels de la santé.

Selon l'infirmière, ce phénomène de polymédication est évident et quotidien. Il n'est pas rare que ses clients, essentiellement des personnes âgées, prennent plus de 3 médicaments par jour. Ce fait est confirmé par le médecin gériatre, conscient de ce problème. Toutefois, il a accentué le fait

d'être plus concerné par l'état de santé actuel de la personne et que par les éventuelles répercussions sur le plus long terme. Pour le médecin, ces personnes prennent beaucoup de médicaments à cause des comorbidités liées à leur maladie initiale. Toutefois, la « patiente » prend jusqu'à 11 médicaments différents par jour mais ne s'estime pas polymédiquée. D'après elle, elle est dans la moyenne des personnes de son âge (73 ans) quant au nombre de médicaments consommés.

Un autre point abordé a été la question du point de vue sur ce phénomène : est-ce que l'infirmier est un « garde-fou » afin de prévenir la polymédication ?

Pour l'infirmière, la réponse est oui. Elle estime que cette représentation vient de la charge de travail de plus en plus importante des médecins traitants et que le médecin en général n'est pas aussi présent que l'infirmier auprès des patients.

Le médecin interrogé est conscient des responsabilités plus importantes de l'infirmier en soins de longue durée ou à domicile car il ne peut être aussi près du patient qu'à l'hôpital. Il n'apprécie pas l'idée du « garde-fou », il insiste sur l'importance de prendre l'avis des collaborateurs pour un changement de traitement et précise que la demande provient souvent de ces derniers.

Quant à la « patiente », tous ses traitements ont été prescrits par son médecin traitant qui lui a expliqué pourquoi il le prescrivait, comment les prendre et s'ils étaient compatibles entre eux.

Dans l'optique de prévenir la polymédication, l'infirmière estime indispensable d'avoir des connaissances suffisantes en pharmacologie afin d'avoir une meilleure argumentation auprès du médecin pour un changement ou une réduction de traitement. De plus, il existe d'autres outils d'aide à la décision comme « *Beers Criteria For Potentially Inappropriate Medication In Older Adults* » et le « *STOPP START Toolkit (Screening tool of older people's potentially inappropriate prescriptions/ Screening tool to alert doctors to right i.e appropriate, indicated treatments)* » (Wikipedia The Free Encyclopedia, 2015).

Ces deux outils, qui se trouvent en annexe (voir Appendice A) n'étaient pas connus par l'infirmière.

Pour terminer, l'infirmière a souligné le fait que son rôle était également d'apporter une éducation médicamenteuse chez ses clients et d'inclure l'entourage de la personne soignée dans cet enseignement afin de renforcer la sécurité liée à la prise d'un traitement médicamenteux. La personne âgée interrogée, par exemple, connaît son traitement, sait pourquoi elle prend tel ou tel médicament, a lu la notice d'emballage et sait reconnaître un effet secondaire sans toutefois pouvoir l'attribuer à un médicament en particulier. Elle utilise un semainier qui l'aide énormément, elle n'oublie que très rarement de prendre son traitement. Et en cas d'oubli, elle ne prendra pas deux fois la dose prescrite en compensation.

Ces entretiens nous confirment que l'infirmier a un rôle-clé dans la surveillance de la prise médicamenteuse chez les patients, un rôle de

collaborateur avec les médecins et les pharmaciens ainsi qu'un rôle de communicateur indispensable auprès des patients et de leur entourage, que ce soit à propos des traitements ou de leurs effets. Tous ces rôles se retrouvent dans notre référentiel de compétences HES (voir Appendice B).

Enfin, l'interdisciplinarité et la confiance des médecins pour leurs collègues infirmiers jouent un rôle fondamental dans la prise en charge des patients avec un traitement médicamenteux conséquent.

Toutefois, selon le médecin gériatre, l'idée de donner l'autorisation de prescription aux infirmiers pourrait aider à court terme. Ceci dit, cela pourrait par ailleurs poser un problème de responsabilité. En effet, est-ce que l'infirmier continuerait d'appeler le médecin s'il y avait des complications suite à une mauvaise prescription de l'infirmier ? Le médecin pense que malgré le fait que l'infirmier ait cette responsabilité de prescrire, il y aura toujours besoin des connaissances d'un médecin dans des situations problématiques concernant les médicaments.

A partir de ces entretiens, nous pouvons ressortir plusieurs thèmes qu'il sera important de développer pour éclairer notre sujet : notamment la polymédication, l'éducation thérapeutique, la prévention et la personne âgée. Ce seront là les concepts que nous travaillerons dans le cadre de ce travail.

#### 4.4 Concepts retenus

Au vu de cette revue de littérature, nous avons retenu ces concepts car chez la personne âgée, la polymédication est une problématique évidente et en augmentation. Nous cherchons dans le cadre de ce travail des moyens pour prévenir cet aspect. Et qui dit prévention, dit éducation.

Ainsi nous pouvons retenir les concepts suivants :

- la personne âgée
- la polymédication
- la prévention
- l'éducation thérapeutique

Ceci nous permettra d'aborder également le rôle infirmier et les perspectives pour la pratique.

# **5 Concepts et champs disciplinaires infirmiers**

## 5.1 Présentation des concepts retenus

### 5.1.1 Personne âgée

L'étude scientifique du vieillissement est la gériatrie. Cette période présentant une grande variabilité pour chaque individu, l'expérience du vieillissement est donc unique et personnelle. Ce n'est pas un processus qui se déclenche à partir d'un certain âge. Les capacités physiques et les besoins des personnes âgées varient grandement (Bee, Boyd & Gosselin, 2011).

Nous avons choisi de présenter le concept de la personne âgée selon 3 aspects. Nous décrivons la personne âgée sur un plan biologique, social et juridique.

#### 5.1.1.1 Sur le plan biologique

La perte fonctionnelle progressive des systèmes corporels débute vers la fin de la quarantaine et évolue graduellement jusqu'à la fin de la vie.

Chez la personne âgée, il y a 4 principaux changements sur le système nerveux (réduction de la masse cérébrale, perte de la substance grise, diminution de la densité des dendrites et ralentissement de la vitesse synaptique) qui ont des conséquences sur la mémoire ou sur les capacités de réaction de la personne.

Au cours du vieillissement, les cinq sens subissent un déclin inévitable. La vue diminue, l'audition est altérée avec comme risque un isolement social ou une fausse impression de désorientation si la personne n'a pas révélé son trouble auditif.

La diminution du goût, de l'odorat et du toucher peut avoir des conséquences directes sur la santé. L'odorat améliorant le goût des aliments, la personne aura moins envie de se préparer un plat cuisiné ou même de manger. De même, une diminution de la reconnaissance du goût salé peut inciter la personne à assaisonner de manière plus conséquente ses plats. Un apport élevé en sel augmente la probabilité d'avoir de l'hypertension.

Le vieillissement se manifeste par un ralentissement général dû à une diminution de la densité dendritique des neurones. D'autres modifications corporelles comme l'arthrite ou la perte de l'élasticité musculaire influent sur ce ralentissement. Une diminution des fonctions motrices est à noter au cours du vieillissement avec pour conséquence une diminution de l'endurance, de la dextérité et de l'équilibre (Bee et al., 2011).

Plutôt que de développer les conséquences du vieillissement sur chaque organe, nous nous concentrerons sur les atteintes physiologiques liées à l'âge qui modifient la pharmacocinétique (absorption, distribution, métabolisation et élimination du médicament).

L'absorption du médicament par diffusion au travers de la paroi de l'intestin grêle, qui dépend de la concentration, ne subit pas de modification avec l'âge. Par contre, du fait de la diminution de la motilité intestinale et du débit sanguin, la vitesse d'absorption et le pic d'effet de certains médicaments peuvent être ralentis.

La distribution du médicament est fonction de sa capacité à pénétrer le compartiment aqueux et lipidique. Avec l'âge, la quantité totale d'eau



corporelle diminue. Dès lors, les médicaments hydrosolubles auront une concentration plus élevée. Ainsi, pour une même dose, la concentration sera plus élevée chez la personne âgée que chez la personne jeune. L'augmentation de la masse grasseuse chez la personne âgée contribue à diminuer la concentration plasmatique du médicament (la graisse sert de réservoir aux médicaments liposolubles) mais la durée d'action est augmentée.

Quant à la métabolisation et à l'élimination du médicament, celles-ci sont modifiées à cause de la diminution de la circulation hépatique et rénale chez la personne âgée. Une adaptation de la posologie est donc nécessaire (Stoehr, 2005).

Les aspects cognitifs (attention et mémoire) sont modifiés chez la personne âgée. L'attention sélective (habileté d'un individu à inhiber une réponse automatique) et l'attention divisée (augmenter le volume de la radio tout en conduisant par exemple) sont les deux formes touchées par une augmentation de l'âge. Toutefois, la recherche visuelle n'est pas forcément atteinte par le vieillissement.

Les pertes de mémoire deviennent plus fréquentes avec l'âge et les personnes âgées prendront plus de temps pour passer un test. Elles feront également plus d'erreurs. Ces pertes plus fréquentes peuvent s'expliquer par une augmentation du temps de réaction et une diminution de la rapidité de traitement de l'information (Bee et al., 2011).

Ces pertes cognitives peuvent avoir une influence sur la consommation de médicaments. La personne pourra par exemple prendre deux fois la dose prescrite car elle a oublié qu'elle avait déjà pris une première dose.

#### *5.1.1.2 Sur le plan social*

Les changements dans l'exercice des rôles à un âge avancé sont la conséquence des changements physiques et cognitifs. En effet, l'importance, les responsabilités et les attentes d'un rôle diminuent.

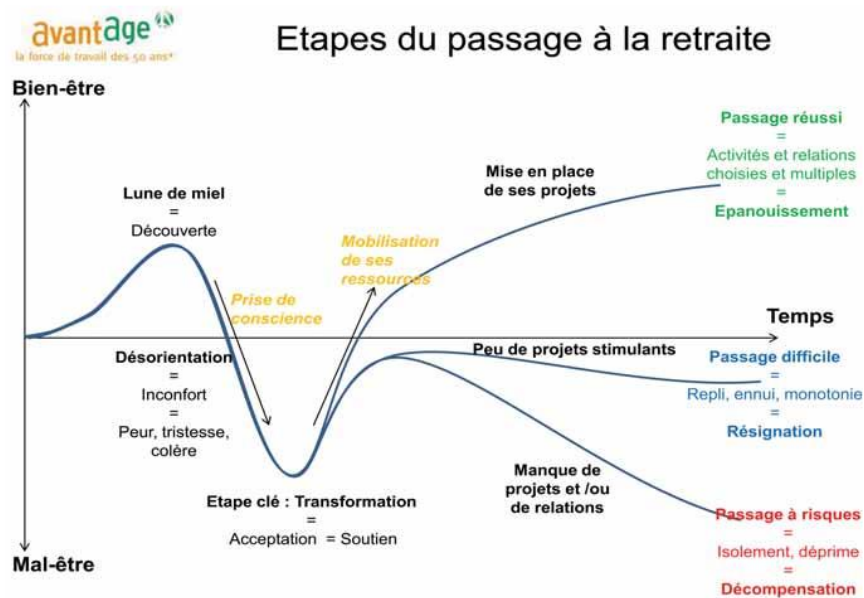
Les relations conjugales à un âge avancé ne diffèrent que peu des relations conjugales des adultes plus jeunes. Toutefois, la satisfaction de la relation diffère. La loyauté, la familiarité et l'investissement personnel sont les sources de satisfaction ; la relation repose moins sur la passion que sur l'ouverture réciproque.

En d'autres termes, l'affection et le bonheur d'être ensemble ne disparaissent pas avec le vieillissement.

Avec l'âge, bien que le nombre d'amis diminue, les relations amicales gagnent en importance, sont réciproques et équitables. Le mode d'être en relation ne change pas avec l'âge. Les relations avec les enfants sont toujours marquées par les exigences du rôle parental. De plus les frères et sœurs deviennent souvent l'unique source de soutien émotionnel (Bee et al., 2011).

L'une des étapes marquantes du vieillissement est le départ à la retraite. Ce départ demande un effort de réadaptation car la personne passe d'une vie

« active » à une vie « passive » impliquant un changement de statut social, de repères et d'organisation (Michel, 2014).



Tiré de :

[http://www.fr.avantage.ch/fs/documents/LExpress\\_15.11.13.pdf](http://www.fr.avantage.ch/fs/documents/LExpress_15.11.13.pdf)

#### 5.1.1.3 Sur le plan juridique et légal

Selon une définition de l'OMS, une personne âgée est une personne de 60 ans ou plus (Organisation mondiale de la Santé, 2015) alors qu'en Suisse, afin de bénéficier d'une rente ordinaire de vieillesse et être considéré comme une personne âgée, il est nécessaire d'avoir atteint l'âge de 65 ans pour les hommes et 64 ans pour les femmes (Office fédéral des assurances sociales OFAS, 2015). De plus, la personne âgée garde l'exercice de ses droits civils pour autant qu'elle ait la capacité de discernement.

#### 5.1.2 Polymédication

La polymédication est un problème de santé publique touchant un nombre croissant d'individus, notamment les personnes âgées. Cela s'explique par

divers facteurs qui sont en cause, tels que l'accroissement de la prévalence des maladies chroniques avec l'allongement de l'espérance de vie, la reconnaissance de l'efficacité de la prévention secondaire, ainsi que l'accroissement de la palette thérapeutique. De plus, physiologiquement, les personnes âgées éliminent plus difficilement les médicaments et leur organisme est plus fragile. La polymédication est donc considérée comme un indicateur de fragilité (Mazzocato, David, Benaroyo & Monod, 2013).

La prise de médicament augmente différentes pathologies chroniques et les symptômes spécifiques qui affectent majoritairement cette population âgée. Il ne s'agit pas nécessairement d'un phénomène négatif. Un traitement optimal prend en compte parfois la prise de plusieurs médicaments se justifiant par la présence de plusieurs pathologies. Cela pour traiter des comorbidités souvent plus lourdes (Mazzocato et al., 2013).

Cependant, les risques sont bien présents. Il s'agit d'un risque d'événements iatrogènes en raison du risque d'interaction médicamenteuse et d'interférence avec les pathologies présentes.

L'OMS (1969) définit les événements iatrogènes comme suit : « Toute réponse néfaste et non recherchée à un médicament survenant à des doses utilisées chez l'homme à des fins de prophylaxie, de diagnostic et de traitement » (Lannoy, 2012).

L'augmentation des effets secondaires et le risque de non compliance de la personne face au traitement sont également des risques importants.

### 5.1.2.1 Définition

Mais qu'entendons-nous par le terme de « polymédication » ? Est-ce qu'il y a une définition univoque ?

Le terme de polymédication n'est pas univoquement défini, mais il est cerné par le biais de plusieurs concepts (quantitatifs et qualitatifs) :

D'un point de vue quantitatif, la première définition donnée dans la littérature correspond à un nombre minimum de médicaments différents consommés par jour ou par semaine. Certains auteurs définissent la polymédication à partir de 3 médicaments tel que le fait ISAR (Instrument de screening des aînés à risques) (McCusker, Bellavance, Cardin et al., 1999 ; dans Pire, Fournier, Schoevaerds, Spinewine & Swine, 2009). Quant à eux, Jorgensen, Johansson, Kennerfalk, Wallander et Svardstudd (2001) définissent la polymédication à partir de 5 médicaments.

Par contre, Mazzocato et al. (2013) définissent la polymédication comme une prise quotidienne de 5 médicaments ou plus et la polypharmacie excessive comme 10 médicaments ou plus.

Pour ce travail, nous allons nous référer à cette dernière définition car elle est souvent utilisée dans les études épidémiologiques. Cela s'explique car c'est le nombre pivot au-delà duquel les risques d'effets indésirables sont fortement accrus.

D'un point de vue qualitatif, la polymédication est définie par l'association de différents types de médicaments. De plus, elle est définie par l'association

inappropriée de médicaments et leurs conséquences néfastes (Pire et al., 2009).

#### *5.1.2.2 Epidémiologie*

Dans ce travail, nous souhaitons cibler une population majoritaire à ce phénomène. Les personnes âgées sont cette population. Cependant, la population âgée peut se retrouver à domicile, hospitalisée, suivant des prestations ambulatoires ou encore en établissement médico-social (EMS). En Suisse, selon l'Office fédéral de la statistique (2015), plus de 84'000 personnes âgées de 65 ans et plus vivent dans un EMS. Cette proportion étant considérable, la population cible de ce travail sera les personnes âgées de plus de 65 ans vivant en EMS.

Selon une étude de Kaufmann, Kelly, Rosenberg, Anderson et Mitchell (2002), le nombre de médicaments consommé selon les types d'institutions varie. En voici un bref résumé, permettant d'accentuer les risques de notre population cible : Ambulatoire, 2-7 médicaments ; Domicile, 6-7 médicaments ; Maison de retraite, 8 médicaments.

Egalement selon cette même étude, les médicaments les plus prescrits en maison de retraite sont : les Psychotropes (67%) et antidépresseur (46%), les Laxatifs (50%), les Médicaments pour le système cardio-vasculaire (50%) dont les Béta-bloquants (23%), les Analgésiques (42%), les Diurétiques (41%), l'Aspirine (38%), les Antiulcéreux (30%) et les Inhibiteurs de l'enzyme de conversion (25%).

Nous pouvons constater que cette population est à haut risque de polymédication. Par conséquent, il est nécessaire de pouvoir améliorer nos interventions auprès de ces personnes.

### *5.1.2.3 Conséquences*

Plusieurs conséquences peuvent être induites par la polymédication. Tout d'abord, une diminution de la compliance au traitement. En effet, plusieurs études démontrent que la compliance diminue en fonction que le nombre de médicaments augmentent. Par exemple, Barat, Andreasen et Damsgaard (2001) démontrent qu'à partir de 5 médicaments, le taux de compliance descend en dessous de 50%.

La survenue d'effets secondaires est une autre conséquence importante. Elle s'accroît considérablement avec le nombre de médicaments, ainsi qu'avec les interactions médicamenteuses et les interférences avec les pathologies. L'étude de Fulton et Allen (2005) démontre dans leur recherche, que 20 à 25% des hospitalisations sont causées par l'apparition d'événements iatrogènes médicamenteux.

De plus, des troubles non prévus peuvent survenir suite à la prise simultanée de plusieurs médicaments à cause des interactions. Hajjar, Cafiero et Hanlon (2007) parlent de syndromes gériatriques. Il s'agit de symptômes tels qu'une augmentation des risques de chute, des troubles cognitifs, une dénutrition, de la confusion, etc.

L'exposition aux effets secondaires est plus importante chez les personnes âgées car elles ont un métabolisme plus lent et cela a pour conséquence une élimination des médicaments plus longue.

L'ensemble de ces troubles a des conséquences considérables sur le bien-être et la santé des personnes âgées. Cela engendre un coût important d'hospitalisation, de durée de séjour et de médicaments.

En conclusion, il est important de tenir compte qu'une grande partie de la population de plus de 65 ans est « polymédiquée » et que cela peut avoir de grandes conséquences. L'enjeu est donc d'avoir un meilleur contrôle sur cette polymédication et d'améliorer la qualité de vie du patient en diminuant les risques.

### **5.1.3 Prévention**

L'Organisation mondiale de la Santé (1999) définit la prévention comme étant « les actes destinés à protéger patients ou d'autres membres du public des menaces à la santé, actuelles ou potentielles et de leurs conséquences débilitantes ».

L'infirmier joue un rôle clé dans cette prévention sur plusieurs niveaux. Il a l'unique opportunité d'éduquer le patient et sa famille à propos des stratégies qui sont mises en place, avec l'objectif de réduire les risques liés aux comportements non propices à une bonne santé.

Nous avons étudié certaines mesures qui interviennent avant, pendant et après l'annonce d'un diagnostic médical par exemple.



Les initiatives qui forment la prévention primaire ont pour objectif de prévenir les risques des maladies à travers l'éducation du patient et de la promotion de la santé. Parmi ces actions nous pouvons citer l'activité physique, la lutte contre le tabagisme, une alimentation saine et des vaccinations. Ce type de prévention s'adresse à l'ensemble de la population.

Les initiatives de la prévention secondaire tentent d'identifier et de détecter des maladies dans des stades précoces car c'est à ce moment que la maladie a le plus de chance d'être traitée avec succès. Un autre objectif consiste à diminuer la propagation des maladies transmissibles comme le syndrome d'immunodéficience acquise (SIDA) et les hépatites. Nous sommes dans le domaine du dépistage où des examens et tests sont effectués régulièrement chez ceux qui présentent des facteurs de risques connus pour une maladie. Ce dépistage est en général réalisé au niveau patient/médecin ou par d'autres professionnels de la santé sur une échelle plus large comme dans le dépistage par mammographie. L'infirmier a aussi la possibilité d'identifier les patients qui ont des facteurs de risque et de travailler avec ces derniers afin de prévenir le début d'une maladie et d'ainsi diminuer son incidence.

Dans la prévention tertiaire, il est question du traitement pour la maladie et de réduire les conséquences qui lui sont liées. La prévention tertiaire vise à diminuer les incapacités en faisant appel aux soins médicaux et par une réhabilitation sociale. Son but est donc de maximiser les capacités qui restent chez une personne déjà touchée par une maladie.

Enfin, la prévention quaternaire, moins connue que les trois précédentes, essaie d'identifier ceux qui risquent d'être surmédicalisés car ils sont en phase terminale d'une maladie et reçoivent des soins palliatifs ou à cause des comorbidités liées à leur pathologie initiale. Cette quatrième prévention tente de proposer d'autres façons d'intervenir en remplaçant la médecine dite « non nécessaire » par des moyens éthiquement acceptables (Jamouille, 2010).

Nous pouvons citer des thérapies alternatives comme des massages, aromathérapie, acupuncture, etc. (CARESEARCH palliative care knowledge network, 2012).

A travers ce travail de Bachelor, nous supposons que la surmédicalisation est synonyme de polymédication. Nous pouvons également proposer le postulat que chez la personne âgée, souvent surmédicalisée suite à sa dégénérescence physiologique et psychologique, nous sommes certes dans la prévention tertiaire mais aussi au cœur de la prévention quaternaire.

La prévention de la polymédication est souvent considérée comme une affaire du domaine médical et pharmaceutique mais il existe des outils, déjà utilisés par ces derniers, à disposition des infirmiers. Nous en citons trois qui sont utilisés par les médecins, pharmaciens et infirmiers qui ont accès à ces instruments :

1. Le *Beers Criteria for Potentially Inappropriate Medication Use in Older Adults*, est un guide pour les professionnels de la santé qui a pour objectif d'augmenter la sécurité des médicaments prescrits chez la personne âgée (voir Appendice A). Cette liste tente d'accentuer une

« déprescription » des médicaments non nécessaires qui réduira les complications associées avec la polymédication (Wikipedia The Free Encyclopedia, 2015).

2. Les outils STOPP « *Screening tool of older people's potentially inappropriate prescriptions* » et START « *Screening tool to alert doctors to right i.e. appropriate, indicated treatments* » ont pour objectif de réduire les traitements et prescriptions inappropriés en les remplaçant par des prescriptions dites appropriées (Fischer & Ryan, 2012) (voir appendice A).
3. ARMOR « *Assess, review, minimize, optimize, reassess* » prend en compte le profil clinique du patient et essaie d'appuyer sur la qualité de vie de la personne en tant que facteur clé pour changer ou arrêter ses traitements médicamenteux (Fischer & Ryan, 2012).

Pour le moment, ces outils semblent peu connus par la plupart des infirmiers, surtout en Europe. Toutefois, d'autres moyens existent sans doute pour faire face à ce phénomène ; c'est la question à laquelle nous souhaitons répondre dans le cadre de ce travail.

#### **5.1.4 Education thérapeutique**

L'éducation thérapeutique assiste et soutient les patients dans l'acquisition ou le maintien des compétences nécessaires pour vivre avec une maladie chronique, comme par exemple, le diabète (World Health Organization Europe, 1998).

La question se pose de savoir comment utiliser l'éducation thérapeutique face à un patient polymédiqué.

Afin d'être efficaces dans la démarche thérapeutique, l'infirmier a besoin de plusieurs atouts comme le respect, la capacité d'identifier des situations éthiques et une communication adaptée qui permet d'engager et développer les relations thérapeutiques mais également de reconnaître les besoins des personnes qui sont touchées par les changements dans leur santé.

Un outil favorisé par l'infirmier est l'entretien motivationnel. A travers une conversation entre patient et soignant, l'infirmier transmet un message qu'il définit en fonction d'objectifs thérapeutiques.

Nous essayons d'aider le patient à gérer et trouver un équilibre entre sa maladie et son mode de vie.

En général les maladies chroniques nécessitent plusieurs traitements médicamenteux. Un de nos objectifs est que le patient adhère au traitement prescrit par son médecin. Nous intervenons dans la transmission des informations concernant ces médicaments, rappelons l'importance de suivre les instructions, de prendre correctement les traitements et de reconnaître certains effets néfastes liés à leur consommation.

L'éducation thérapeutique d'un patient se déroule normalement avec en premier un diagnostic éducatif. Cette étape nous aide à mieux connaître la personne en face de nous, à identifier ses besoins et à savoir quelles sont les compétences nécessaires pour qu'elle devienne acteur de sa santé. Nous devons ensuite formuler un programme personnalisé qui sera revu

régulièrement afin d'évaluer la progression du patient dans cette démarche thérapeutique.

Il est important d'inclure la famille dans cette éducation thérapeutique. Chez la personne âgée nous avons vu qu'il existe des changements cognitifs qui altèrent l'attention et la mémoire. Cette aide additionnelle qu'apporte l'entourage du patient est d'autant plus essentielle dans le cas des patients qui demeurent chez eux et non dans le milieu hospitalier, où la surveillance thérapeutique est réalisée par les équipes soignantes.

Face à la polymédication, nous sommes une source d'information pour le patient. Nous pouvons discuter avec le patient et/ou sa famille, que ce soit en hôpital, en home médicalisé ou à domicile, afin de leur apprendre l'importance de garder une liste de tous leurs médicaments prescrits et non prescrits, leurs dosages et la raison pour laquelle ils ont été prescrits. A travers nos entretiens, nous avons l'occasion d'apprendre au patient les effets secondaires liés à leur médication et, si nécessaire, des restrictions alimentaires dans les cas de certains anticoagulants par exemple. Créer un lien de confiance à travers l'éducation thérapeutique est primordial pour le suivi ainsi qu'une adhérence correcte à leur traitement dans le but de réduire le risque de polymédication.

Il existe des livrets pour le patient et sa famille afin de mieux connaître les médicaments. Notre rôle est de rendre plus facile la prise de médicaments. L'éducation thérapeutique nous aide à vérifier la compréhension chez le patient vis-à-vis de sa médication.

En complément des livrets proposés nous pouvons organiser des ateliers ou faire des jeux de rôle afin de voir si la personne en face de nous a bien assimilé les informations concernant sa prescription médicamenteuse.

Il existe également des organisations comme « *The National Council on Patient Information and Education* » (NCPIE) qui a pour objectif de fournir des programmes éducatifs sur les médicaments pour le patient et pour les professionnels de la santé (National Council on Patient Information and Education, 2015).

Un de nos grands objectifs est de rendre le patient aussi autonome que possible dans la gestion de sa maladie. Cette auto-gestion fait partie de la théorie de soins de Dorothea Orem, théorie choisie comme cadre théorique de ce travail, qui valorise l'auto-soin de la personne.

## **5.2 Cadre théorique**

Comme cadre théorique, nous avons choisi la théorie de Dorothea Orem car elle valorise la notion d'autonomie chez la personne.

Cette théorie est composée de trois théories. La première est la théorie de l'auto soin qui comprend les activités initiées et effectuées par la personne dans l'objectif de maintenir sa santé et son bien-être. La seconde nous concerne plus en tant qu'infirmier car elle indique quand les soins infirmiers sont nécessaires. Il s'agit de la théorie du déficit d'auto soin. La troisième est

la théorie des systèmes de soins, celle-ci expose comment les besoins vont être comblés par l'infirmier, le patient ou les deux ensembles.

A partir de notre sujet cadre (les approches médicamenteuses dans l'accompagnement des personnes âgées) nous avons posé cette question : Quel est le rôle infirmier dans la polymédication chez la personne âgée ?

Dans la théorie de Dorothea Orem, un des postulats annonce que la personne doit être responsable pour ses propres soins et ceux d'un membre de sa famille qui aurait besoin de soins également. Un autre postulat expose que la connaissance des problèmes de santé est nécessaire chez la personne afin de promouvoir un comportement d'auto soins.

Ce sont souvent des idées qui ne sont pas toujours réalisables selon les capacités de la personne. C'est ici que le postulat qui nous informe que les soins infirmiers sont l'interaction entre l'infirmier et une, voire plusieurs personnes, entre en action. Nous sommes là pour apporter des informations, stabiliser, minimiser et contrôler les effets d'un problème de santé ou selon Orem, un déficit d'auto soins là où notre intervention est sollicitée et/ou nécessaire.

Voici un lien pour démontrer la pertinence de cette théorie et notre problématique de polymédication chez la personne âgée : lorsque nous allons à la pharmacie pour acheter un médicament, nous sommes en train de faire preuve d'auto soin car nous avons pris cette décision nous-mêmes, de prendre soin de nous. Lorsque nous sommes hospitalisés dans un service de médecine longue durée, dans un home, au bénéfice des soins à domicile et que les

décisions sur les traitements médicamenteux sont prises par une équipe multidisciplinaire, nous sommes dans le déficit de l'auto soin.

A travers nos recherches sur le thème de la polymédication, nous avons constaté qu'il existe une corrélation entre l'âge et le nombre de médicaments prescrits. Ajouter le fait qu'avec cette consommation thérapeutique vient une augmentation des risques des effets indésirables et que le vieillissement affecte la capacité du corps dans l'absorption, métabolisme et l'élimination de ces drogues, nous pouvons dire que notre rôle en tant qu'infirmier va devenir une exigence. Nos interventions auprès des personnes en déficit d'auto soin seront entre autres de soutenir, éduquer, guider, promouvoir un développement personnel et dans certains cas d'agir pour la personne.

Il existe des critiques de cette théorie, l'une d'entre elles étant le fait que la théorie d'Orem est orientée sur la maladie et ne peut donc pas être applicable dans des situations de bien-être. Si nous prenons notre problématique, nous sommes déjà dans la maladie et nous pourrions donc utiliser cette théorie afin de limiter les conséquences liées à cette polymédication (Current Nursing, 2012).



## 6 Méthode

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Afin de préciser et clairement délimiter notre question de recherche, nous avons utilisé la méthode PICOT. La question définie grâce à cette méthode nous a ensuite permis d'interroger différentes bases de données dans le but de sélectionner les articles les plus appropriés pour y répondre.

Au regard des concepts développés, nous avons défini la question de recherche suivante au moyen de la méthode PICOT :

*Comment l'infirmier peut-il, par l'exercice de son rôle professionnel (Intervention) réduire les complications / conséquences liées à la polymédication (Outcome ou résultat) chez la personne âgée en Home / EMS (Population) ?*

Il s'agit dès lors d'une question de type « intervention » car nous cherchons à démontrer comment l'infirmier peut agir pour prévenir la polymédication. Nous souhaitons définir quel est le moyen le plus efficace pour prévenir les conséquences liées à la polymédication. Il y a donc une évaluation, une décision et une intervention infirmière. Il n'est pas question d'évaluer la signification de la polymédication pour la personne âgée, ni de trouver les causes ou de déterminer quel est le meilleur test diagnostique pour le suivi de la polymédication.

## 6.1 Descripteurs selon tableau

Le tableau ci-dessous présente les descripteurs MeSH et OVID nécessaires à l'interrogation des bases de données afin de maximaliser le nombre d'articles en concordance avec notre question de recherche.

Nous n'avons pas de groupe de comparaison (C) ni un facteur temps (T) car ce n'est pas le but recherché ni pertinent selon les concepts développés.

|                         | <b>P</b>             |                            | <b>I</b>          | <b>C</b> | <b>O</b>          |                             | <b>T</b> |
|-------------------------|----------------------|----------------------------|-------------------|----------|-------------------|-----------------------------|----------|
| <b>Mots-clés</b>        | <i>Personne âgée</i> | <i>En home</i>             | <i>Infirmier</i>  | -        | <i>Prévention</i> | <i>De la polymédication</i> | -        |
| <b>Descripteur MeSH</b> | Aged                 | Nursing homes for the aged | Nurses            | -        | Prevention        | Polypharmacy                | -        |
| <b>Descripteur OVID</b> | Aged                 | Nursing homes              | Registered Nurses | -        | Prevention        | Polypharmacy                | -        |

## 6.2 Critères de sélection des articles

Pour mieux cibler les articles, nous avons définis plusieurs critères.

Premièrement, l'année de publication n'excède pas les dix ans afin de garder une pertinence scientifique et une évaluation des pratiques probantes actuelles. Ensuite, nous avons effectué nos recherches dans les bases de données (Pubmed, Cinhal, Psycinfo, Medline, Cochrane).

Les articles sélectionnés correspondent au meilleur niveau de preuve possible en fonction de notre question de recherche, à savoir des revues systématiques ou des essais contrôlés randomisés. Etant donné le niveau de

preuve des articles sélectionnés, nous n'avons pas tenu compte de l'impact factor qui, le cas échéant, aurait dû être supérieur à 1.5.

Enfin, nous n'avons sélectionné que les articles écrits en français et en anglais.

Le détail des requêtes de recherche selon les différentes bases de données se trouve en annexe (voir Appendice C).

Est présenté également sous forme de tableau, un résumé des articles retenus (voir Appendice D) qui comportent les titres, les auteurs, le niveau de preuves et les bases de données utilisées.

De même, les différents articles analysés selon la grille de Fortin (2010) sont également en annexe (voir Appendice E).

Pour conclure, nous présentons un tableau qui résume globalement chacun des articles, selon 3 thèmes principaux, soit : la polymédication, la population et les interventions (voir Appendice F)

# **7 Synthèse des résultats et discussion**

Cette partie du travail présentera tout d'abord les différents résultats de chacun des articles puis nous répondrons à notre question de recherche. Nous terminerons ensuite avec les perspectives pour la pratique infirmière.

## **7.1 Synthèse des résultats des articles**

Pour chaque article, nous présentons le but de la recherche, la population étudiée et les principaux résultats.

### **7.1.1 Article 1 : Strategies to reduce medication errors with reference to older adults**

Hodgkinson, Koch, Nay et Nichols (2006) ont cherché, au travers d'une revue systématique, les meilleures preuves existantes sur des stratégies permettant de prévenir ou réduire l'incidence des erreurs médicamenteuses chez des personnes âgées (spécifiquement les personnes âgées de 65 ou plus) en milieu de soins aigus, subaigus et en home.

Les auteurs ont identifié 20 études, 3 revues systématiques et 1 revue qui correspondent aux critères fixés.

Les moyens permettant de prévenir les erreurs médicamenteuses dans cette étude n'ont pas toutes été efficaces soit par manque de preuve, soit car l'intervention ne montre pas une amélioration significative. Les auteurs nous informent que des recherches supplémentaires sont nécessaires afin de déterminer l'efficacité des méthodes étudiées. Néanmoins les auteurs proposent les actions suivantes : un système informatisé qui favoriserait la

transmission des ordres médicaux du médecin aux autres professionnels de la santé. Cet outil pourrait également réduire les erreurs liées à la rédaction des prescriptions ; un stockage nominatif des médicaments permettrait de réduire les erreurs ; l'intervention d'un pharmacien qui vérifierait les commandes de médicaments et pourrait aussi être sollicité en cas de besoin par l'équipe, en tant que conseiller ; la nécessité de contrôler et de vérifier les ordres médicaux avant leur administration par deux infirmiers diminue les erreurs (Hodgkinson et al., 2006).

### **7.1.2 Article 2 : Registered nurses' medication management of the elderly in aged care facilities**

Dans cet article, Lim, Chiu, Dohrmann, et Tan (2010) ont cherché à identifier les connaissances des infirmiers dans la gestion des médicaments ainsi que les réactions néfastes chez les personnes âgées (65 ans et plus) au travers d'un pré-test et d'un post test. Suite à l'étude, les résultats démontrent que les infirmiers n'ont pas suffisamment de connaissances sur la pharmacologie et la gestion de la médication. Néanmoins, les infirmiers démontrent qu'en ayant suivi un apprentissage supplémentaire, ils sont capables de progresser dans leur pratique et donc de diminuer les risques liés à la médication.

### **7.1.3 Article 3 : Polypharmacy : Misleading, but manageable**

Les auteurs ont effectué une revue de la littérature afin de trouver une définition du mot polymédication et sa prévalence chez les personnes âgées.

Onze publications ont été analysées et le consensus entre quatre de ces dernières est que la polymédication est une médication qui ne correspond au diagnostic et/ou est associé avec le mot inapproprié. Cette étude a évalué l'usage des médicaments potentiellement inapproprié chez les personnes âgées. C'est à dire les molécules connues qui interfèrent avec le bon fonctionnement du système nerveux central et celles qui ont un effet anticholinergique (Bushardt, Massey, Simpson, Ariail & Simpson, 2008).

#### **7.1.4 Article 4 : Polypharmacy in the Elderly : A Literature Review**

Dans cette revue de la littérature, les auteurs ont essayé de développer la thématique de la polymédication, définie dans leurs résultats comme des médicaments non indiqués cliniquement. Leur recherche a ciblé la personne âgée, 60 ans et plus. Les auteurs voulaient trouver quelles interventions pourraient pallier ce phénomène. Leurs résultats ont montré que la polymédication est toujours un problème et qu'il n'existe pas suffisamment de recherches concernant les méthodes d'évaluation de ce phénomène. Néanmoins les auteurs ont constaté que l'utilisation de certains outils, notamment le Beers Criteria, pourrait être bénéfique en identifiant les effets indésirables et les médicaments qui doivent soit être évités soit utilisés précautionneusement chez les personnes âgées (Fulton & Allen, 2005).

#### **7.1.5 Article 5 : Polypharmacy in elderly patients**

Cette revue de la littérature a tenté d'étudier la notion de polymédication et d'évaluer les études sur la diminution de ce phénomène chez la personne



âgée. Les auteurs constatent que non seulement la polymédication est en augmentation, elle est aussi un facteur de risque de morbidité et mortalité chez la personne âgée. Cinq des 21 études considérées dans cette revue, ciblant les personnes de 65 ans ou plus, ont démontré une amélioration de la polymédication, dans le sens d'une réduction des médicaments inappropriés (Hajjar et al., 2007).

#### **7.1.6 Article 6 : Interventions to improve the appropriate use of polypharmacy for older people (Review)**

Dans cet article, les auteurs ont examiné 139 articles. Plusieurs interventions ont été étudiées, ciblant les interventions pour améliorer la polymédication, un soutien de décision informatisé, interventions pharmaceutiques, utilisation du Beers Criteria et la médication appropriée index (MAI). Les interventions ont démontré une réduction dans les prescriptions inappropriées. L'effet de ces interventions sur les hospitalisations était moins évident. Les auteurs concluent qu'il n'est pas certain que les interventions améliorent la polymédication. Toutefois, elles peuvent être bénéfiques en diminuant les prescriptions inappropriées. Cette revue de la littérature a étudié des interventions qui visent une amélioration d'une polymédication appropriée chez les personnes de 65 ans ou plus (Patterson, Hughes, Kerse, Cardwell & Bradley, 2012).

### **7.1.7 Article 7 : Health Outcomes and Polypharmacy in Elderly**

#### **Individuals : An Integrated Literature Review**

Cette revue de littérature a permis de démontrer que la polymédication était un prédicteur significatif d'un ensemble de complications majeures telles que : des hospitalisations, le placement en home, la mortalité, les déséquilibres glycémiques et en particulier les hypoglycémies avec leurs conséquences parfois graves, des fractures, une altération de la mobilité, des affections respiratoires telles que des pneumonies ou encore une baisse de l'état général à mettre en lien avec une malnutrition. Cette revue de littérature démontre que les effets de la polymédication sont significatifs à différents niveaux et fait état de l'importance de considérer ce sujet comme primordial dans une perspective de santé publique face à une population vieillissante (Frazier, 2005).

Frazier (2005) a inclus les études seulement si il s'agissait de recherche originale sur la relation entre la polymédication et les conséquences sur la santé. Les études devaient également décrire les conséquences pour la santé chez une population âgée spécifiquement (minimum 60 ans).

### **7.1.8 Article 8 : Interventions to optimise prescribing for older people in care homes (Review)**

Allred, Raynor, Hughes, Barber, Chen et Spoor (2013) avait pour but de déterminer les effets des interventions qui optimisent les prescriptions pour les personnes âgées vivant en home. La revue de littérature effectuée incluait

des essais contrôlés randomisés évaluant les interventions visant à améliorer les prescriptions des personnes âgées (65 ans ou plus) vivant dans des institutions de soins. Une étude était incluse si elle mesurait un ou plus des conséquences primaires ou secondaires suivantes : effets indésirables, hospitalisation, mortalité, qualité de vie, problèmes liés à la médication, médication appropriée et coûts.

8 études ont été retenues pour analyse ; les interventions évaluées sont diverses et souvent multiformes. La revue de la médication était une composante de 7 études, les études multidisciplinaires de cas sont évaluées dans 3 études, 2 études évaluent les interventions de formation de l'équipe soignante du home et 1 étude seulement a évalué l'utilisation des supports technologiques d'aide à la décision. Aucune étude n'a mesuré la qualité de vie. Les auteurs concluent à un manque d'évidence d'un effet des interventions sur les conséquences primaires pour la santé (Alldred et al., 2013). Toutefois, Alldred et al. (2013) précisent que les interventions ont permis d'identifier et résoudre les problèmes liés à la médication et améliorer la justesse de la médication.

#### **7.1.9 Article 9 : Interventions to optimise prescribing in care**

##### **homes : systematic review**

En effectuant cette recherche, Loganathan, Singh, Franklin, Bottle et Majeed (2011) avaient pour but de passer en revue les effets des interventions pour optimiser les prescriptions dans les homes. Les critères de sélection, entre

autre, sont : des études contrôlées randomisées ou non-randomisées, l'âge moyen des résidents est supérieur ou égal à 65 ans et un contexte de home.

Au total, 16 articles correspondent aux critères de sélection sur 512 articles identifiés. Au travers des 16 articles retenus, les auteurs identifient plusieurs chevauchements entre plusieurs interventions. 8 études ont évalué l'impact de la formation du personnel dont 6 qui ont montré une amélioration dans la qualité des prescriptions, 3 études ont évalués l'impact des interventions dirigées par un pharmacien sur les prescriptions dont 1 seule étude a montré un effet significatif, 3 études ont évalué les effets des réunions d'équipe multidisciplinaire sur les prescriptions dont 2 ont montré des résultats significatifs. Enfin, 2 études ont évalué les effets des supports informatisés d'aide à la décision clinique sur les prescriptions chez les personnes âgées dont 1 a identifié de manière significative des prescriptions plus appropriées (Loganathan et al., 2011).

**7.1.10 Article 10 : Improving the Quality of Pharmacotherapy  
in Elderly Primary Care Patients Through Medication  
Reviews : A Randomised Controlled Study**

Milos, Rekman, Bondesson, Eriksson, Jakobsson, Westerlund et Midlöv (2013) avaient pour but d'évaluer un modèle structuré pour une revue de la médication dirigée par un pharmacien et de mesurer ses effets sur un nombre de patients consommant des médicaments potentiellement inappropriés et ayant 10 médicaments ou plus et 3 psychotropes ou plus.

Milos et al. (2013) ont réalisé un essai contrôlé randomisé auprès de patients âgés de 75 ans ou plus, vivant en home ou en communauté. L'intervention a été une revue de la médication par un pharmacien, basée sur une évaluation infirmière des symptômes. Un total de 369 patients a été inclus dans cette étude. 182 dans le groupe intervention et 187 dans le groupe contrôle. Un tiers des patients dans les deux groupes a au moins un médicament inapproprié. Deux mois après la revue de la médication, le nombre de patients du groupe intervention avec au moins un médicament potentiellement inapproprié et le nombre de patient du groupe intervention utilisant 10 ou plus de médicaments a diminué ( $p = 0.007$  et  $p = 0.001$ , respectivement) alors qu'il n'y a pas eu de changement significatif dans le groupe contrôle. Aucun changement n'a été observé dans le nombre de patient utilisant 3 psychotropes ou plus. Toutefois, le dosage de ces médicaments tend à diminuer.

Des problèmes liés aux médicaments ont été identifiés chez 93% des 182 patients du groupe intervention. Au total, il y a eu 431 problèmes liés aux médicaments dans le groupe intervention (2.5 problèmes liés aux médicaments par patient en moyenne) et 16% des problèmes liés aux médicaments étaient liés aux médicaments potentiellement inappropriés (Milos et al., 2013).

## **7.2 Développement des résultats en lien avec la question**

### **PICOT**

Afin de répondre à notre question de recherche (*Comment l'infirmier peut-il, par l'exercice de son rôle professionnel réduire les complications / conséquences liées à la polymédication chez la personne âgée en home / EMS ?*), nous présentons les résultats des articles analysés en fonction de plusieurs thématiques qui ressortent clairement de cette revue de littérature : éducation thérapeutique, approche multidisciplinaire, connaissances et formation du personnel de santé, logiciels et outils d'aide à la décision, autres interventions.

#### **7.2.1 Education thérapeutique**

Parmi les interventions possibles, l'éducation thérapeutique du patient et de sa famille semble la plus prometteuse (Frazier, 2005 ; Hajjar et al., 2007 ; Loganathan et al., 2011). Toutefois, celle-ci doit être réalisée de manière approfondie (Frazier, 2005). Les différents articles ne précisent toutefois pas la nature même des interventions d'éducation thérapeutique ni l'objectif à atteindre pour chaque patient.

#### **7.2.2 Approche multidisciplinaire**

Une approche multidisciplinaire face à la polymédication joue un rôle important dans l'amélioration des prescriptions chez les personnes en home. Une telle équipe sera constituée au minimum d'un médecin, d'un pharmacien et d'un infirmier (Alldred et al., 2013), ce dernier ayant un rôle d'évaluation

clinique des symptômes (Milos et al., 2013). Le pharmacien se charge de la revue de la médication et peut également avoir un rôle de conseiller (Hodgkinson et al., 2006). Le médecin est responsable du changement de la prescription.

### **7.2.3 Connaissances et formation du personnel de santé**

Afin de prévenir les conséquences liées à la polymédication, l'infirmier doit être à jour concernant les dernières informations sur les médicaments. Cela induit la nécessité d'une formation accrue du personnel (Frazier, 2005 ; Alldred et al., 2013 ; Lim et al., 2010 ; Loganathan et al., 2011), notamment dans l'utilisation des outils d'évaluation et de prévention de la polymédication (outils STOPP/START, Beers Criteria) (Patterson et al., 2012). Enfin, les infirmiers en pratique avancée ayant le droit de prescription doivent régulièrement revoir la médication afin d'éliminer les médicaments inutiles ou inappropriés (Frazier, 2005). Favoriser la formation du personnel a induit une amélioration des prescriptions (Loganathan et al., 2011).

### **7.2.4 Logiciels et outils d'aide à la décision**

L'utilisation de logiciels et d'outils d'aide à la décision fait partie intégrante des interventions possibles, notamment les outils permettant d'évaluer les contre-indications, les interactions et les effets secondaires des médicaments (Frazier, 2005). Un système informatisé de transmissions et de rédaction des prescriptions permet non seulement une diminution des erreurs médicamenteuses (Hodgkinson et al., 2006) mais cela permettrait aussi un

report précis du nombre et du type de médication au médecin prescripteur comme le suggère Frazier (2005) pour diminuer les effets de la polymédication.

Toutefois, l'utilisation d'un système informatisé peut avoir ses points faibles comme par exemple l'incapacité de calculer les dosages journaliers ou un taux élevé de fausses alertes (Loganathan et al., 2011).

Des moyens mnémotechniques sont proposés dans le but de réduire les effets de la polymédication. Cependant, des recherches supplémentaires sont nécessaires afin de valider leur efficacité (Fulton & Allen, 2005).

### **7.2.5 Autres interventions**

Régime et exercice sont également des interventions non médicamenteuses possibles afin de diminuer les conséquences liées à la polymédication (Hajjar et al., 2007). Il est également recommandé de disposer d'une politique claire impliquant une vérification régulière du dossier de soins à chaque fois qu'un patient a plus de 5 médicaments prescrits (Frazier, 2005).

Améliorer les prescriptions est un processus complexe. Une combinaison d'interventions est nécessaire afin d'obtenir une efficacité significative dans la réduction des conséquences liées à la polymédication (Loganathan et al., 2011).

## **7.3 Perspectives et propositions pour la pratique**

Aux Etats-Unis ou au Canada, l'infirmier a le droit de prescription. Cette possibilité étant envisagée en Europe, quels seraient les aspects dont il faudrait



tenir compte afin de prévenir la polymédication ? (Kroezen, Van Dijk, Groenewegen & Francke, 2011).

De même, si un médicament peut s'acheter en supermarché, l'infirmier ne devrait-il pas avoir ce droit de prescription ? Car en effet, cela renforcerait le rôle infirmier. Il aurait plus de responsabilités et ainsi plus de visibilité.

A contrario, une augmentation des responsabilités professionnelles induit forcément plus de responsabilité pénale.

Par exemple, en Suisse, une personne peut être condamnée pénalement si elle n'a pas respecté son devoir de diligence lorsqu'elle effectue des opérations en rapport avec des produits thérapeutiques (Chancellerie fédérale, 2015, art. 86 LPTh).

La formation Bachelor en soins infirmiers a pour but de former un praticien réflexif. Ce travail sur la polymédication, ses aspects préventifs, éducatifs et alternatifs peut donner des pistes pour la pratique dans le sens où l'infirmier est responsable de l'administration des traitements médicamenteux. En effet, il est le dernier maillon de la chaîne du médicament, depuis la prescription jusqu'à l'administration.

Face au médecin responsable de la prescription, des connaissances sur la polymédication et ses conséquences peuvent lui permettre d'argumenter la mise en place d'une alternative à une substance chimique.

Autre aspect, l'infirmier est responsable de la préparation des médicaments. Est-ce qu'une diminution du nombre de médicaments ne pourra

pas, dès lors, diminuer le temps de préparation et aussi le nombre d'erreurs liées à cette préparation ?

En lien avec cette préparation, une personne bénéficiant des soins à domicile peut tout à fait sortir acheter ses médicaments au supermarché ou à la pharmacie. L'infirmier n'a alors peu ou pas de contrôle sur ce qu'elle consomme comme médicaments en plus de ceux prescrits par un médecin.

Dès lors, pour la pratique infirmière, l'utilisation des outils créés dans le but de prévenir la polymédication est d'une pertinence évidente. En effet, selon l'Office fédérale de la santé publique OFSP (2013) et sa politique de santé « Santé 2020 », la priorité va dans le sens d'une diminution des médicaments afin d'améliorer la qualité et réduire les coûts.

Le Conseil fédéral souhaite, avec les modifications proposées, améliorer l'accès de la population aux médicaments. Il est donc question de simplifier la commercialisation des médicaments et phytomédicaments mais également d'avoir une gamme plus étendue de médicaments pédiatriques. « Ces adaptations concernent également les dispositions relatives aux rabais et aux bonus ainsi qu'à l'automédication. » (Swissmedic, 2015).

# 8 Conclusion

En guise de conclusion, les éléments facilitants et contraignants ainsi que les limites du travail sont présentés. Nous abordons également les perspectives de recherche à mener par la suite et les nouvelles questions que ce travail a suscitées.

## **8.1 Apport du Travail de Bachelor**

Un des éléments facilitant de ce travail a été la mise en place de séminaires de préparation au travail de Bachelor. En effet, les exercices de recherche et d'analyse d'articles effectués en amont permettent un gain de temps et une pertinence des recherches. Toutefois, le temps écoulé entre la présentation des différents séminaires et le début de la rédaction du travail de Bachelor est un point contraignant dans le sens où il y a un risque d'oubli.

Rédiger ce travail en groupe de trois personnes a été à la fois facilitant et contraignant. Facilitant dans le sens où cela a permis une répartition des tâches selon les forces de chacun mais contraignant pour fixer des rencontres afin de mettre en commun nos recherches.

Le suivi de notre directrice de travail de Bachelor nous a permis de progresser et garder un cadre au fur et à mesure de la rédaction. Sa disponibilité, son engagement ainsi que ses connaissances dans le domaine de la recherche nous a été bénéfique pour la réalisation du document.

Notre prise de contact avec des professionnels de santé afin de développer la problématique a été un aspect positif de ce travail au même titre que la

possibilité de choisir la thématique en fonction de nos expériences de stage. Cela a accru notre motivation à effectuer des recherches sur ce sujet qu'est la polymédication. Notre manque de connaissances à ce propos nous a poussés à développer le concept dans son ensemble.

La charge de travail en parallèle et les définitions multiples existantes de la polymédication sont les derniers éléments contraignants que nous avons identifiés.

Cette recherche a permis de développer particulièrement les rôles d'expert, de communicateur, de manager et d'apprenant (voir Appendice B). Nous avons également développé un regard plus réflexif sur la prise en charge médicamenteuse des personnes âgées. Cela est d'autant plus important que la population tend à vieillir. Pour terminer, en regard de « Santé 2020 » (Office fédéral de la santé publique OFSP, 2013), cela va dans le sens d'apporter une qualité de soins.

## **8.2 Limites**

Une des premières limites de ce travail est la difficulté à définir clairement la polymédication. Il n'y a pas de consensus à ce propos et les critères d'évaluation de la polymédication varient suivant les auteurs. Du fait de cette définition changeante, il est difficile de réaliser des essais contrôlés randomisés. La polymédication n'est pas une unité statistique. De même, les effets de la polymédication sont variables selon l'individu, son âge, les types de

médicaments consommés ou encore le métabolisme de l'individu. Cela nous amène au point suivant, celui de la difficulté à généraliser les résultats obtenus. En effet, les pratiques diffèrent selon les pays et le nombre d'articles analysés n'est pas toujours représentatif. La langue des articles joue également un rôle. Nous avons sélectionné uniquement des articles en anglais et en français alors que nos recherches ont abouti sur des articles en espagnol ou chinois par exemple.

Enfin, dernier point et non des moindres, une approche multidisciplinaire est nécessaire dans la gestion de la polymédication. Cela demande du temps et de l'argent. La décision finale par rapport au changement de la médication revient au médecin. Cela pose donc la limite du rôle médico-délégué de l'infirmier.

### **8.3 Perspectives pour la recherche**

Comme le souligne la plupart des articles, il y a un manque d'évidences, de preuves concernant les interventions infirmières possibles qui permettent un contrôle de la polymédication chez la personne âgée.

Il est donc nécessaire de réaliser plus de recherches d'un point de vue infirmier afin d'identifier les interventions permettant de réduire les conséquences liées à la polymédication. Des recherches mesurant également l'impact de la polymédication sur la qualité de vie des personnes sont nécessaires.

Au vu de la proximité de l'infirmier auprès des patients, nous avons un rôle-clé dans la prévention de la polymédication de par l'évaluation des manifestations cliniques. En ce sens, des recherches approfondies sur les différents symptômes et outils d'évaluation sont recommandées.

Bien que des articles ciblant l'impact infirmier sur la polymédication existent, ces derniers ne sont pas d'un niveau de preuve suffisant pour être inclus dans une recherche telle que celle-ci. Ainsi, des études de type revue de littératures doivent être réalisées.

Ce travail nous amène à nous poser d'autres questions, notamment le fait de savoir si, dans les pays où l'infirmier peut prescrire des médicaments, il joue un rôle dans la polymédication. Un pharmacien et un médecin voient les patients ponctuellement alors qu'un infirmier les voit tous les jours. Ainsi, des recherches ayant pour but de déterminer si l'infirmier avec un droit de prescription est plus attentif et bienveillant et s'il a un impact positif sur la polymédication sont recommandées.

Un point à ne pas négliger non plus est la transmission possible de médicaments entre différentes personnes (amis, collègues de travail, famille). En effet, il sera probablement très difficile d'empêcher et d'avoir le contrôle sur ce type de transactions. Le développement du marché du médicament sur internet peut également accroître la consommation et par là, l'impossibilité de contrôler la thérapie médicamenteuse. Toutefois, des recherches approfondies appuyant nos propos sont nécessaires.

De même, de nombreuses personnes gardent des médicaments périmés ou dont la prescription est terminée (Hodgkinson et al., 2006). Cela accentue ainsi la difficulté de gestion du traitement.

La polymédication ne peut pas se traiter de manière linéaire. Il faut une équipe pluridisciplinaire et plusieurs interventions en parallèle.



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# 10 Appendices

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## **10.1 Appendice A : STOPP / START Toolkit et Beers**

**Criteria – outils d'aide à l'évaluation de prescriptions  
inappropriées**

For a print friendly version (to print double sided to fold into a booklet) please contact Sue Hawker at Sue.Hawker@cumbria.NECSU.nhs.uk

# **STOPP START Toolkit**

## **Supporting Medication Review**

### **STOPP:**

**Screening Tool of Older People's potentially inappropriate Prescriptions.**

### **START:**

**Screening Tool to Alert doctors to Right i.e. appropriate, indicated Treatments.<sup>1</sup>**

**STOPP: Screening Tool of Older People's  
potentially inappropriate Prescriptions.<sup>1</sup>**

Prescriptions that are potentially inappropriate in  
persons aged  $\geq 65$  years of age

**START: Screening Tool to Alert doctors to Right  
i.e. appropriate, indicated Treatments.<sup>1</sup>**

Medication that should be considered for people  $\geq 65$   
years of age where no contraindication exists

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# An evidence based approach to prescribing in the elderly.

## Introduction

A definition of medication review is “a structured, critical examination of a patient’s medicines with the objective of reaching an agreement with the patient about treatment, optimising the impact of medicines, minimising the number of medication-related problems and reducing waste”.<sup>2</sup>

It is commonly agreed that older people are at greater risk of adverse effects from their medicines due to age related changes in their major organs which in turn alter pharmacokinetics and pharmacodynamics. They also often have multiple co-morbidities leading to drug-drug interactions or cautions and contraindications to preferred treatments.

These patients however are often excluded from drug trials making it difficult for the clinician to weigh up the benefits versus risks, let alone explain them to the patient. Furthermore, although with increasing age a patient can move from benefiting from a treatment to being at significant risk from it, there can be difficulty in stopping medication for the fear of being accused of ageism.

This document is based on the STOPP START Tool a medication review tool designed to identify medication where the risks outweigh the benefits in the elderly and vice versa.

Eighteen experts in geriatric pharmacotherapy initially contributed to suggesting and then rating the criteria. The STOPP criteria were evaluated (along with Beer’s criteria<sup>3</sup>) against hospital admissions — one third of the patients with “potentially inappropriate prescriptions”

according to STOPP criteria presented with an associated adverse drug event.

All recommendations from the STOPP START Tool are included here, and where space allows, local and national guidance (in blue-edged boxes) these can only be considered correct at time of publication.

The tool was validated in patients aged 65 and over but there is still a place for clinical judgement in deciding whether a person is “elderly” in terms of the potential effects of medication.

The recommendations are grouped according to the main British National Formulary chapters<sup>4</sup> with the STOPP items on the left (coloured red) and the START items (coloured green) on the right of the double page. The rationale for the intervention is given in italics.

The process of medication review is covered in the practice guide to clinical medication review.<sup>5</sup> As well as using the list of drugs here to decide which might need to be stopped in the frail elderly it should also be considered if the drug gives daily symptomatic benefit, prevents rapid worsening of symptoms or replaces a hormone vital for normal function e.g. thyroxine. If so it should normally be continued.

A study of prescribing in general practice in Scotland<sup>6</sup> used a panel of GPs and pharmacists to develop “prescribing safety indicators” (PSI) to judge the prescribing against. These were mostly either high risk drug combinations (drug interactions) or drug-disease combinations (contraindications). The indicators not already covered by STOPP are given in the blue supporting information boxes however it is the clinicians responsibility to consider other drug interactions or contra-indications not listed here.

The following drugs or drug classes were most often implicated in a UK study<sup>7</sup> looking at cause of admission in two hospitals over a six month period (result given as percentage of adverse drug reaction—ADR—related admissions which in turn were 6.5% of all admissions).

|     |                                   |       |
|-----|-----------------------------------|-------|
| 1.  | NSAIDs including aspirin          | 29.6% |
| 2.  | Diuretics                         | 27.3% |
| 3.  | Warfarin                          | 10.5% |
| 4.  | ACEI/A2RAS                        | 7.7%  |
| 5.  | Antidepressants including lithium | 7.1%  |
| 6.  | Betablockers                      | 6.8%  |
| 7.  | Opiates                           | 6.0%  |
| 8.  | Digoxin                           | 2.9%  |
| 9.  | Prednisolone                      | 2.5%  |
| 10. | Clopidogrel                       | 2.4%  |

This study was in patients over the age of 16, but clinicians will recognise that these drugs are commonly prescribed in older people.

The authors suggested that over 70% of the ADRs were avoidable. These findings are supported by a 2006 systematic review<sup>8</sup> which found the four most common drug groups associated with preventable drug-related admissions to be antiplatelets (16%), diuretics (15.9%), NSAIDs (11%) and anticoagulants (8.3%). In addition to those listed above, they found drugs used in diabetes (3.5%), positive inotropes (3.2%), calcium channel blockers (2.8%) and antiepileptics (2.3%) were also implicated. (This review was not confined to the UK population and not all studies were specific to older people).

If wanting to reduce the burden of polypharmacy in gradual steps it might be prudent to tackle the above drugs as a priority after removing ineffective or unnecessary treatment.

Many anticholinergic (antimuscarinic) drugs are included in the STOPP sections already but as combining anticholinergic drugs increases the risk of side effects (including confusion, falls and death) the Anticholinergic Cognitive Burden scale<sup>9</sup> for some commonly prescribed drugs is given on page 27 and in more detail in the appendices of the practice guide to clinical medication review.<sup>5</sup>

Particular caution should be taken if considering stopping the following drugs (continue treatment, gradual withdrawal or specialist advice before stopping):<sup>10</sup>

- ACEI and diuretics used in heartfailure.
- Amiodarone, CCBs, betablockers or digoxin used to control heart rate or rhythm.
- Anticonvulsants used in epilepsy.
- Antidepressant, antipsychotic or mood stabilizing drugs.
- Antimuscarinic or other drugs used in Parkinson’s disease.
- Steroids, DMARDs or immunosuppressant drugs.

Further information to aid the assessment of benefits versus risks including number needed to treat and number needed to harm can be found in the appendices of the practice guide.<sup>5</sup>

## Colour Key.



Medication to consider stopping in patients over 65 from the STOPP Tool<sup>1</sup>



Medication to consider starting in patients over 65 from the START Tool<sup>1</sup>



National and local guidance e.g. NICE Guidelines<sup>11</sup> or other supporting/useful information e.g. prescribing safety indicators (PSI).

## STOPP: Screening Tool of Older People's potentially inappropriate Prescriptions.<sup>1</sup>

The following STOPP prescriptions are potentially inappropriate in persons aged ≥65 years of age

### Gastrointestinal System BNF Chapter 1

#### Diphenoxylate, loperamide or codeine phosphate

- for treatment of diarrhoea of unknown cause\* (*risk of delayed diagnosis, may exacerbate constipation with overflow diarrhoea, may precipitate toxic megacolon in inflammatory bowel disease, may delay recovery in unrecognised gastroenteritis*).
- for treatment of severe infective gastroenteritis i.e. bloody diarrhoea, high fever or severe systemic toxicity (*risk of exacerbation or protraction of infection*).
- **Prochlorperazine** or **metoclopramide** with Parkinsonism (*risk of exacerbating Parkinsonism*).
- **Proton pump inhibitor** at **treatment dose** for peptic ulcer disease at full therapeutic dosage for > 8 weeks (*earlier discontinuation or dose reduction for maintenance/ prophylactic treatment of peptic ulcer disease, oesophagitis or GORD indicated*).
- **Anticholinergic antispasmodic drugs** with chronic constipation (*risk of exacerbation of constipation*).

Review enteral nutrition: [NICE CG32](#) (Nutrition support in adults) recommends assessment using a tool such as MUST:  
[www.bapen.org.uk/pdfs/must/must\\_full.pdf](http://www.bapen.org.uk/pdfs/must/must_full.pdf)

## START: Screening Tool to Alert doctors to Right i.e. appropriate, indicated Treatments.<sup>1</sup>

These START medications should be considered for people ≥ 65 years of age with the following conditions, where no contraindication exists.

### Gastrointestinal System BNF Chapter 1

- **Proton Pump Inhibitor** with severe gastro-oesophageal acid reflux disease or peptic stricture requiring dilatation.
- **Fibre supplement** for chronic, symptomatic diverticular disease with constipation.



#### **NICE CG59 Osteoarthritis**

"Offer a standard NSAID...Co-prescribe with a **proton pump inhibitor**"

Local dyspepsia and gastric ulcer prescribing guidelines are available from the **Medicines Management** intranet pages.<sup>5</sup>

\* For diarrhoea of unknown cause consider the possibility of Clostridium difficile infection (CDI) if there is a history of antibiotic use or recent hospital discharge.

Stop antimotility agents and PPIs

Stop antibiotics

## Cardiovascular System BNF Chapter 2

### STOPP

- **Digoxin** at a long-term dose > 125µg/day with impaired renal function — estimated GFR <50ml/min (*increased risk of toxicity*).

#### Loop diuretic

- for dependent ankle oedema only i.e. no clinical signs of heart failure (*no evidence of efficacy, compression hosiery usually more appropriate*).
- as first-line monotherapy for hypertension (*safer, more effective alternatives available*).
- **Thiazide diuretic** with a history of gout (*may exacerbate gout*).

#### Beta-blocker

- in combination with verapamil (*risk of symptomatic heart block*).
- **Non-cardioselective beta-blocker** with Chronic Obstructive Pulmonary Disease (COPD) (*risk of bronchospasm*).

#### Calcium channel blockers

- with chronic constipation (*may exacerbate constipation*).
- Use of **diltiazem or verapamil** with NYHA Class III or IV heart failure (*may worsen heart failure*).
- **Vasodilator drugs** known to cause hypotension in those with persistent postural hypotension i.e. recurrent > 20mmHg drop in systolic blood pressure (*risk of syncope, falls*). *Stop if patient has fallen in past 3 months*.

#### Aspirin

- with a past history of peptic ulcer disease without histamine H2 receptor antagonist or Proton Pump Inhibitor (*risk of bleeding*).
- at dose > 150mg day (*increased bleeding risk, no evidence for increased efficacy*).
- with no history of coronary, cerebral or peripheral arterial symptoms or occlusive arterial event (*not indicated*).
- to treat dizziness not clearly attributable to cerebrovascular disease (*not indicated*).
- with concurrent bleeding disorder (*high risk of bleeding*).

#### Warfarin

- for first, uncomplicated deep venous thrombosis for longer than 6 months duration (*no proven added benefit*).
- for first uncomplicated pulmonary embolus for longer than 12 months duration (*no proven benefit*).
- with concurrent bleeding disorder (*high risk of bleeding*).
- Use of aspirin and warfarin in combination without gastroprotection (avoid cimetidine because of interaction with warfarin) (*high risk of gastrointestinal bleeding*).

#### Clopidogrel

- with concurrent bleeding disorder (*high risk of bleeding*).

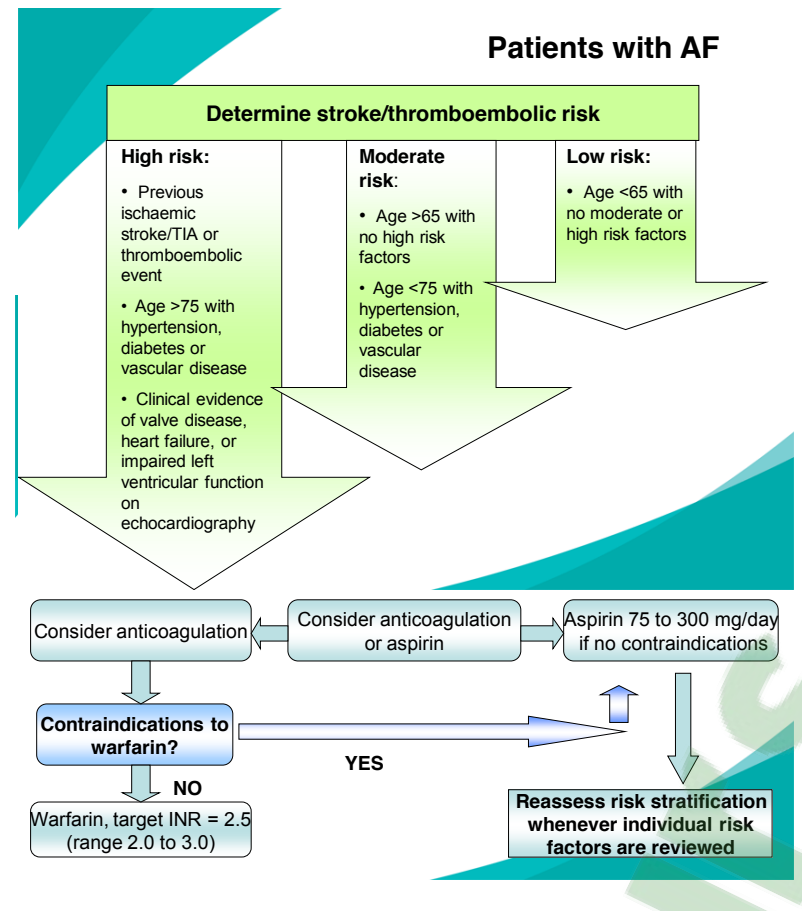
#### Dipyridamole

- as monotherapy for cardiovascular secondary prevention (*no evidence for efficacy except in ischaemic stroke*).
- with concurrent bleeding disorder (*high risk of bleeding*).

**Prescribing safety indicators:** The combination of NSAIDs, ACEI/A2RA and diuretic is considered particularly risky. Antiplatelets should not be combined with warfarin—even if indicated the benefits are unlikely to outweigh the harms in the frail elderly.



**NICE CG36 Atrial Fibrillation (AF)**  
When to start warfarin or aspirin in AF:



**NICE TA 210** covers which antiplatelet to use to prevent occlusive vascular events e.g. **MI** use aspirin first line; **ischaemic stroke** use clopidogrel first line and **TIA** use MR dipyridamole AND aspirin.

## Cardiovascular System BNF Chapter 2

### START

- **Warfarin** in the presence of chronic atrial fibrillation (see NICE guidance on page 12).
- **Aspirin** in the presence of chronic atrial fibrillation, where warfarin is contraindicated, but not aspirin.
- **Aspirin** with a documented history of atherosclerotic coronary disease in patients with sinus rhythm.
- **Clopidogrel** with a documented history of ischaemic stroke or peripheral vascular disease
- **Antihypertensive** therapy where systolic blood pressure consistently >160 mmHg.
- **Statin** therapy with a documented history of coronary, cerebral or peripheral vascular disease, where the patient's functional status remains independent for activities of daily living and life expectancy is > 5 years.\*
- **Angiotensin Converting Enzyme (ACE) inhibitor** with chronic heart failure.
- **ACE inhibitor** following acute myocardial infarction.
- **Beta-blocker** with chronic stable angina.

\***NICE CG 67** Lipid Modification Prescribing Guidelines do not specify a degree of independence or life expectancy for secondary prevention (offer to all adults with clinical evidence of CVD); in primary prevention they suggest systematic strategies are used to identify people aged 40-74 likely to be at high risk— statins *can* be started in older people but risk calculators are inaccurate, they may be at greater risk from the treatment and benefit is unlikely to be gained until after five years of therapy.

## Respiratory System BNF Chapter 3

### STOPP

- **Theophylline** as monotherapy for COPD (*safer, more effective alternatives; risk of adverse effects due to narrow therapeutic index*).
- **Systemic corticosteroids** instead of inhaled corticosteroids for maintenance therapy in moderate-severe COPD (*unnecessary exposure to long-term side-effects of systemic steroids*).
- **Nebulised ipratropium** with glaucoma (*may exacerbate glaucoma*).
- **First generation antihistamines** (*sedative, may impair sensorium*). *Stop if patient has fallen in past 3 months*.

## Respiratory System BNF Chapter 3

### START

- Regular inhaled **beta 2 agonist** or **anticholinergic (antimuscarinic)** agent for mild to moderate asthma or COPD.
- Review patients with mild or moderate COPD at least once a year and severe or very severe COPD (FEV1 <50% predicted) at least twice a year. Follow NICE guidance regarding treatment selection for COPD. (Use BTS/SIGN guidelines for asthma).

### NICE CG 101 COPD



#### Theophylline

Only offer theophylline after trials of short- and long-acting bronchodilators or to people who cannot use inhaled therapy.

#### Oral Corticosteroids

Maintenance use of oral corticosteroid therapy in COPD is not normally recommended.

Some people with advanced COPD may need maintenance oral corticosteroids if treatment cannot be stopped after an exacerbation. Keep the dose as low as possible, monitor for osteoporosis and offer prophylaxis.

### NICE CG 101 COPD

Assess the need for **oxygen** therapy in people with any of the following:

- very severe airflow obstruction (FEV1 <30% predicted)
- cyanosis
- polycythaemia
- peripheral oedema
- raised jugular venous pressure
- oxygen saturations less than or equal to 92% breathing air.

Give people with FEV1 < 30% a course of **antibiotic** and **oral corticosteroid** tablets to keep at home.

# Central Nervous System

## BNF Chapter 4

### STOPP

#### Tricyclic antidepressants (TCAs)

- with dementia (*risk of worsening cognitive impairment*).
- with glaucoma (*likely to exacerbate glaucoma*).
- with cardiac conductive abnormalities (*pro-arrhythmic effects*).
- with constipation (*likely to worsen constipation*).
- with an opiate or calcium channel blocker (*risk of severe constipation*).
- with prostatism or prior history of urinary retention (*risk of urinary retention*).

#### Benzodiazepines

- if long-term (i.e. > 1 month) and long-acting e.g. chlordiazepoxide, flurazepam, nitrazepam and benzodiazepines with long-acting metabolites e.g. diazepam (*risk of prolonged sedation, confusion, impaired balance, falls*).
- if fallen in past 3 months

#### Antipsychotics\*

- long-term (i.e. > 1 month) as hypnotics (*risk of confusion, hypotension, extra-pyramidal side effects, falls*).
- long-term (> 1 month) in those with parkinsonism (*likely to worsen extra-pyramidal symptoms*).
- if fallen in past 3 months (may cause gait dyspraxia, Parkinsonism).
- **Phenothiazines** in patients with epilepsy (*may lower seizure threshold*).
- **Anticholinergics** to treat extra-pyramidal side-effects of antipsychotic medications (*risk of anticholinergic toxicity*).

- **Selective serotonin re-uptake inhibitors** (SSRI's) with a history of clinically significant hyponatraemia (*<130mmol/l within the previous 2 months*).
- **First generation antihistamines** if prolonged use (> 1 week) i.e. chlorphenamine, cyclizine, promethazine (*risk of sedation and anti-cholinergic side effects*).

#### Opiates

- Use of long-term strong opiates as first line therapy for mild-moderate pain (*WHO analgesic ladder not observed—more details page 16*).
- Regular opiates for more than 2 weeks in those with chronic constipation without concurrent use of laxatives (*risk of severe constipation*).
- long-term in those with dementia unless for palliative care or management of chronic pain syndrome (*exacerbation of cognitive impairment*).
- long-term in those with recurrent falls (*risk of drowsiness, postural hypotension, vertigo*).

#### NICE CG90 Depression in Adults:

The first step in mild depression is not routinely to prescribe e.g. offer cognitive behavioural therapy (CBT).

**Prescribing safety indicators:** The combination of tricyclic antidepressants and heart failure is considered risky (reduced contractility and pro-arrhythmic).<sup>12</sup>

\*When reviewing antipsychotics the original diagnosis must be carefully considered—if for psychosis then benefit may well outweigh risks. See also page 19—dementia.

## Central Nervous System BNF Chapter 4

Further information:

**Welsh MeReC** gives guidance on stopping benzodiazepines, antidepressants and antipsychotics available at

[www.wemerec.org](http://www.wemerec.org).

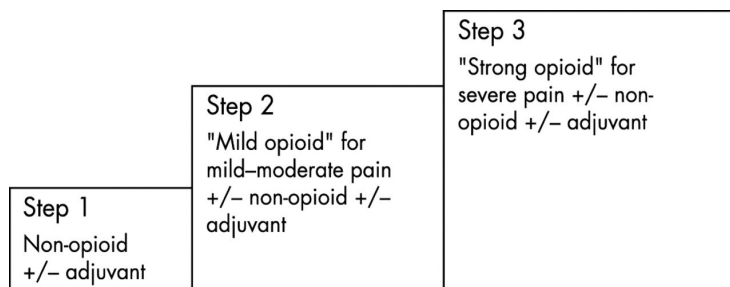
**Patient.co.uk** has both [patient information](#) and [professional resources](#) on stopping benzodiazepines.

For **palliative care** the website **www.gp-palliativecare.co.uk** contains local information e.g. NHS Cumbria End of Life Strategy and national guidance.

### WHO analgesic ladder:

Mild opioid: codeine, dihydrocodeine, tramadol.

Strong opioid: morphine, diamorphine, buprenorphine, oxycodone, pethidine, tramadol—at high doses.



## Central Nervous System BNF Chapter 4

### START

- **Levodopa** in idiopathic Parkinson's disease with definite functional impairment and resultant disability.
- **Antidepressant** drug in the presence of moderate-severe depressive symptoms lasting at least three months.

**NICE CG42 Dementia** covers the use of **acetylcholinesterase inhibitors (AChEIs) and memantine** in dementia. They should be started by a specialist and reviewed by a specialist team to ascertain if it is worthwhile continuing them.

Acetylcholinesterase inhibitors are indicated in mild to moderate Alzheimer's Disease (AD).

Memantine is indicated in moderate AD if AChEIs are contraindicated or not tolerated and is indicated in severe AD.

In elderly patients with dementia, **antipsychotic drugs** are associated with a small increased risk of mortality and an increased risk of stroke or transient ischaemic attack. Furthermore, elderly patients are particularly susceptible to postural hypotension and to hyper- and hypothermia in hot or cold weather.<sup>5</sup>

**Cumbria Partnership Trust** guidance on treating BPSD (behavioural and psychological symptoms in patients with dementia) are available from the **Medicines Management** intranet pages.<sup>5</sup>

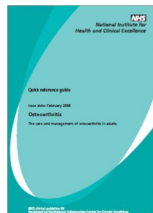
## Endocrine System BNF Chapter 6

### STOPP

- **Glibenclamide or chlorpropamide** with type 2 diabetes mellitus (*risk of prolonged hypoglycaemia*).
- **Beta-blockers** in those with diabetes mellitus and frequent hypoglycaemic episodes i.e. > 1 episode per month (*risk of masking hypoglycaemic symptoms*).

### Oestrogens

- with a history of breast cancer or venous thromboembolism (*increased risk of recurrence*)
- without progestogen in patients with intact uterus (*risk of endometrial cancer*).



### NICE CG87 Type 2 Diabetes covers:

-offering lifestyle advice as well as medication to achieve individually set HbA1c levels (and not to pursue highly intensive management to levels of less than 6.5%)

-self monitoring of blood glucose only when it can be used as part of the overall management

-which medication to use

**Prescribing safety indicators:** Glitazones should not be used in heart failure. The BNF advises caution prescribing glitazones in the elderly because of increased risk of fracture, bladder cancer and heart failure.

## Endocrine System BNF Chapter 6

### START

- **Metformin** with type 2 diabetes +/- metabolic syndrome (in the absence of renal impairment—estimated GFR <50ml/min).
- **ACE inhibitor** or Angiotensin Receptor Blocker in diabetes with nephropathy i.e. overt urinalysis proteinuria or microralbuminuria (>30mg/24 hours) +/- serum biochemical renal impairment—estimated GFR <50ml/min.
- **Antiplatelet** therapy in diabetes mellitus if one or more co-existing major cardiovascular risk factor present (hypertension, hypercholesterolaemia, smoking history).\*
- **Statin** therapy in diabetes mellitus if one or more co-existing major cardiovascular risk factor present.\*

\*In 2009 The **MHRA** issued advice that aspirin is not licensed for primary prevention and recent studies supported its use only in secondary prevention. However they did state that the benefits and risks have to be considered for individual patients particularly the benefits with vascular disease including diabetes (but also the risks of gastrointestinal harms).<sup>13</sup>

**NICE CG 67** Lipid Modification Prescribing Guidelines re primary prevention say that diabetics should be considered at high risk. **NICE CG 66** Type 2 Diabetes says that patients over 40 years should be offered a statin irrespective of CVD status (based on the cost effectiveness of simvastatin).

## Urogenital System BNF Chapter 7

### STOPP

#### Bladder antimuscarinic drugs\*

- with dementia (*risk of increased confusion, agitation*).
- with chronic glaucoma (*risk of acute exacerbation of glaucoma*).
- with chronic constipation (*risk of exacerbation of constipation*).
- with chronic prostatism (*risk of urinary retention*).

#### Alpha-blockers

- in males with frequent incontinence i.e. one or more episodes of incontinence daily (*risk of urinary frequency and worsening of incontinence*).
- with long-term urinary catheter *in situ* i.e. more than 2 months (*drug not indicated*).

\***Fesoterodine** is a “black drug” locally i.e. unsuitable for prescribing as other drugs are preferred. The traffic light prescribing guidelines are available from the **Medicines Management** intranet pages.<sup>5</sup>

Improvement with antimuscarinic drugs is generally small (less than 20% compared to placebo) so patients may have been tried on several brands. Even if on a formulary drug consider a drug holiday to reassess efficacy. There is no reason to expect patches or slow release versions to be more effective.<sup>5</sup>

## Urogenital System BNF Chapter 7

### START

#### NICE CG40 Urinary incontinence in women

There is evidence to support the use of pelvic floor muscle training and bladder training ahead of medication (see table below).

Immediate release oxybutinin should be offered to women with OAB or mixed UI if bladder training has been ineffective. There is no evidence of clinically significant differences between the antimuscarinic drugs.

OAB: overactive bladder syndrome

UI: urinary incontinence

#### Manage conservatively

|                              | Stress UI | Mixed UI | Urge UI or OAB | First pregnancy |
|------------------------------|-----------|----------|----------------|-----------------|
| Pelvic floor muscle training | *         | *        |                | *               |
| Bladder training             |           | *        | *              |                 |
| Antimuscarinic treatment     |           | *        | *              |                 |

# Musculoskeletal System

## BNF Chapter 10

### STOPP

#### Non-steroidal anti-inflammatory drug (NSAID)

- with history of peptic ulcer disease or gastrointestinal bleeding, unless with concurrent histamine H2 receptor antagonist, PPI or misoprostol (*risk of peptic ulcer relapse*).
- with moderate-severe hypertension (moderate: 160/100mmHg – 179/109mmHg; severe:  $\geq 180/110$ mmHg) (*risk of exacerbation of hypertension*).
- with heart failure (*risk of exacerbation of heart failure*).
- with warfarin (*risk of gastrointestinal bleeding*).
- with chronic renal failure - estimated GFR 20-50ml/min. (*risk of deterioration in renal function*).
- Long-term use of NSAID (>3 months) for relief of mild joint pain in osteoarthritis (*simple analgesics preferable and usually as effective for pain relief*).
- Long-term **NSAID** or **colchicine** for chronic treatment of gout where there is no contraindication to allopurinol (*allopurinol first choice prophylactic drug in gout*).
- Long-term **corticosteroids** (>3 months) as monotherapy for rheumatoid arthritis or osteoarthritis (*risk of major systemic corticosteroid side-effects*).

**Prescribing safety indicators:** NSAIDs should not be prescribed in patients with peptic ulcer disease or in patients aged 75 or over without gastroprotection.

NSAIDs should not be prescribed in patients aged 65+ with eGFR <60 or to patients with heart failure.

# Musculoskeletal System

## BNF Chapter 10

### START

- **Disease-modifying anti-rheumatic drug (DMARD)** with active moderate-severe rheumatoid disease lasting > 12 weeks.
- **Bisphosphonates** in patients taking maintenance oral corticosteroid therapy.
- **Calcium and Vitamin D** supplement in patients with known osteoporosis (radiological evidence or previous fragility fracture or acquired dorsal kyphosis).

#### NICE [TA160](#) and [TA161](#) cover prevention of osteoporosis.

In primary prevention, women aged 75 and over do not require a DEXA scan before starting alendronic acid if they have two or more clinical risk factors or indicators of low BMD; for secondary prevention this is reduced to one or more.



For treatments other than alendronic acid a DEXA scan is required because the treatments are only indicated at certain T scores; unless, in *secondary prevention*, the clinician considers it inappropriate or unfeasible.

In 2011 concerns were raised about cardiovascular risks of calcium and vitamin D supplements. The MHRA<sup>13</sup> issued guidance that the data limitations meant that there should be no change to current practice.

There were also reports of atypical fractures with long term bisphosphonate therapy. The MHRA advice was to periodically review the benefits and risks, particularly after 5 years therapy.

## Wound Management

Local Wound Management Prescribing Guidelines are available from the **Medicines Management** intranet pages.<sup>5</sup>

If after using a silver product for 1-2 weeks, no improvement in the wound is seen, then a full reassessment of the wound and patient should be undertaken.

## Anticholinergic Burden Scale (ACB)<sup>9</sup>

A total score of three or more is considered clinically relevant. More scores are given in appendices of the practice guide to clinical medication review.<sup>5</sup>

| Score 1                       | Score 2                                   | Score 3                                    |
|-------------------------------|---|--|
| Alverine                      | Amantadine                                | Amitriptyline & most TCAs                  |
| Atenolol & most beta-blockers | Belladonna alkaloids not otherwise listed | Atropine                                   |
| Bupropion                     | Carbamazepine                             | Chlorphenamine and sedating antihistamines |
| Chlorthalidone                | Cyproheptadine                            | Dicylomine                                 |
| Cimetidine & H2RAs            | Methotrimeprazine (Levomepromazine)       | Doxepin and others related to TCAs         |
| Codeine & other opiates       | Oxcarbazepine                             | Hyoscine (scopolamine)                     |
| Diazepam & BZDs               | Pethidine                                 | Olanzapine and most atypicals              |
| Digoxin                       | Pimozide                                  | Orphenadrine                               |
| Furosemide & other diuretics  | Cetirizine & non-sedating antihistamines* | Oxybutynin and most incontinence drugs     |
| Haloperidol                   | Loperamide*                               | Paroxetine and most SSRIs                  |

\*From NHS Scotland Polypharmacy Guidance Oct 2012

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Every effort has been made to ensure the information in this document is current and correct at the time of publication, however errors may have occurred and data for individual drugs, national or local guidance may have changed. Where there is any doubt, information should be checked against manufacturers' recommendations, published literature or other specialist sources.

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# AGS BEERS CRITERIA FOR POTENTIALLY INAPPROPRIATE MEDICATION USE IN OLDER ADULTS

FROM THE AMERICAN GERIATRICS SOCIETY

This clinical tool, based on *The AGS 2012 Updated Beers Criteria for Potentially Inappropriate Medication Use in Older Adults (AGS 2012 Beers Criteria)*, has been developed to assist healthcare providers in improving medication safety in older adults. Our purpose is to inform clinical decision-making concerning the prescribing of medications for older adults in order to improve safety and quality of care.

Originally conceived of in 1991 by the late Mark Beers, MD, a geriatrician, the *Beers Criteria* catalogues medications that cause adverse drug events in older adults due to their pharmacologic properties and the physiologic changes of aging. In 2011, the AGS undertook an update of the criteria, assembling a team of experts and funding the development of the AGS 2012 *Beers Criteria* using an enhanced, evidence-based methodology. Each criterion is rated (quality of evidence and strength of evidence) using the American College of Physicians' Guideline Grading System, which is based on the GRADE scheme developed by Guyatt et al.

The full document together with accompanying resources can be viewed online at [www.americangeriatrics.org](http://www.americangeriatrics.org).

## INTENDED USE

The goal of this clinical tool is to improve care of older adults by reducing their exposure to Potentially Inappropriate Medications (PIMs).

- This should be viewed as a guide for identifying medications for which the risks of use in older adults outweigh the benefits.
- These criteria are not meant to be applied in a punitive manner.
- This list is not meant to supersede clinical judgment or an individual patient's values and needs. Prescribing and managing disease conditions should be individualized and involve shared decision-making.
- These criteria also underscore the importance of using a team approach to prescribing and the use of non-pharmacological approaches and of having economic and organizational incentives for this type of model.
- Implicit criteria such as the STOPP/START criteria and Medication Appropriateness Index should be used in a complementary manner with the 2012 AGS *Beers Criteria* to guide clinicians in making decisions about safe medication use in older adults.

The criteria are not applicable in all circumstances (eg, patient's receiving palliative and hospice care). If a clinician is not able to find an alternative and chooses to continue to use a drug on this list in an individual patient, designation of the medication as potentially inappropriate can serve as a reminder for close monitoring so that the potential for an adverse drug effect can be incorporated into the medical record and prevented or detected early.

**TABLE 1:** 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

| Organ System/<br>Therapeutic Category/Drug(s)   | Recommendation, Rationale,<br>Quality of Evidence (QE) & Strength of Recommendation (SR)   |
|---|--|
| <i>Anticholinergics (excludes TCAs)</i>   |  |
| First-generation antihistamines (as single agent or as part of combination products) <ul style="list-style-type: none"> <li>■ Brompheniramine</li> <li>■ Carbinoxamine</li> <li>■ Chlorpheniramine</li> <li>■ Clemastine</li> <li>■ Cyproheptadine</li> <li>■ Dexbrompheniramine</li> <li>■ Dexchlorpheniramine</li> <li>■ Diphenhydramine (oral)</li> <li>■ Doxylamine</li> <li>■ Hydroxyzine</li> <li>■ Promethazine</li> <li>■ Triprolidine</li> </ul> | <p><b>Avoid.</b></p> <p>Highly anticholinergic; clearance reduced with advanced age, and tolerance develops when used as hypnotic; increased risk of confusion, dry mouth, constipation, and other anticholinergic effects/toxicity.</p> <p>Use of diphenhydramine in special situations such as acute treatment of severe allergic reaction may be appropriate.</p> <p>QE = High (Hydroxyzine and Promethazine), Moderate (All others); SR = Strong</p> |
| Antiparkinson agents <ul style="list-style-type: none"> <li>■ Bzotropine (oral)</li> <li>■ Trihexyphenidyl</li> </ul>   | <p><b>Avoid.</b></p> <p>Not recommended for prevention of extrapyramidal symptoms with antipsychotics; more effective agents available for treatment of Parkinson disease.</p> <p>QE = Moderate; SR = Strong</p>   |

Table 1 (continued from page 1)

**TABLE 1:** 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults

| Organ System/<br>Therapeutic Category/Drug(s)  | Recommendation, Rationale,<br>Quality of Evidence (QE) & Strength of Recommendation (SR)  |
|--|---|
| Antispasmodics <ul style="list-style-type: none"> <li>■ Belladonna alkaloids</li> <li>■ Clidinium-chlordiazepoxide</li> <li>■ Dicyclomine</li> <li>■ Hyoscyamine</li> <li>■ Propantheline</li> <li>■ Scopolamine</li> </ul>  | <p><b>Avoid except in short-term palliative care to decrease oral secretions.</b></p> <p>Highly anticholinergic, uncertain effectiveness.</p> <p>QE = Moderate; SR = Strong</p>   |
| <i>Antithrombotics</i>   |   |
| Dipyridamole, oral short-acting* (does not apply to the extended-release combination with aspirin)   | <p><b>Avoid.</b></p> <p>May cause orthostatic hypotension; more effective alternatives available; IV form acceptable for use in cardiac stress testing.</p> <p>QE = Moderate; SR = Strong</p>   |
| Ticlopidine*   | <p><b>Avoid.</b></p> <p>Safer, effective alternatives available.</p> <p>QE = Moderate; SR = Strong</p>  |
| <i>Anti-infective</i>  |   |
| Nitrofurantoin   | <p><b>Avoid for long-term suppression; avoid in patients with CrCl &lt;60 mL/min.</b></p> <p>Potential for pulmonary toxicity; safer alternatives available; lack of efficacy in patients with CrCl &lt;60 mL/min due to inadequate drug concentration in the urine.</p> <p>QE = Moderate; SR = Strong</p>  |
| <i>Cardiovascular</i>  |   |
| Alpha <sub>1</sub> blockers <ul style="list-style-type: none"> <li>■ Doxazosin</li> <li>■ Prazosin</li> <li>■ Terazosin</li> </ul>   | <p><b>Avoid use as an antihypertensive.</b></p> <p>High risk of orthostatic hypotension; not recommended as routine treatment for hypertension; alternative agents have superior risk/benefit profile.</p> <p>QE = Moderate; SR = Strong</p>  |
| Alpha agonists <ul style="list-style-type: none"> <li>■ Clonidine</li> <li>■ Guanabenz*</li> <li>■ Guanfacine*</li> <li>■ Methyl dopa*</li> <li>■ Reserpine (&gt;0.1 mg/day)*</li> </ul>   | <p><b>Avoid clonidine as a first-line antihypertensive. Avoid others as listed.</b></p> <p>High risk of adverse CNS effects; may cause bradycardia and orthostatic hypotension; not recommended as routine treatment for hypertension.</p> <p>QE = Low; SR = Strong</p>   |
| Antiarrhythmic drugs (Class Ia, Ic, III) <ul style="list-style-type: none"> <li>■ Amiodarone</li> <li>■ Dofetilide</li> <li>■ Dronedarone</li> <li>■ Flecainide</li> <li>■ Ibutilide</li> <li>■ Procainamide</li> <li>■ Propafenone</li> <li>■ Quinidine</li> <li>■ Sotalol</li> </ul> | <p><b>Avoid antiarrhythmic drugs as first-line treatment of atrial fibrillation.</b></p> <p>Data suggest that rate control yields better balance of benefits and harms than rhythm control for most older adults.</p> <p>Amiodarone is associated with multiple toxicities, including thyroid disease, pulmonary disorders, and QT interval prolongation.</p> <p>QE = High; SR = Strong</p> |
| Disopyramide*  | <p><b>Avoid.</b></p> <p>Disopyramide is a potent negative inotrope and therefore may induce heart failure in older adults; strongly anticholinergic; other antiarrhythmic drugs preferred.</p> <p>QE = Low; SR = Strong</p>   |
| Dronedarone  | <p><b>Avoid in patients with permanent atrial fibrillation or heart failure.</b></p> <p>Worse outcomes have been reported in patients taking dronedarone who have permanent atrial fibrillation or heart failure. In general, rate control is preferred over rhythm control for atrial fibrillation.</p> <p>QE = Moderate; SR = Strong</p>  |
| Digoxin >0.125 mg/day  | <p><b>Avoid.</b></p> <p>In heart failure, higher dosages associated with no additional benefit and may increase risk of toxicity; decreased renal clearance may increase risk of toxicity.</p> <p>QE = Moderate; SR = Strong</p>  |

Table 1 (continued from page 2)

| TABLE 1: 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults  |  |
|--|--|
| Organ System/<br>Therapeutic Category/Drug(s)  | Recommendation, Rationale,<br>Quality of Evidence (QE) & Strength of Recommendation (SR)   |
| Nifedipine, immediate release*   | <b>Avoid.</b><br>Potential for hypotension; risk of precipitating myocardial ischemia.<br>QE = High; SR = Strong   |
| Spirolactone >25 mg/day  | <b>Avoid in patients with heart failure or with a CrCl &lt;30 mL/min.</b><br>In heart failure, the risk of hyperkalemia is higher in older adults if taking >25 mg/day.<br>QE = Moderate; SR = Strong  |
| <b>Central Nervous System</b>  |  |
| Tertiary TCAs, alone or in combination:<br>■ Amitriptyline<br>■ Chlordiazepoxide-amitriptyline<br>■ Clomipramine<br>■ Doxepin >6 mg/day<br>■ Imipramine<br>■ Perphenazine-amitriptyline<br>■ Trimipramine  | <b>Avoid.</b><br>Highly anticholinergic, sedating, and cause orthostatic hypotension; the safety profile of low-dose doxepin (≤6 mg/day) is comparable to that of placebo.<br>QE = High; SR = Strong   |
| Antipsychotics, first- (conventional) and second- (atypical) generation (see online for full list)   | <b>Avoid use for behavioral problems of dementia unless non-pharmacologic options have failed and patient is threat to self or others.</b><br>Increased risk of cerebrovascular accident (stroke) and mortality in persons with dementia.<br>QE = Moderate; SR = Strong  |
| Thioridazine<br>Mesoridazine   | <b>Avoid.</b><br>Highly anticholinergic and greater risk of QT-interval prolongation.<br>QE = Moderate; SR = Strong  |
| Barbiturates<br>■ Amobarbital*<br>■ Butobarbital*<br>■ Butalbital<br>■ Mephobarbital*<br>■ Pentobarbital*<br>■ Phenobarbital<br>■ Secobarbital*  | <b>Avoid.</b><br>High rate of physical dependence; tolerance to sleep benefits; greater risk of overdose at low dosages.<br>QE = High; SR = Strong   |
| Benzodiazepines<br>Short- and intermediate-acting:<br>■ Alprazolam<br>■ Estazolam<br>■ Lorazepam<br>■ Oxazepam<br>■ Temazepam<br>■ Triazolam<br>Long-acting:<br>■ Chlorzepam<br>■ Chlordiazepoxide<br>■ Chlordiazepoxide-amitriptyline<br>■ Clidinium-chlordiazepoxide<br>■ Clonazepam<br>■ Diazepam<br>■ Flurazepam<br>■ Quazepam | <b>Avoid benzodiazepines (any type) for treatment of insomnia, agitation, or delirium.</b><br>Older adults have increased sensitivity to benzodiazepines and decreased metabolism of long-acting agents. In general, all benzodiazepines increase risk of cognitive impairment, delirium, falls, fractures, and motor vehicle accidents in older adults.<br>May be appropriate for seizure disorders, rapid eye movement sleep disorders, benzodiazepine withdrawal, ethanol withdrawal, severe generalized anxiety disorder, periprocedural anesthesia, end-of-life care.<br>QE = High; SR = Strong |
| Chloral hydrate*   | <b>Avoid.</b><br>Tolerance occurs within 10 days and risk outweighs the benefits in light of overdose with doses only 3 times the recommended dose.<br>QE = Low; SR = Strong   |
| Meprobamate  | <b>Avoid.</b><br>High rate of physical dependence; very sedating.<br>QE = Moderate; SR = Strong  |

Table 1 (continued from page 3)

| TABLE 1: 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults |   |
|---|---|
| Organ System/<br>Therapeutic Category/Drug(s)   | Recommendation, Rationale,<br>Quality of Evidence (QE) & Strength of Recommendation (SR)  |
| Nonbenzodiazepine hypnotics<br>■ Eszopiclone<br>■ Zolpidem<br>■ Zaleplon                      | <b>Avoid chronic use (&gt;90 days)</b><br>Benzodiazepine-receptor agonists that have adverse events similar to those of benzodiazepines in older adults (e.g., delirium, falls, fractures); minimal improvement in sleep latency and duration.<br>QE = Moderate; SR = Strong  |
| Ergot mesylates*<br>Isoxsuprine*  | <b>Avoid.</b><br>Lack of efficacy.<br>QE = High; SR = Strong  |
| <b>Endocrine</b>  |   |
| Androgens<br>■ Methyltestosterone*<br>■ Testosterone  | <b>Avoid unless indicated for moderate to severe hypogonadism.</b><br>Potential for cardiac problems and contraindicated in men with prostate cancer.<br>QE = Moderate; SR = Weak   |
| Desiccated thyroid  | <b>Avoid.</b><br>Concerns about cardiac effects; safer alternatives available.<br>QE = Low; SR = Strong   |
| Estrogens with or without progestins  | <b>Avoid oral and topical patch. Topical vaginal cream: Acceptable to use low-dose intravaginal estrogen for the management of dyspareunia, lower urinary tract infections, and other vaginal symptoms.</b><br>Evidence of carcinogenic potential (breast and endometrium); lack of cardioprotective effect and cognitive protection in older women. Evidence that vaginal estrogens for treatment of vaginal dryness is safe and effective in women with breast cancer, especially at dosages of estradiol <25 mcg twice weekly.<br>QE = High (Oral and Patch), Moderate (Topical); SR = Strong (Oral and Patch), Weak (Topical) |
| Growth hormone  | <b>Avoid, except as hormone replacement following pituitary gland removal.</b><br>Effect on body composition is small and associated with edema, arthralgia, carpal tunnel syndrome, gynecomastia, impaired fasting glucose.<br>QE = High; SR = Strong  |
| Insulin, sliding scale  | <b>Avoid.</b><br>Higher risk of hypoglycemia without improvement in hyperglycemia management regardless of care setting.<br>QE = Moderate; SR = Strong  |
| Megestrol   | <b>Avoid.</b><br>Minimal effect on weight; increases risk of thrombotic events and possibly death in older adults.<br>QE = Moderate; SR = Strong  |
| Sulfonylureas, long-duration<br>■ Chlorpropamide<br>■ Glyburide                               | <b>Avoid.</b><br>Chlorpropamide: prolonged half-life in older adults; can cause prolonged hypoglycemia; causes SIADH<br>Glyburide: higher risk of severe prolonged hypoglycemia in older adults.<br>QE = High; SR = Strong  |
| <b>Gastrointestinal</b>   |   |
| Metoclopramide  | <b>Avoid, unless for gastroparesis.</b><br>Can cause extrapyramidal effects including tardive dyskinesia; risk may be further increased in frail older adults.<br>QE = Moderate; SR = Strong  |
| Mineral oil, given orally   | <b>Avoid.</b><br>Potential for aspiration and adverse effects; safer alternatives available.<br>QE = Moderate; SR = Strong  |
| Trimethobenzamide   | <b>Avoid.</b><br>One of the least effective antiemetic drugs; can cause extrapyramidal adverse effects.<br>QE = Moderate; SR = Strong   |

Table 1 (continued from page 4)

| TABLE 1: 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults  |   |
|--|---|
| Organ System/<br>Therapeutic Category/Drug(s)  | Recommendation, Rationale,<br>Quality of Evidence (QE) & Strength of Recommendation (SR)  |
| <b>Pain Medications</b>  |   |
| Meperidine   | <b>Avoid.</b><br>Not an effective oral analgesic in dosages commonly used; may cause neurotoxicity; safer alternatives available.<br>QE = High; SR = Strong   |
| Non-COX-selective NSAIDs, oral<br>■ Aspirin >325 mg/day<br>■ Diclofenac<br>■ Diflunisal<br>■ Etodolac<br>■ Fenoprofen<br>■ Ibuprofen<br>■ Ketoprofen<br>■ Meclofenamate<br>■ Mefenamic acid<br>■ Meloxicam<br>■ Nabumetone<br>■ Naproxen<br>■ Oxaprozin<br>■ Piroxicam<br>■ Sulindac<br>■ Tolmetin | <b>Avoid chronic use unless other alternatives are not effective and patient can take gastroprotective agent (proton pump inhibitor or misoprostol).</b><br><br>Increases risk of GI bleeding/peptic ulcer disease in high-risk groups, including those ≥75 years old or taking oral or parenteral corticosteroids, anticoagulants, or antiplatelet agents. Use of proton pump inhibitor or misoprostol reduces but does not eliminate risk. Upper GI ulcers, gross bleeding, or perforation caused by NSAIDs occur in approximately 1% of patients treated for 3–6 months, and in about 2%–4% of patients treated for 1 year. These trends continue with longer duration of use.<br><br>QE = Moderate; SR = Strong |
| Indomethacin<br>Ketorolac, includes parenteral   | <b>Avoid.</b><br>Increases risk of GI bleeding/peptic ulcer disease in high-risk groups (See Non-COX selective NSAIDs)<br>Of all the NSAIDs, indomethacin has most adverse effects.<br>QE = Moderate (Indomethacin), High (Ketorolac); SR = Strong  |
| Pentazocine*   | <b>Avoid.</b><br>Opioid analgesic that causes CNS adverse effects, including confusion and hallucinations, more commonly than other narcotic drugs; is also a mixed agonist and antagonist; safer alternatives available.<br>QE = Low; SR = Strong  |
| Skeletal muscle relaxants<br>■ Carisoprodol<br>■ Chlorzoxazone<br>■ Cyclobenzaprine<br>■ Metaxalone<br>■ Methocarbamol<br>■ Orphenadrine   | <b>Avoid.</b><br>Most muscle relaxants poorly tolerated by older adults, because of anticholinergic adverse effects, sedation, increased risk of fractures; effectiveness at dosages tolerated by older adults is questionable.<br>QE = Moderate; SR = Strong   |

\*Infrequently used drugs. Table 1 Abbreviations: ACEI, angiotensin converting-enzyme inhibitors; ARB, angiotensin receptor blockers; CNS, central nervous system; COX, cyclooxygenase; CrCl, creatinine clearance; GI, gastrointestinal; NSAIDs, nonsteroidal anti-inflammatory drugs; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SR, Strength of Recommendation; TCAs, tricyclic antidepressants; QE, Quality of Evidence

TABLE 2: 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome

| Disease or Syndrome   | Drug(s)  | Recommendation, Rationale, Quality of Evidence (QE) & Strength of Recommendation (SR)  |
|-----------------------|--|--|
| <b>Cardiovascular</b> |  |  |
| Heart failure         | NSAIDs and COX-2 inhibitors<br><br>Nondihydropyridine CCBs (avoid only for systolic heart failure)<br>■ Diltiazem<br>■ Verapamil<br><br>Pioglitazone, rosiglitazone<br><br>Cilostazol<br>Dronedarone | <b>Avoid.</b><br><br>Potential to promote fluid retention and/or exacerbate heart failure.<br><br>QE = Moderate (NSAIDs, CCBs, Dronedarone), High (Thiazolidinediones (glitazones)), Low (Cilostazol); SR = Strong |

Table 2 (continued from page 5)

TABLE 2: 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome

| Disease or Syndrome             | Drug(s)  | Recommendation, Rationale, Quality of Evidence (QE) & Strength of Recommendation (SR)  |
|---------------------------------|--|--|
| Syncope                         | Acetylcholinesterase inhibitors (AChEs)<br>Peripheral alpha blockers<br>■ Doxazosin<br>■ Prazosin<br>■ Terazosin<br><br>Tertiary TCAs<br><br>Chlorpromazine, thioridazine, and olanzapine                  | <b>Avoid.</b><br><br>Increases risk of orthostatic hypotension or bradycardia.<br><br>QE = High (Alpha blockers), Moderate (AChEs, TCAs and antipsychotics); SR = Strong (AChEs and TCAs), Weak (Alpha blockers and antipsychotics)  |
| <b>Central Nervous System</b>   |  |  |
| Chronic seizures or epilepsy    | Bupropion<br>Chlorpromazine<br>Clozapine<br>Maprotiline<br>Olanzapine<br>Thioridazine<br>Thiothixene<br>Tramadol   | <b>Avoid.</b><br><br>Lowers seizure threshold; may be acceptable in patients with well-controlled seizures in whom alternative agents have not been effective.<br><br>QE = Moderate; SR = Strong   |
| Delirium                        | All TCAs<br>Anticholinergics (see online for full list)<br>Benzodiazepines<br>Chlorpromazine<br>Corticosteroids<br>H <sub>2</sub> -receptor antagonist<br>Meperidine<br>Sedative hypnotics<br>Thioridazine | <b>Avoid.</b><br><br>Avoid in older adults with or at high risk of delirium because of inducing or worsening delirium in older adults; if discontinuing drugs used chronically, taper to avoid withdrawal symptoms.<br><br>QE = Moderate; SR = Strong  |
| Dementia & cognitive impairment | Anticholinergics (see online for full list)<br>Benzodiazepines<br>H <sub>2</sub> -receptor antagonists<br>Zolpidem<br>Antipsychotics, chronic and as-needed use  | <b>Avoid.</b><br>Avoid due to adverse CNS effects.<br>Avoid antipsychotics for behavioral problems of dementia unless non-pharmacologic options have failed and patient is a threat to themselves or others. Antipsychotics are associated with an increased risk of cerebrovascular accident (stroke) and mortality in persons with dementia.<br>QE = High; SR = Strong |
| History of falls or fractures   | Anticonvulsants<br>Antipsychotics<br>Benzodiazepines<br>Nonbenzodiazepine hypnotics<br>■ Eszopiclone<br>■ Zaleplon<br>■ Zolpidem<br><br>TCAs/SSRIs   | <b>Avoid unless safer alternatives are not available; avoid anticonvulsants except for seizure.</b><br><br>Ability to produce ataxia, impaired psychomotor function, syncope, and additional falls; shorter-acting benzodiazepines are not safer than long-acting ones.<br><br>QE = High; SR = Strong  |
| Insomnia                        | Oral decongestants<br>■ Pseudoephedrine<br>■ Phenylephrine<br>Stimulants<br>■ Amphetamine<br>■ Methylphenidate<br>■ Pemoline<br>Theobromines<br>■ Theophylline<br>■ Caffeine                               | <b>Avoid.</b><br><br>CNS stimulant effects.<br><br>QE = Moderate; SR = Strong  |
| Parkinson's disease             | All antipsychotics (see online publication for full list, except for quetiapine and clozapine)<br><br>Antiemetics<br>■ Metoclopramide<br>■ Prochlorperazine<br>■ Promethazine                              | <b>Avoid.</b><br>Dopamine receptor antagonists with potential to worsen parkinsonian symptoms.<br><br>Quetiapine and clozapine appear to be less likely to precipitate worsening of Parkinson disease.<br><br>QE = Moderate; SR = Strong   |

Table 2 (continued from page 6)

**TABLE 2:** 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome

| Disease or Syndrome                       | Drug(s)  | Recommendation, Rationale, Quality of Evidence (QE) & Strength of Recommendation (SR)   |
|---|--|---|
| <i>Gastrointestinal</i>                   |  |   |
| Chronic constipation                      | <p>Oral antimuscarinics for urinary incontinence</p> <ul style="list-style-type: none"> <li>■ Darifenacin</li> <li>■ Fesoterodine</li> <li>■ Oxybutynin (oral)</li> <li>■ Solifenacin</li> <li>■ Tolterodine</li> <li>■ Trospium</li> </ul> <p>Nondihydropyridine CCB</p> <ul style="list-style-type: none"> <li>■ Diltiazem</li> <li>■ Verapamil</li> </ul> <p>First-generation antihistamines as single agent or part of combination products</p> <ul style="list-style-type: none"> <li>■ Brompheniramine (various)</li> <li>■ Carbinoxamine</li> <li>■ Chlorpheniramine</li> <li>■ Clemastine (various)</li> <li>■ Cyproheptadine</li> <li>■ Dexbrompheniramine</li> <li>■ Dexchlorpheniramine (various)</li> <li>■ Diphenhydramine</li> <li>■ Doxylamine</li> <li>■ Hydroxyzine</li> <li>■ Promethazine</li> <li>■ Triprolidine</li> </ul> <p>Anticholinergics/antispasmodics (see online for full list of drugs with strong anticholinergic properties)</p> <ul style="list-style-type: none"> <li>■ Antipsychotics</li> <li>■ Belladonna alkaloids</li> <li>■ Clidinium-chlordiazepoxide</li> <li>■ Dicyclomine</li> <li>■ Hyoscyamine</li> <li>■ Propantheline</li> <li>■ Scopolamine</li> <li>■ Tertiary TCAs (amitriptyline, clomipramine, doxepin, imipramine, and trimipramine)</li> </ul> | <p><b>Avoid unless no other alternatives.</b></p> <p>Can worsen constipation; agents for urinary incontinence: antimuscarinics overall differ in incidence of constipation; response variable; consider alternative agent if constipation develops.</p> <p>QE = High (For Urinary Incontinence), Moderate/Low (All Others); SR = Strong</p> |
| History of gastric or duodenal ulcers     | <p>Aspirin (&gt;325 mg/day)</p> <p>Non-COX-2 selective NSAIDs</p>  | <p><b>Avoid unless other alternatives are not effective and patient can take gastroprotective agent (proton-pump inhibitor or misoprostol).</b></p> <p>May exacerbate existing ulcers or cause new/additional ulcers.</p> <p>QE = Moderate; SR = Strong</p>   |
| <i>Kidney/Urinary Tract</i>               |  |   |
| Chronic kidney disease stages IV and V    | <p>NSAIDs</p> <p>Triamterene (alone or in combination)</p>   | <p><b>Avoid.</b></p> <p>May increase risk of kidney injury.</p> <p>May increase risk of acute kidney injury.</p> <p>QE = Moderate (NSAIDs), Low (Triamterene); SR = Strong (NSAIDs), Weak (Triamterene)</p>   |
| Urinary incontinence (all types) in women | <p>Estrogen oral and transdermal (excludes intravaginal estrogen)</p>  | <p><b>Avoid in women.</b></p> <p>Aggravation of incontinence.</p> <p>QE = High; SR = Strong</p>   |

Table 2 (continued from page 7)

**TABLE 2:** 2012 AGS Beers Criteria for Potentially Inappropriate Medication Use in Older Adults Due to Drug-Disease or Drug-Syndrome Interactions That May Exacerbate the Disease or Syndrome

| Disease or Syndrome  | Drug(s)   | Recommendation, Rationale, Quality of Evidence (QE) & Strength of Recommendation (SR)   |
|--|---|---|
| Lower urinary tract symptoms, benign prostatic hyperplasia | <p>Inhaled anticholinergic agents</p> <p>Strongly anticholinergic drugs, except antimuscarinics for urinary incontinence (see Table 9 for complete list).</p> | <p><b>Avoid in men.</b></p> <p>May decrease urinary flow and cause urinary retention.</p> <p>QE = Moderate; SR = Strong (Inhaled agents), Weak (All others)</p> |
| Stress or mixed urinary incontinence                       | <p>Alpha-blockers</p> <ul style="list-style-type: none"> <li>■ Doxazosin</li> <li>■ Prazosin</li> <li>■ Terazosin</li> </ul>                                  | <p><b>Avoid in women.</b></p> <p>Aggravation of incontinence.</p> <p>QE = Moderate; SR = Strong</p>   |

Table 2 Abbreviations: CCBs, calcium channel blockers; AChEIs, acetylcholinesterase inhibitors; CNS, central nervous system; COX, cyclooxygenase; NSAIDs, nonsteroidal anti-inflammatory drugs; SR, Strength of Recommendation; SSRIs, selective serotonin reuptake inhibitors; TCAs, tricyclic antidepressants; QE, Quality of Evidence

**TABLE 3:** 2012 AGS Beers Criteria for Potentially Inappropriate Medications to Be Used with Caution in Older Adults

| Drug(s)  | Recommendation, Rationale, Quality of Evidence (QE) & Strength of Recommendation (SR)   |
|--|---|
| Aspirin for primary prevention of cardiac events   | <p><b>Use with caution in adults ≥80 years old.</b></p> <p>Lack of evidence of benefit versus risk in individuals ≥80 years old.</p> <p>QE = Low; SR = Weak</p>   |
| Dabigatran   | <p><b>Use with caution in adults ≥75 years old or if CrCl &lt;30 mL/min.</b></p> <p>Increased risk of bleeding compared with warfarin in adults ≥75 years old; lack of evidence for efficacy and safety in patients with CrCl &lt;30 mL/min</p> <p>QE = Moderate; SR = Weak</p> |
| Prasugrel  | <p><b>Use with caution in adults ≥75 years old.</b></p> <p>Greater risk of bleeding in older adults; risk may be offset by benefit in highest-risk older patients (eg, those with prior myocardial infarction or diabetes).</p> <p>QE = Moderate; SR = Weak</p>                 |
| <p>Antipsychotics</p> <p>Carbamazepine</p> <p>Carboplatin</p> <p>Cisplatin</p> <p>Mirtazapine</p> <p>SNRIs</p> <p>SSRIs</p> <p>TCAs</p> <p>Vincristine</p> | <p><b>Use with caution.</b></p> <p>May exacerbate or cause SIADH or hyponatremia; need to monitor sodium level closely when starting or changing dosages in older adults due to increased risk.</p> <p>QE = Moderate; SR = Strong</p>   |
| Vasodilators   | <p><b>Use with caution.</b></p> <p>May exacerbate episodes of syncope in individuals with history of syncope.</p> <p>QE = Moderate; SR = Weak</p>   |

Table 3 Abbreviations: CrCl, creatinine clearance; SIADH, syndrome of inappropriate antidiuretic hormone secretion; SSRIs, selective serotonin reuptake inhibitors; SNRIs, serotonin-norepinephrine reuptake inhibitors; SR, Strength of Recommendation; TCAs, tricyclic antidepressants; QE, Quality of Evidence

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## **10.2 Appendice B : Référentiel de compétences HES 3<sup>ème</sup> année Bachelor**

# Bachelor HES-SO en soins infirmiers



Semestre  automne  printemps

Répétition

Lieu de période de formation pratique

Institution :

Service :

Site de formation :

Nom de l'étudiant-e :

Promotion :

Période du / au :

PFP 5  PFP 6

## ÉVALUATION DES COMPÉTENCES – niveau 3<sup>ème</sup> année bachelor

Synthèse de l'évaluation:

Pistes/propositions pour le développement futur des compétences

Nombre de jours d'absence non compensée :      jours

Date et Signatures

Étudiant-e:  
(a pris connaissance)

Praticien-ne formateur-trice  
NOM PRENOM

Formateur-trice HES  
(a pris connaissance)

Résultat<sup>1</sup>:

A  B  C  
 D  E  F

<sup>1</sup>Résultat

Seuil d'insuffisance : 1 rôle non acquis ou plus

Échelle de notation

- A = Excellent : résultat remarquable avec quelques insuffisances mineures ;
- B = Très Bien : résultat supérieur à la moyenne malgré un certain nombre d'insuffisances ;
- C = Bien : travail généralement bon malgré un certain nombre d'insuffisances notables ;
- D = Satisfaisant : travail honnête mais comportant des lacunes importantes ;
- E = Passable : le résultat satisfait aux critères minimaux ;
- F = Insuffisant : la répétition du module est nécessaire.

## Hes·so

Haute Ecole Spécialisée  
de Suisse occidentale  
Fachhochschule Westschweiz  
University of Applied Sciences  
Western Switzerland







C3. Participer à la prise de décision au sein des groupes intraprofessionnelles ou interprofessionnelles en y défendant l'éthique professionnelle.

| Critères d'évaluation                                   | Indicateurs (non-exhaustifs) évalués en situation   |
|---|---|
| Participation adéquate à des prises de décision éthique | <ul style="list-style-type: none"> <li>- Favorise la connaissance et le partage des informations nécessaires à la conduite des projets et objectifs communs</li> <li>- Favorise la participation de chaque membre de l'équipe, le consensus et le respect des décisions prises</li> <li>- Intègre la dimension éthique dans les prises de décision à propos des personnes soignées</li> </ul> |

Commentaire général

Appréciation globale      Acquis  (maîtrise)      En voie d'acquisition  (maîtrise partielle)      Non acquis  (maîtrise insuffisante)

#### D. Compétences du rôle de manager

D1. Mettre en œuvre les projets de soins de manière efficace dans le cadre des conditions générales institutionnelles et légales.

| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation  |
|---|--|
| Pertinence de l'organisation de son travail et de celui de ses collaborateurs | <ul style="list-style-type: none"> <li>- Organise de manière efficace les interventions professionnelles pour les personnes sous sa responsabilité, en hiérarchisant et priorisant les interventions</li> <li>- Participe activement à l'organisation des soins du service en tenant compte des contraintes institutionnelles et extra-institutionnelles</li> <li>- Explique les enjeux des instruments en vigueur (RAI, LEP, DRG, PLAISIR) pour la pratique infirmière</li> </ul> |

D2. Participer à la mise en œuvre et à l'évaluation des normes de qualité des soins basés sur les connaissances scientifiques et identifier les besoins en matière d'innovation.

| Critères d'évaluation  | Indicateurs (non-exhaustifs) évalués en situation  |
|--|--|
| Justesse de l'application et de la réflexion sur les standards qualité | <ul style="list-style-type: none"> <li>- Propose des nouvelles méthodes et processus de travail en se basant sur des modèles actuels</li> <li>- Démontre sa compréhension des démarches, outils et méthodes qualité en vigueur dans l'institution</li> </ul> |

D3. Utiliser de manière efficiente et critique les technologies de l'information.

| Critères d'évaluation  | Indicateurs (non-exhaustifs) évalués en situation  |
|--|--|
| Utilisation critique des outils informatiques et des technologies de l'information | <ul style="list-style-type: none"> <li>- Utilise adéquatement les outils informatiques à disposition</li> <li>- Respecte les règles et lois en vigueur en ce qui concerne la protection des données</li> <li>- Utilise régulièrement les bases de données à disposition</li> </ul> |

D4. Développer son leadership et prendre une part active dans le développement de sa carrière professionnelle.

| Critères d'évaluation               | Indicateurs (non-exhaustifs) évalués en situation   |
|-------------------------------------|---|
| Qualité du leadership professionnel | <ul style="list-style-type: none"> <li>- Démontre son intérêt pour des nouveaux projets</li> <li>- Recherche des données probantes et les promeut</li> <li>- Transmet aux étudiants junior sa vision pour le développement de la profession</li> <li>- Partage ses projets de carrière</li> </ul> |

Commentaire général

Appréciation globale      Acquis  (maîtrise)      En voie d'acquisition  (maîtrise partielle)      Non acquis  (maîtrise insuffisante)

## E. Compétences du rôle de promoteur ou promotrice de la santé

| E1. S'engager en faveur de la santé et de la qualité de vie et soutenir les intérêts des patient-e-s et de leurs proches.   |   |
|---|---|
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Importance accordée à la santé et à la qualité de vie des patients et de leurs proches  | <ul style="list-style-type: none"> <li>- Intègre systématiquement des aspects de santé et de qualité de vie des personnes soignées et de leurs proches dans les projets de soins</li> <li>- Mobilise et coordonne les ressources du réseau socio-sanitaires pour garantir la qualité de vie des personnes soignées</li> </ul>   |
| E2. Intégrer, dans sa pratique professionnelle, des concepts de promotion de la santé et de prévention de la maladie, pour les individus et les groupes et participer activement à leur mise en oeuvre.<br>E4. Participer au développement des approches de promotion de la santé et de prévention de la maladie.                                     |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Maîtrise de la démarche éducative   | <ul style="list-style-type: none"> <li>- Évalue les besoins en promotion de la santé, prévention et éducation thérapeutique des personnes soignées, de leur entourage et des groupes</li> <li>- Planifie et réalise des interventions ciblées et adaptées en se basant sur les recommandations et modèles actuels</li> <li>- Utilise des modèles infirmiers et interdisciplinaires pour déterminer et argumenter ses interventions préventives et éducatives</li> </ul> |
| E3. Encourager les patient-e-s et leurs proches à utiliser, de manière différenciée et individuelle, les moyens disponibles pour surmonter la maladie ou la prévenir, dans le souci d'assurer la meilleure qualité de vie possible.   |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Pertinence des interventions de promotion de la santé en regard de l'autonomie du patient et de son entourage   | <ul style="list-style-type: none"> <li>- Soutient l'autonomie des personnes soignées en respectant leurs choix, leur rythme, leur culture et en leur donnant toutes les informations nécessaires au maintien de leur santé</li> <li>- Identifie les différents enjeux liés à la promotion de la santé</li> </ul>  |
| Commentaire général   |   |
| <p>Appréciation globale</p> <p style="text-align: center;">             Acquis <input type="checkbox"/> (maîtrise)             <span style="margin-left: 100px;">En voie d'acquisition <input type="checkbox"/> (maîtrise partielle)</span> <span style="margin-left: 100px;">Non acquis <input type="checkbox"/> (maîtrise insuffisante)</span> </p> |   |

## F. Compétences du rôle d'apprenant-e et formateur ou formatrice

| F1. Maintenir et développer ses compétences professionnelles à travers une formation continue et soutenir la formation professionnelle pratique des étudiant-e-s, en s'appuyant sur des données scientifiques et pertinentes. |   |
|---|---|
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Actualisation régulière des connaissances   | <ul style="list-style-type: none"> <li>- Démonstre son envie d'apprendre</li> <li>- Actualise ses connaissances en fonction des situations professionnelles rencontrées</li> </ul>  |
| Qualité de l'encadrement des étudiants  | <ul style="list-style-type: none"> <li>- Participe à l'encadrement des étudiants juniors</li> <li>- Utilise des stratégies différenciées et créatives dans son encadrement</li> <li>- Donne des feed-back constructifs</li> </ul>   |
| F2. Identifier des problématiques, relatives à la pratique des soins, propices à des projets de développement et de recherche et partager sa connaissance des résultats de recherche avec l'équipe.                           |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Pertinence du questionnement professionnel  | - Pose des questions régulières et pertinentes à propos des situations professionnelles rencontrées   |
| Pertinence et régularité du partage de savoirs issus de la recherche au sein de l'équipe professionnelle  | <ul style="list-style-type: none"> <li>- Utilise des résultats de recherche dans sa pratique</li> <li>- Partage régulièrement sa connaissance des résultats de recherche au sein de l'équipe</li> <li>- Analyse les pratiques de soins en regard des données probantes et émet des propositions d'amélioration</li> </ul> |

| F3. Améliorer et développer les soins par sa pratique réflexive.  |   |
|---|---|
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Utilisation adéquate de l'auto et hétéro-évaluation   | - S'auto-évalue régulièrement de manière autonome en fonction de ses objectifs et des compétences à développer<br>- Demande et utilise l'hétéro-évaluation pour progresser  |
| Qualité de sa pratique réflexive  | - Elabore du savoir à partir des expériences vécues et le confronte à l'équipe de soins<br>- Élabore des propositions d'amélioration des soins<br>- Confronte ses idées et réflexions avec l'équipe professionnelle |
| Commentaire général   |   |
| Appréciation globale Acquis <input type="checkbox"/> (maîtrise) En voie d'acquisition <input type="checkbox"/> (maîtrise partielle) Non acquis <input type="checkbox"/> (maîtrise insuffisante) |   |

## G. Compétences du rôle de professionnel-le

| G1. Démontrer une attitude respectueuse de l'éthique professionnelle et un engagement envers les patient-e-s, leurs proches et la société.  |   |
|---|---|
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Qualité de la réflexion éthique et de son impact sur la pratique professionnelle  | - Connaît ses propres valeurs, celles des personnes soignées et de leur entourage et celles du contexte de soins et les intègre dans sa réflexion<br>- S'appuie sur les principes éthiques et le code de déontologie de la profession |
| G2. Représenter sa profession et s'impliquer dans son développement.  |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Qualité de son engagement professionnel   | - Se positionne sur les questions liées à l'évolution des soins infirmiers et de la formation infirmière<br>- Se positionne sur les questions d'actualité liées à l'évolution des politiques socio-sanitaires locales ou nationales   |
| G3. Contribuer à la qualité de vie des personnes et de la société   |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Adéquation de son engagement en faveur du développement durable   | - Applique, de manière systématique, les protocoles de gestion des déchets et du matériel en vigueur<br>- Démonstre des attitudes responsables face à la protection de l'environnement  |
| G4. S'engager pour le maintien de sa propre santé et celle de ses pairs.  |   |
| Critères d'évaluation   | Indicateurs (non-exhaustifs) évalués en situation   |
| Utilisation adéquate des mesures de protection de soi, d'autrui   | - Travaille de manière ergonomique<br>- Mobilise les précautions d'hygiène et de sécurité actualisées<br>- Met en place des stratégies et mobilise des ressources visant à préserver sa propre santé et celle des autres              |
| Commentaire général   |   |
| Appréciation globale Acquis <input type="checkbox"/> (maîtrise) En voie d'acquisition <input type="checkbox"/> (maîtrise partielle) Non acquis <input type="checkbox"/> (maîtrise insuffisante) |   |

## 10.3 Appendice C : Tableau de la recherche méthodologique des articles

Légende :

Informations sur chaque étape de la recherche ; **Article sélectionné.**

| Base de données  | Termes MeSH ou OVID  | Nombre d'articles trouvés | Nombres d'articles retenus selon le titre | Remarques, arguments de choix  |
|--|--|---------------------------|---|--|
| <b>1<sup>ère</sup> recherche :</b> dans la base de données "PsycInfo" en utilisant tous les Ovid termes afin de tomber sur un article très ciblé. On retient un article pertinent.     |  |                           |   |  |
| PsycInfo   | Aged <i>AND</i> Nursing homes <i>AND</i> Registered Nurses <i>AND</i> prevention <i>AND</i> polypharmacy | 1                         | 1   | Utilisation de tous les Ovid termes<br><br>Article retenu, et apparait dans l'ensemble des recherches effectuées<br><br>Revue systématique   |
| <b>2<sup>ème</sup> recherche:</b> en élargissant le champ de recherche en ciblant les personnes âgées, l'infirmier et le concept de polymédication qui est un concept clé (important). |  |                           |   |  |
| PsycInfo   | Aged <i>AND</i> Registered nurses <i>AND</i> polypharmacy  | 3                         | 1   | Strategies to reduce medication errors with reference to older adults.<br><br>Revue systématique<br><br>= article identique que le précédent |
| <b>3<sup>ème</sup> recherche:</b> en élargissant davantage en remplaçant l'Ovid terme "polypharmacy" par "prevention" → résultat : trop d'articles pas suffisamment spécifiques.       |  |                           |   |  |

|   |  |     |   |  |   |
|---|--|-----|---|--|---|
| PsycInfo  | Aged <i>AND</i> Registered Nurses <i>AND</i> prevention            | 124 | 3 | Development and clinical gains of nurse-led medication monitoring profiles.<br><br>Niveau de preuve insuffisant. | Enlever le concept de résultat de « polypharmacy » pour mettre le concept de la prévention uniquement = élargie trop la recherche et pas suffisamment spécifique. |
|   |  |     |   | Medication-related falls in the elderly: Causative factors and preventive strategies.                            | Quelques articles sont trouvés, mais niveau de preuve insuffisant.  |
|   |  |     |   | Strategies to reduce medication errors with reference to older adults.   | Revue systématique = article identique et déjà sélectionné  |
| <b>4<sup>ème</sup> recherche</b> : Enlever le Ovid terme de la personne âgée et préciser le contexte du home. De plus, replacer le terme de la polymédication qui est indispensable pour trouver des articles pertinents et appropriés. |  |     |   |  |   |
| PsycInfo  | Nursing homes <i>AND</i> Registered Nurses <i>AND</i> polypharmacy | 3   | 1 | Strategies to reduce medication errors with reference to older adults.   | Revue systématique = article identique et déjà sélectionné  |
| <b>5<sup>ème</sup> recherches</b> : étant donné que la recherché précédente n'apporte rien de plus, élargir la recherché en proposant uniquement les termes "Registered Nurses" et "polypharmacy".                                      |  |     |   |  |   |
| PsycInfo  | Registered Nurses <i>AND</i> polypharmacy                          | 10  | 3 | Strategies to reduce medication errors with reference to older adults.   | Revue systématique = article identique et déjà sélectionné  |

|  |   |     |   |   |  |
|--|---|-----|---|---|--|
|  |   |     |   | Medication errors in elderly acute care-- a systematic review.  | -  |
|  |   |     |   | Medication-related falls in the elderly: Causative factors and preventive   | Déjà trouvé, mais niveau de preuve insuffisant.            |
| <b>6<sup>ème</sup> recherche:</b> La recherche précédente à donner des résultats d'articles déjà trouvé. Donc on élargie la recherche en utilisant uniquement les Ovid termes « Aged » et « Polypharmay ».           |   |     |   |   |  |
| PsycInfo   | Aged <i>AND</i> Polypharmacy                                    | 644 | 1 | A comparison of the beers and STOPP criteria for identifying the use of potentially inappropriate medications among elderly patients in primary care. | -  |
| <b>7<sup>ème</sup> recherche:</b> Ajout d'un terme pour préciser la recherche, car la précédente récence une trop grande quantité d'articles non pertinent et pas suffisamment ciblée.                               |   |     |   |   |  |
| PsycInfo   | Registered Nurses <i>AND</i> prevention <i>AND</i> polypharmacy | 6   | 2 | Strategies to reduce medication errors with reference to older adults.  | Revue systématique = article identique et déjà sélectionné |
|  |   |     |   | Medication-related falls in the elderly: Causative factors and preventive   | Déjà trouvé, mais niveau de preuve insuffisant.            |
| <b>8<sup>ème</sup> recherche:</b> Avec la recherché précédente, nous retrouvons des articles déjà proposées. Donc dernière recherche en utilisant un autre terme pour "prevention", qui est le terme de "strategies" |   |     |   |   |  |
| PsyInfo  | Registered Nurses <i>AND</i> Strategies <i>AND</i> polypharmacy | 5   | 2 | Voir commentaire  | Même articles (2) trouvé dans la recherche précédente      |

|  |  |    |   |   |  |
|--|--|----|---|---|--|
| <p><b>9<sup>ème</sup> recherche:</b> Pas de nouveaux articles trouvés en modifiant un terme. Je conclus avoir fait une recherche quasiment globale pour cette base de donnée. Prochaine étape, il s'agit d'effectuer la même démarche dans une base de données différente: Medline (OvidSP), qui emploie les mêmes termes OVID. Utilisation de tous les Ovid termes de la question PICOTS.</p> |  |    |   |   |  |
| Medline (OvidSP)   | Aged <i>AND</i> Nursing homes <i>AND</i> Registered Nurses <i>AND</i> prevention <i>AND</i> polypharmacy | 0  | - | -   | Aucune étude trouvée   |
| <p><b>10<sup>ème</sup> recherche:</b> Pas de résultats en utilisant tous les Ovid termes. Donc élargissement de la recherche avec les termes suivants: "Aged", "Registered Nurses" et "polypharmacy". On retient un article pertinent.</p>   |  |    |   |   |  |
| Medline (OvidSP)   | Aged <i>AND</i> Registered nurses <i>AND</i> polypharmacy  | 1  | 1 | <b>Registered Nurses' medication management of the elderly in aged care facilities.</b> | Article retenu, et apparait dans l'ensemble des recherches effectuées                                  |
| <p><b>11<sup>ème</sup> recherche:</b> Elargissement du champ de recherche en ciblant les personnes âgées, l'infirmier et le concept de polymédication qui est un concept clé (important).</p>  |  |    |   |   |  |
| Medline (OvidSP)   | Aged <i>AND</i> Registered Nurses <i>AND</i> Prevention  | 74 | - | -   | Même constat que pour la base de données « PsycInfo ». Trop d'éléments et pas suffisamment spécifique. |
| <p><b>12<sup>ème</sup> recherche:</b> La recherche précédente est trop importante. Enlève le terme de la personne âgée en remplaçant par le contexte du home et retour sur le concept de polymédication.</p>   |  |    |   |   |  |
| Medline (OvidSP)   | Nursing homes <i>AND</i> Registered Nurses <i>AND</i> polypharmacy                                       | 1  | 1 | Registered Nurses' medication management of the elderly in aged care facilities.        | = article identique que le précédent<br>Essai non randomisé  |
| <p><b>13<sup>ème</sup> recherche:</b> Essai d'élargir la recherche en incluant uniquement les termes "Registered Nurses" et "polypharmacy". Même article trouvé que précédemment.</p>  |  |    |   |   |  |



|   |  |      |   |  |  |
|---|--|------|---|--|--|
| Medline (OvidSP)  | Registered Nurses <i>AND</i> polypharmacy  | 1    | 1 | Registered Nurses' medication management of the elderly in aged care facilities. | = article identique que le précédent<br><br>Essai non randomisé  |
| <b>14<sup>ème</sup> recherche:</b> Recherche précédente ne donne qu'un élément. Pas de possibilités supplémentaires pour étoffer la recherche. Met fin à la recherche                   |  |      |   |  |  |
| <b>15<sup>ème</sup> recherche:</b> dans la base de données "Pubmed" en utilisant tous les MeSH termes afin de tomber sur un article très ciblé. Pas de résultats                        |  |      |   |  |  |
| PubMed  | Aged <i>AND</i> Nursing homes for the Aged <i>AND</i> Nurses <i>AND</i> prevention <i>AND</i> polypharmacy | 6    | 1 | Registered Nurses' medication management of the elderly in aged care facilities. | Utilisation de tous les MeSH termes<br><br>Article déjà retenu dans la base de donnée « Medline SP »<br><br>Revue systématique |
| <b>16<sup>ème</sup> recherche:</b> en élargissant le champ de recherche en ciblant les personnes âgées, l'infirmier et le concept de polymédication qui est un concept clé (important). |  |      |   |  |  |
| PubMed  | Aged <i>AND</i> Nurses <i>AND</i> polypharmacy   | 67   | 2 | Registered Nurses' medication management of the elderly in aged care facilities. | Article déjà sélectionné   |
|   |  |      |   | Minimising the risk of polypharmacy.   | Il s'agit d'un article réalisé par un auteur. L'article n'est pas disponible.  |
| <b>17<sup>ème</sup> recherche:</b> en élargissant davantage en remplaçant le MeSH terme "polypharmacy" par "prevention" → résultat : trop d'articles pas suffisamment spécifiques.      |  |      |   |  |  |
| PubMed  | Aged <i>AND</i> Nurses <i>AND</i> prevention   | 3255 | - |  | Trop grand nombre d'articles.  |

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| <p><b>18<sup>ème</sup> recherche :</b> Enlever le MeSH terme de la personne âgée et préciser le contexte du home. De plus, replacer le terme de la polymédication qui est indispensable pour trouver des articles pertinents et appropriés.</p>           |  |     |   |   |   |
| PubMed  | Nursing homes for the aged<br><i>AND</i> Nurses<br><i>AND</i> polypharmacy | 13  | 1 | Registered Nurses' medication management of the elderly in aged care facilities | article déjà sélectionné  |
| <p><b>19<sup>ème</sup> recherches:</b> étant donné que la recherche précédente n'apporte rien de plus, élargir la recherche en proposant uniquement les termes "Registered Nurses" et "polypharmacy".</p>   |  |     |   |   |   |
| PubMed  | Registered Nurses <i>AND</i> polypharmacy                                  | 93  | 0 | -   | -   |
| <p><b>20<sup>ème</sup> recherche:</b> En modifiant nos termes, (tout en gardant un focus sur notre question PICOT), nous observant que la recherche s'élargit et s'ouvre à un grand nombre d'articles pouvant être adéquat pour notre questionnement.</p> |  |     |   |   |   |
| Pubmed  | Nurses <i>AND</i> Aged <i>AND</i> reduce <i>AND</i> polypharmacy           | 507 | 1 | <b>Polypharmacy Misleading but manageable.</b>                                  | Bonne définition de polymédication et des outils sont démontrés pour diminuer son risque. |
| <p><b>21<sup>ème</sup> recherche:</b> Dans le même principe que la recherche précédente, nous allons également introduire un autre terme tel que « Intervention » pour élargir davantage la recherche.</p>  |  |     |   |   |   |
| PubMed  | Elderly <i>AND</i> interventions <i>AND</i> polypharmacy                   | 219 | 3 | <b>Polypharmacy in the elderly a literature review.</b>                         | Bonne définition de polymédication et des outils sont démontrés pour diminuer son risque. |
|   |  |     |   | <b>Polypharmacy in elderly patients</b>   | Les personnes âgées et la polymédication sont ciblées                                     |

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|  |  |    |   | <b>Polypharmacy in the elderly a literature review.</b>  | Revue de littérature.  |
| <b>22<sup>ème</sup> recherche:</b> Les termes utilisés nous ont permis de trouver des articles pertinents en lien avec notre question PICOT. Nous mettons fin à notre recherche dans la base de donnée PubMed. |  |    |   |  |  |
| <b>23<sup>ème</sup> recherche:</b> dans la base de données "Cochrane" en utilisant tous les MeSH termes afin de tomber sur un article très ciblé. On retient un article pertinent.                             |  |    |   |  |  |
| Cochrane Library   | Aged and Nursing homes for the aged and Nurses and Prevention and Polypharmacy | 3  | 1 | Registered nurses' perception of their professional role regarding medication management in nursing care of the elderly  | Le titre correspond à notre question PICOT (professional role, medication management → interventions possibles, elderly)           |
| <b>24<sup>ème</sup> recherche:</b> en élargissant le champ de recherche en ciblant les personnes âgées, l'infirmier et le concept de polymédication qui est un concept clé (important).                        |  |    |   |  |  |
| Cochrane Library   | Aged and Nurses and Prevention and Polypharmacy                                | 27 | 6 | Polymedicine and Aging Enhancing Older Adult Care Through Advanced Practitioners GNPs and elder care pharmacists can help provide optimal pharmaceutical care. | D'après le titre, des praticiens de pratique avancée et des pharmaciens peuvent améliorer les soins pharmaceutiques (intervention) |
|  |  |    |   | Beers Criteria for Potentially Inappropriate Medication Use in Older Adults.   | Le titre donne une possibilité d'intervention (Beers Criteriaria) dans la prévention de la polymédication chez les personnes âgées |

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|  |  |  |  | <p>The dangers of polypharmacy: nurses should be on high alert when caring for elderly patients on multiple medications.</p> | <p>Le titre reprend les mots-clés de notre question PICOT (polypharmacy, nurses, elderly patient) et « high alert » sous-tend la possibilité de moyens de surveillance et d'intervention.</p>   |
|  |  |  |  | <p>Health Outcomes and Polypharmacy in Elderly Individuals.</p>  | <p>Article déjà sélectioné.</p>   |
|  |  |  |  | <p>Teaching older adults to self-manage medications: preventing adverse drug reactions.</p>                                  | <p>Présente un moyen d'intervention possible (éducation thérapeutique dans la gestion de son traitement) afin de prévenir les réactions indésirables.</p>                                       |
|  |  |  |  | <p>Nurses' observations and experiences of problems and adverse effects of medication management in home care.</p>           | <p>Le titre reprend les observations et expériences des problèmes dans la gestion des traitements à domicile. Il sous-tend des interventions possibles en fonction des problèmes identifiés</p> |

**25<sup>ème</sup> recherche:** en élargissant davantage en utilisant les MeSH termes « polypharmacy » et « nurse ». De plus, nous ciblons les types d'articles : reviews, other reviews et trials. Nous retenons 3 articles pertinents sur 8 que nous utiliserons pour notre analyse.

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| Cochrane Library | Polypharmacy AND Nurse | Cochrane Reviews :<br>3 | 1 | <b>Interventions to improve the appropriate use of polypharmacy for older people (review)</b>  | Le titre reprend les mots-clés de notre question (intervention, polypharmacy, older people), revue systématique |
|                  |                        | Other Reviews :<br>3    | 2 | <b>Health Outcomes and Polypharmacy in Elderly Individuals</b>   | Revue de littérature, reprend 2 mots-clés (polypharmacy, elderly individuals),                                  |
|                  |                        |                         |   | <b>Interventions to optimise prescribing in care homes : systematic review</b>   | Revue systématique, home care, optimise prescribing   |
|                  |                        | Trials : 31             | 5 | Primary care strategies to maintain independance of frail older people : looking for evidence across border                                  | Strategies to maintain independance, frail older people, trials   |
|                  |                        |                         |   | Digital method for medication review   | Méthode pour la revue de la médication, essai   |
|                  |                        |                         |   | Optimizing drug treatment among older people in residential care facilities in Helsinki – A RCT  | Essai contrôlé randomisé  |
|                  |                        |                         |   | <b>Improving the quality of pharmacotherapy in elderly primary care patients through medication reviews : a Randomised Controlled Trials</b> | Essai contrôlé randomisé, revue des médicaments par un pharmacien sur la base des examens infirmiers            |

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|  |   |   |   | Effects of medication assesement as part of a comprehensive geriatric assesement on drug use over a 1-year periodo : a population based intervention study | Evaluation de la médication (intervention) chez les personnes âgées   |
| <p><b>26<sup>ème</sup> recherche</b> : Fin des recherches sur la base de données « Cochrane Library ». Nous avons 10 articles retenus pour nos analyses. Afin d'étoffer l'analyse, nous interrogeons une dernière base de donnée : « Cinhal ». Utilisation des MeSH termes « Nursing homes », Registered Nurses » et « polypharmacy ».</p> |   |   |   |  |   |
| Cinhal   | Nursing homes<br><i>AND</i><br>Registered Nurses <i>AND</i><br>polypharmacy | 3 | 2 | Registered nurses' perception of their professional role regarding medication management in nursing care of the elderly.                                   | Selon le titre, les mots-clés se retrouve tous (infirmier, gestion du traitement, personne âgée, institution de soin) et cela correspond à notre sujet de recherché |
|  |   |   |   | Monitoring Medication use in Older Adults  | Reprend également certains mots-clés. Donne aussi des recommandations pratiques pour la gestion du traitement médicamenteux   |
| <p><b>27<sup>ème</sup> recherches</b>: 2 articles sont ressortis, mais nous l'avons déjà sélectionné précédemment. Autre recherche en ciblant les personnes âgées et en utilisant un autre terme pour désigner l'intervenant infirmier : « Nurses » au lieu de « Registered Nurses ». Même résultats que recherche précédente.</p>         |   |   |   |  |   |

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| Cinhal   | Aged <i>AND</i><br>Nursing homes<br><i>AND</i><br>Nurses <i>AND</i><br>Polypharmacy | 5  | 2 | Registered nurses' perception of their professional role regarding medication management in nursing care of the elderly.                                       |   |
|  |   |    |   | Monitoring Medication use in Older Adults  |   |
| <b>28<sup>ème</sup> recherche:</b> En élargissant le champ de recherche en retirant le terme lié au contexte « home ». |   |    |   |  |   |
| Cinhal   | Aged <i>AND</i><br>Nurses <i>AND</i><br>Polypharmacy                                | 58 | 9 | Minimising the risk of polypharmacy  | Titre semble donner des recommandations pour diminuer la polymédication |
|  |   |    |   | Registered nurses' perception of their professional role regarding medication management in nursing care of the elderly.                                       | Article déjà sélectionné  |
|  |   |    |   | Polymedicine and Aging Enhancing Older Adult Care Through Advanced Practitioners GNPs and elder care pharmacists can help provide optimal pharmaceutical care. | Article déjà sélectionné  |
|  |   |    |   | Health Outcomes and Polypharmacy in Elderly Individuals  | Article déjà sélectionné  |
|  |   |    |   | Beers Criteria for Potentially Inappropriate   | Article déjà sélectionné  |

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|  |                                  |    |   | Medication Use in Older Adults.  |  |
|  |                                  |    |   | Medication Regimens in Older Home Care Patients.   | Dit dans le résumé que les infirmiers doivent être vigilants. Des interventions possibles sont peut être décrites.                                     |
|  |                                  |    |   | A primer for advanced practice acute care and critical care nurses, part 1   | Selon résumé : infirmier en pratique avancée, gestion des médicaments  |
|  |                                  |    |   | Monitoring medication use in older adult   | Article déjà sélectionné   |
|  |                                  |    |   | Teaching older adults to self-manage medications: preventing adverse drug reactions.   | Article déjà sélectionné   |
| <p><b>29<sup>ème</sup> recherche:</b> 58 articles, dont 9 sont pertinents. Cependant, la majorité de ceux-ci ont déjà été sélectionnés. Nous n'en retenons donc aucun supplémentaire pour l'analyse.</p>   |                                  |    |   |  |  |
| Cinhal   | Polypharmacy AND Aged (RCT only) | 29 | 1 | Improving the Quality of Pharmacotherapy in Elderly Primary Care Patients Through Medication Reviews: A Randomised Controlled Study. | Donne une intervention (revue de la médication), essai contrôlé randomisé, population correspondant à notre question PICOT<br><br>Article déjà retenu. |
| <p><b>30<sup>ème</sup> recherche:</b> Fin de la recherche.</p> <p><b>Bilan de la recherche :</b> 30 recherches sur 5 bases de données. Un total de 35 articles retenus selon leur titre, dont 10 d'entre eux sont pertinents et que nous utiliserons pour notre analyse.</p> |                                  |    |   |  |  |



## 10.4 Appendice D : Tableau récapitulatif des articles sélectionnés et retenus pour l'analyse

| N° articles | Titre article  | Auteurs   | Niveau de preuve                                  | Base de données  |
|-------------|--|---|---|------------------|
| 1           | Strategies to reduce medication errors with reference to older adults.                 | Hodgkinson, B., Koch, S., Nay, R., & Nichols, K. (2006).                                | Systematic review                                 | PsycInfo         |
| 2           | Registered Nurses' medication management of the elderly in aged care facilities.       | Lim, L. M., Chiu, L. H., Dohrmann, J., & Tan, K.-L. (2010).                             | Non randomised trials                             | Medline (SP)     |
| 3           | Polypharmacy Misleading but manageable.  | Bushardt, R. L., Massey, E. B., Simpson, T. W., Ariail, J. C., & Simpson, K. N. (2008). | Literature review                                 | Pubmed           |
| 4           | Polypharmacy in the elderly : a literature review.                                     | Fulton, M. M., & Allen, E. R. (2005).   | Literature review                                 | Pubmed           |
| 5           | Polypharmacy in elderly patients   | Hajjar, E. R., Cafiero, A. C., & Hanlon, J. T. (2007).                                  | Literature review                                 | Pubmed           |
| 6           | Interventions to improve the appropriate use of polypharmacy for older people (review) | Patterson, S. M., Hughes, C., Kerse, N., Cardwell, C. R., & Bradley, M. C. (2012).      | systematic review of randomised controlled trials | Cochrane Library |
| 7           | Health Outcomes and Polypharmacy in Elderly Individuals                                | Frazier, S. C. (2005).  | literature review                                 | Cochrane Library |

|           |   |   |   |                  |
|-----------|---|---|---|------------------|
| <b>8</b>  | Interventions to optimise prescribing for older people in care homes (Review)   | Alldred, D. P., Raynor, D. K., Hughes, C., Barber, N., Chen, T. F., & Spoor, P. (2013).                 | systematic review of randomised controlled trials | Cochrane Library |
| <b>9</b>  | Interventions to optimise prescribing in care homes : systematic review   | Loganathan, M., Singh, S., Franklin, B. D., Bottle, A., & Majeed, A. (2011).                            | Systematic review                                 | Cochrane Library |
| <b>10</b> | Improving the quality of pharmacotherapy in elderly primary care patients through medication reviews : a Randomised Controlled Trials | Milos, V., Rekman, E., Bondesson, Å., Eriksson, T., Jakobsson, U., Westerlund, T., & Midlöv, P. (2013). | Randomised controlled clinical trial              | Cochrane Library |

## 10.5 Appendice E : Analyses des articles selon les grilles de Fortin (2010) et articles originaux

### 10.5.1 Appendice E1 : Article n° 1 – Strategies to reduce médication errors with reference to older adults

|              |   |
|--------------|---|
| Article n° 1 | <b>Strategies to reduce medication errors with reference to older adults</b>  |
| Auteurs      | Hodgkinson, B., Koch, S., Nay, R., & Nichols, K. (2006).  |
| Titre        | Les stratégies pour réduire les erreurs de médication avec pour références les personnes âgées.<br>Le concept de polymédication n'est pas mis spécifiquement en avant.  |
| Résumé       | <p>Le résumé synthétise clairement le résumé de la recherche, ou l'on retrouve :</p> <ul style="list-style-type: none"> <li>• <b>Background</b> : En Australie, environ 59% de la population utilise des médicaments prescrits. 86% de ces personnes sont des personnes âgées. 83% de la population de plus de 85 ans utilisent 2 ou + médicaments simultanément. L'étude précise que les plus grandes erreurs de médication sont due à : une mauvaise prescription, la distribution, l'administration et des erreurs de contrôles. Les sujets âgés sont donc plus vulnérables.</li> <li>• <b>Objectifs</b> : Présenter la meilleure preuve de stratégie pour prévenir ou réduire les incidences dues aux erreurs de médication liées à la prescription, la distribution et l'administration des médicaments chez la personne âgée.</li> <li>• <b>Méthode</b> : Utilise des écrits systématiques, ainsi que des « trials randomisé et contrôlé » et d'autres méthodes de recherches comme des « non-aleatoire controlled trials », études longitudinales. Ce sont des études trouvées dans plusieurs bases de données. L'échantillonnage comprend les personnes impliquées dans la prescription, l'administration et distribution des médicaments des personnes âgées (+65 ans).</li> <li>• <b>Résultats</b> : Les stratégies qui ont eu des preuves pour réduire les incidences dues à la médication sont :</li> </ul> |

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|  | <ul style="list-style-type: none"> <li>○ système informatisé qui favoriserait des transmissions des ordres médicaux du médecin aux autres professionnels de la santé.</li> <li>○ Cet outil pourrait réduire les erreurs liées à la calligraphie des prescriptions</li> <li>○ un stockage nominatif des médicaments permettrait de réduire les erreurs</li> <li>● <b>Conclusions et discussion</b> : N'apparaît pas dans le résumé.</li> <li>● <b>Mots clés</b> : « intervention studies ; medication errors ; nursing ; prevention »</li> </ul>  |
| <b>INTRODUCTION</b>                                |  |
| <b>Problème de la recherche</b>                    | <p>Le problème est bien expliqué. L'étude présente les problèmes principaux. Soit, les erreurs de médicaments dues aux erreurs de prescription, d'administration et de distribution chez les personnes âgées.</p> <p>Une partie des admissions des sujets âgés dans les hôpitaux est due à des problèmes de médication, du fait qu'ils ont plus de médicaments. Cela augmente le risque d'incidence et par conséquent d'admissions dans les hôpitaux. Cela a pour conséquence une forte augmentation des charges financières. (17 à 29 billions de dollars par ans aux USA qui auraient pu être « économisés » suite à ces erreurs de médicaments.</p>   |
| <b>Recension des écrits<br/>Cadre de recherche</b> | <p>De nombreuses recherches ont été recensées pour une bonne compréhension de l'ampleur du problème :</p> <ul style="list-style-type: none"> <li>● « Australian conceal for safety and quality in hearth care, (2002) » présentent les différents types d'erreurs de médicaments dans la pratique médicale au quotidien (tout contexte confondu) : médicaments inappropriés (30%), erreur de prescription (22%), erreur d'administration (18%), doses inappropriées (15%), effets secondaires (13%), réactions allergiques (11%), erreur de distribution (10%), overdose (8%).</li> <li>● « Australian conceal for safety and quality in hearth care, (2002) » présente les facteurs qui contribuent aux incidents : manque de communication entre les patients et professionnels de santé (23%), erreurs de jugements (22%), mauvaise communication entre les personnels soignants (19%), consultations de plusieurs médecins (15%), mauvaise reconnaissances des symptômes/signes (15%), mauvaise rédaction de l'histoire du patient (13%), praticiens généraux</li> </ul> |

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|                               | <p>trop occupés, fatigués, trop rapide, mauvaise compréhension du patient de son problème et/ou du traitement (10%), mauvaise évaluation du patient (10%).</p> <ul style="list-style-type: none"> <li>• Australian conceal for safety and quality in hearth care (2002) a tenté de décrire les différents types d'erreurs de médication à chaque étape du processus : Etape 1 = erreur de prescription/ordonnance des médicaments. Etape 2 = distribution. Etape 3 = erreur d'administration. Etape 4 = erreur de rapport de médicaments. Etape 5 = erreur selon le lieu.</li> </ul> <p>Ces recensions présentent une base solide pour l'étude, Elles définissent bien l'ensemble des problèmes. L'étude est pertinente pour la discipline médicale, et peut être utile pour la discipline infirmière.</p> |
| Buts et question de recherche | <p>L'étude cherche à :</p> <ul style="list-style-type: none"> <li>• Présenter les meilleures preuves stratégiques pour prévenir ou réduire les incidents dus aux erreurs de médication associée à la prescription, la distribution, et administration des médicaments (des sujets âgés dans les établissements de soins).</li> </ul> <p>La question spécifique de l'étude est la suivante :</p> <ul style="list-style-type: none"> <li>• « Quelles stratégies/interventions sont les plus efficaces dans la réduction des incidents de médications dans les établissements de soins ».</li> </ul>  |
| <b>METHODE</b>                |  |
| Population et échantillon     | La population visée sont les personnes qui ont prescrit, administré et distribué des médicaments aux personnes âgées, soit : les infirmiers, futurs infirmiers, pharmaciens, médecins.   |
| Considérations éthiques       | <p>Il s'agit d'une revue systématique. Elle prend en compte plusieurs autres revues systématiques et des essais contrôlés randomisés qui évaluent les stratégies pour réduire et prévenir les incidences liées à la médication. En l'absence d'essais contrôlés randomisés, d'autres méthodes ont été utilisées telles que des études longitudinales, « cohorte or case-control studies », et des études descriptives. Ainsi que des études qualitatives.</p> <p>Il n'y a pas de considération éthique.</p>  |
| Devis de recherche            | Dans un premier temps, ils ont cherché des études sur la base de données Pubmed avec comme MeSH termes : medication errors, aged, prescriptions, drug). Ils ont également cherché selon différents titres : Medications  |

|   |   |
|---|---|
|   | <p>errors, adverse event, aged, elderly, adults, drugs, medication.</p> <p>Ces termes ont également été utilisés dans d'autres bases de données tels que : Embase, CINHALL, Current Contents, Cochrane Library, ProceedingsFirst, Social Science Index et International Pharmaceuticals Abstracts.</p>  |
| <p>Modes de collectes de données -<br/>Conduite de la recherche -<br/>Analyse des données</p> | <p>13 cliniciens, pharmaciens et d'autres professionnels de la santé étaient présents pour guider le déroulement de la recherche en définissant les critères pour l'introduction de l'étude, l'identification des termes clés de la recherche et une base de données pertinente et évaluer l'importance clinique des résultats.</p> <p>Des centaines d'articles sont ressortis et au final 20 études et 3 revues systématiques ont été retenus. Cela d'après différents critères de sélection tel que : 1. force d'une preuve : niveau de preuve, la qualité et la précision statistique. 2. La grandeur des effets et 3. la pertinence de la preuve. Ces différents critères sont clairement expliqués.</p> <p>La fiabilité et la validité des articles et des revues systématiques ont été contrôlées et analysées selon différents critères de sélection. 13 cliniciens, pharmaciens et d'autres professionnels de la santé étaient présents pour guider le déroulement de la recherche en définissant les critères pour l'introduction de l'étude, l'identification des termes clés de la recherche et une base de données pertinente et évaluer l'importance clinique des résultats.</p> <p>Des centaines d'articles sont ressortis et au final 20 études et 3 revues systématiques ont été retenus. Cela d'après différents critères de sélection tel que : 1. force d'une preuve : niveau de preuve, la qualité et la précision statistique. 2. La grandeur des effets et 3. la pertinence de la preuve. Ces différents critères sont clairement expliqués.</p> <p>La fiabilité et la validité des articles et des revues systématiques ont été contrôlées et analysées selon différents critères de sélection qui sont expliqués.</p> |
| <b>RESULTATS</b>  |   |
| <p>Présentation des résultats</p>   | <p>Les résultats des différentes études retenues sont présentés sous forme de tableaux, complétés par des textes narratifs.</p>   |

|                                      |   |
|--------------------------------------|---|
|                                      | <p>Ils répondent à la question de recherche posée dans la méthode, soit : « Quelles stratégies/interventions sont les plus efficaces dans la réduction des incidents de médications dans les établissements de soins ? »</p> <p>Une revue systématique et 20 études ont été utilisées pour répondre à cette question. La majorité des études utilisées n'était pas spécifique aux personnes âgées.</p> <p>Plusieurs résultats ont été retenus et présentés dans cette étude. Chacun d'eux sont résumés en annexe dans des tableaux comprenant principalement : type d'étude, auteurs de l'étude utilisé ; niveau d'évidence (niveau de preuve) ; la population étudiée, les interventions, les résultats ainsi la durée du suivi.</p>   |
| <b>DISCUSSION</b>                    |   |
| <b>Interprétations des résultats</b> | <p>Plusieurs résultats sont donnés dans cette revue systématique. Certaines études sont centrées sur les différents corps de métiers (médecin, pharmacien et infirmiers) et d'autres sont plus générales.</p> <p>Une étude (Spencer et al., 2005) relève l'efficacité ou non d'un système informatisé sur le nombre d'erreurs de médications (prescription, unité de processus, distribution, livraison, administration). Il n'y a pas de changements significatifs.</p> <p>Une autre étude (Brown et al., 1995) cherche à déterminer si un moyen informatisé au chevet du lit du patient est efficace. Les résultats ne montrent pas de différences avec ou sans le moyen informatisé auprès du patient.</p> <p>L'étude de Kucukarsian et al. (2003) démontre que l'intervention d'un pharmacien dans une équipe de soins diminue considérablement (de 20 à 30%) le nombre d'erreurs de médication.</p> <p>L'étude de Pape (2003) démontre qu'un infirmier spécifique et désigné pour l'administration de médicaments a une diminution du nombre de distractions. Il ne met pas en évidence si cela est bénéfique pour diminuer les risques d'erreurs.</p> <p>Finalement, une étude (Kruse et al., 1992) met en évidence que les erreurs liées à la médication diminuent s'il y a un double contrôle des infirmiers avant la distribution des médicaments.</p> |

|  |  |
|--|--|
| <p>Conséquences et recommandations</p> | <p>Dans la discussion, ils donnent des informations et de recommandations concernant la gestion des médicaments :</p> <ul style="list-style-type: none"><li>• Un système informatisé doit être considéré comme une stratégie permettant de réduire les risques d'une mauvaise lecture des ordonnances.</li><li>• Médicament au nom du patient : les médicaments qui sont déjà triés et dosés pour chaque individu diminuent le risque d'erreur en comparaison avec des médicaments stockés comme nous en voyons habituellement dans les hôpitaux.</li><li>• L'intervention d'un pharmacien afin de revérifier les commandes et d'être sollicité en tant que conseiller spécialisé.</li><li>• La vérification effectuée par deux infirmiers avant l'administration des traitements montre une diminution des erreurs médicamenteuses.</li><li>• Plus de recherches sont nécessaires afin de confirmer si d'autres interventions pourraient réduire ces erreurs liées aux médicaments.</li></ul> |
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SYSTEMATIC REVIEW

# Strategies to reduce medication errors with reference to older adults

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## Abstract

**Background** In Australia, around 59% of the general population uses prescription medication with this number increasing to about 86% in those aged 65 and over and 83% of the population over 85 using two or more medications simultaneously. A recent report suggests that between 2% and 3% of all hospital admissions in Australia may be medication related with older Australians at higher risk because of higher levels of medicine intake and increased likelihood of being admitted to hospital. The most common medication errors encountered in hospitals in Australia are prescription/medication ordering errors, dispensing, administration and medication recording errors. Contributing factors to these errors have largely not been reported in the hospital environment. In the community, inappropriate drugs, prescribing errors, administration errors, and inappropriate dose errors are most common.

**Objectives** To present the best available evidence for strategies to prevent or reduce the incidence of medication errors associated with the prescribing, dispensing and administration of medicines in the older persons in the acute, subacute and residential care settings, with specific attention to persons aged 65 years and over.

**Search strategy** Bibliographic databases PubMed, Embase, Current contents, The Cochrane Library and others were searched from 1986 to present along with existing health technology websites. The reference lists of included studies and reviews were searched for any additional literature.

**Selection criteria** Systematic reviews, randomised controlled trials and other research methods such as non-randomised controlled trials, longitudinal studies, cohort or case-control studies, or descriptive studies that evaluate strategies to identify and manage medication incidents. Those people who are involved in the prescribing, dispensing or administering of medication to the older persons (aged 65 years and older) in the acute, subacute or residential care settings were included. Where these studies were limited, evidence available on the general patient population was used.

**Data collection and analysis** Study design and quality were tabulated and relative risks, odds ratios, mean differences and associated 95% confidence intervals were calcu-

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lated from individual comparative studies containing count data where possible. All other data were presented in a narrative summary.

**Results** Strategies that have some evidence for reducing medication incidents are:

- computerised physician ordering entry systems combined with clinical decision support systems;
- individual medication supply systems when compared with other dispensing systems such as ward stock approaches;
- use of clinical pharmacists in the inpatient setting;
- checking of medication orders by two nurses before dispensing medication;
- a Medication Administration Review and Safety committee; and
- providing bedside glucose monitors and educating nurses on importance of timely insulin administration.

In general, the evidence for the effectiveness of intervention strategies to reduce the incidence of medication errors is weak and high-quality controlled trials are needed in all areas of medication prescription and delivery.

**Key words:** intervention studies, medication errors, nursing, prevention.

## Introduction

### Background

In Australia, around 59% of the general population uses prescription medication with this number increasing to about 86% in those aged 65 and over, and with 83% of the population over 85 using two or more medications simultaneously.<sup>1</sup>

A recent report suggests that between 2% and 3% of all hospital admissions in Australia may be medication related.<sup>2</sup> The Harvard Medical Practice study in the USA found that in hospital patients disabled by some form of medical treatment, 19% of recorded adverse events were related to medications.<sup>3</sup>

Older Australians have higher rates of medication incidents because of higher levels of medicine intake and increased likelihood of being admitted to hospital (hospital statistics being the main source of medication incident reporting).<sup>4</sup>

In the community setting, it has been estimated that up to 400 000 adverse drug events may be managed in general practices each year in Australia.<sup>4</sup>

The financial burden is staggering with one estimate putting the cost of preventable medication errors in the USA alone between \$17 and \$29 billion per year.<sup>5</sup> In Australia, the cost has been estimated at over \$350 million annually.<sup>2</sup>

*What are the types and causes of medication errors?*

Studies examining the types and causes of medication errors occurring in older adults ( $\geq 65$  years) are limited. However, evidence is available on the general population and is taken

to be representative of those issues that would arise in the geriatric setting. Where specific reference to older adults is found, it is highlighted in this report.

In a recent review by the Australian Council for Safety and Quality in Health Care, the types of medication errors most frequently encountered in an Australian healthcare setting and their likely causes were presented.<sup>4</sup> The results of this report present the best data with a particular focus on Australia that is presently available and are summarised as follows.

*Errors in hospital.* The most common errors related to medication that are encountered in hospitals in Australia are:

- prescription/medication ordering errors;
- dispensing errors;
- errors in administration of medicines; and
- errors in the medication record.

**Table 1** Types of medication errors in general medical practice

| Type of incident         | Rate per 100 incidents |
|--------------------------|------------------------|
| Inappropriate drug       | 30                     |
| Prescribing error        | 22                     |
| Administration error     | 18                     |
| Inappropriate dose       | 15                     |
| Side-effect              | 13                     |
| Allergic reaction        | 11                     |
| Dispensing error         | 10                     |
| Overdose                 | 8                      |
| System inadequacies      | 7                      |
| Drug omitted or withheld | 6                      |

Source: Australian Council for Safety and Quality in Health Care (2002, p. 33).<sup>4</sup>

Data from the Australian Incident Monitoring System showed that most medication incidents occurring in hospital were categorised as omissions (>25%), overdoses (20%), wrong medicines (10%), drug of addiction discrepancy (<5%), incorrect labelling (<5%) or an adverse drug reaction (<5%). However, little is known as to why medication errors occur in Australian hospitals. Failure to read, or misreading the chart, and a lack of robust systems for prescribing and ordering were suggested as the reasons for most of these errors.<sup>4</sup>

Errors can occur at any step in the medication process. A recent Australian review has attempted to describe the types of medication errors at each stage in the process, which is summarised as follows.<sup>4</sup>

**Prescription/medication ordering errors.** Medication errors occur during the prescribing or interpretation/translocation of orders from one document to another.

Based on limited Australian data on prescription errors, approximately 2% of all prescriptions have the potential to cause an adverse event with the most common causes being the wrong or ambiguous dose, missing dose, or the directions for use were unclear or absent. This can be compared with other countries in which the medication error rates have been reported to be between 2% and 7%.<sup>6</sup>

**Dispensing errors.** Dispensing errors occurring within the hospital pharmacy have not been comprehensively studied. Error rates have been reported to range from 0.08% to 0.8% of all items dispensed. However, the causes and the potential for adverse events have not been reported.<sup>4</sup>

**Errors in administration of medicines.** These errors occur when different patient medication supply systems are used.

When patients are given medicines from a common ward supply, error rates are between 15% and 20% compared with error rates of between 5% and 8% when individual patient medicine supplies are provided.<sup>4</sup>

Timing errors as high as 8% of administered doses have been shown to occur as a result of a patient being provided with a medicine at least 1 h before or 1 h after the scheduled time. These errors occur most likely because of time constraints and are unlikely to cause harm in the majority of cases.<sup>4</sup>

**Errors in the medication record.** A common error is the lack of documentation of previous adverse drug reactions and allergies. Australian studies have found that previously known adverse drug reactions were not recorded in 75–77% of cases evaluated. In another study 8% of cases had omissions of known allergic reactions in patient records. The causes and potential for adverse drug events were not described.<sup>4</sup>

**Table 2** Factors contributing to incidents in general practice

| Contributing factor   | Rate per 100 incidents |
|---|------------------------|
| Poor communication between patient and health professionals | 23                     |
| Action of others (not general practitioner or patient)      | 23                     |
| Error of judgement  | 22                     |
| Poor communication between health professionals             | 19                     |
| Patient consulted other medical officer                     | 15                     |
| Failure to recognise signs and symptoms                     | 15                     |
| Patient's history not adequately reviewed                   | 13                     |
| Omission of checking procedure                              | 10                     |
| General practitioner tired, rushed or running late          | 10                     |
| Patient misunderstood their problem and/or treatment        | 10                     |
| Inadequate patient assessment                               | 10                     |

No correlation between these contributing factors and the resulting incident (Table 1) was made.

Source: Australian Council for Safety and Quality in Health Care (2002, p. 33).<sup>4</sup>

*Errors in the community setting.* The review described medication incidents in general practice and community pharmacies.<sup>4</sup> General practitioners (GPs) and pharmacists were asked to provide explanation as to why the medication incidents occurred.

**General practice.** The types of medication incidents most commonly reported are described in Table 1. The factors contributing to these errors are summarised in Table 2.

**Pharmacies.** The most common types of dispensing errors reported by pharmacists are the selection of the incorrect strength, incorrect product or misinterpretation of a prescription. The major reason for selecting the incorrect strength or product has been described as the result of 'look alike' or 'sound alike' error.

The report<sup>4</sup> describes an Australian survey of 209 community pharmacists where the major factors cited for contributing to dispensing errors were cited as:

- high prescription volume;
- overwork;
- fatigue;
- interruptions to dispensing; and
- 'look alike, sound alike' drug names.

*Other factors that contribute to medication errors.* The review also described other possible factors that could contribute to medication error.<sup>4</sup>

**Inadequate continuity of care.** Medication histories upon admission or discharge from hospital are often incomplete. Studies reviewing discharge prescriptions for patients found that 15% of medications intended to be continued were

omitted at discharge, or that at least one medicine on average was omitted from the discharge prescription. At admission one study found that on average one medicine was not documented on the medication history for every two patients.

In one survey of 106 GPs regarding the type of information they received from hospital about their patients, no notification was provided to the GPs in over 50% of cases. Because of a change in patient medications by the hospital in 87% of cases, the patient's medicine at discharge was different from what the GP understood before admission in 72% of cases.

Finally, in a regional hospital in Queensland, of the referral medical records of 100 oncology patients, 72% had the potential for one or more errors in the patient's medication. The most common reasons for these errors were described as:

- insufficient documentation to allow dosages to be confirmed;
- handwritten or illegible medication orders; and
- lack of instruction about the length of time between cycles of chemotherapy.

**Multiple healthcare providers.** In one study of 204 people, 48% had medicines prescribed by more than one doctor and 28% had medicines dispensed by more than one pharmacist. The effect on medication error and adverse drug events has not been studied.

**Keeping unnecessary medications.** This involves keeping medications that are no longer in use or have passed their expiry date. In one small study where pharmacists made home visits to assist in medication management, 21% of people were keeping medicines that were no longer in use and 20% were keeping expired medications. The effect on medication error and adverse drug events has not been studied.

**Generic names/trade names.** One study found that 29% of consumers did not understand the difference between the generic and trade name of a medication. Again, the effect on medication error and adverse drug events has not been studied.

**Understanding the label.** In a single survey 84% 'older consumers' incorrectly interpreted the instruction to 'take one tablet every 6 h, 1 h before food'. The effect on medication error and adverse drug events has not been studied.

As medication errors can occur at all stages in the medication process, from prescription by physicians to delivery of medication to the patient by nurses, and in any site in the health system, it is essential that interventions be targeted at all aspects of medication delivery.<sup>4</sup>

Therefore, it is vital that healthcare providers be aware of the current evidence in relation to effective interventions for reducing the incidence of medication errors. This review attempts to summarise the best available evidence on these research interventions highlighting where possible, prevention in the aged care arena.

## Objectives

To present the best available evidence for strategies to prevent or reduce the incidence of medication errors associated with the prescribing, dispensing and administration of medicines in the older persons in the acute, subacute and residential care settings.

The specific review question to be addressed is: what strategies/interventions are most effective in reducing the incidence of medication incidents (errors) in the acute, subacute and residential care settings?

## Review method

An expert panel of 13 clinicians, nurses, pharmacists and other allied health professionals was established to guide the systematic review process by defining the criteria for study inclusion, identification of key search terms and relevant databases, and evaluating the clinical importance of the resulting evidence (Appendix 1).

## Criteria for considering studies for this review

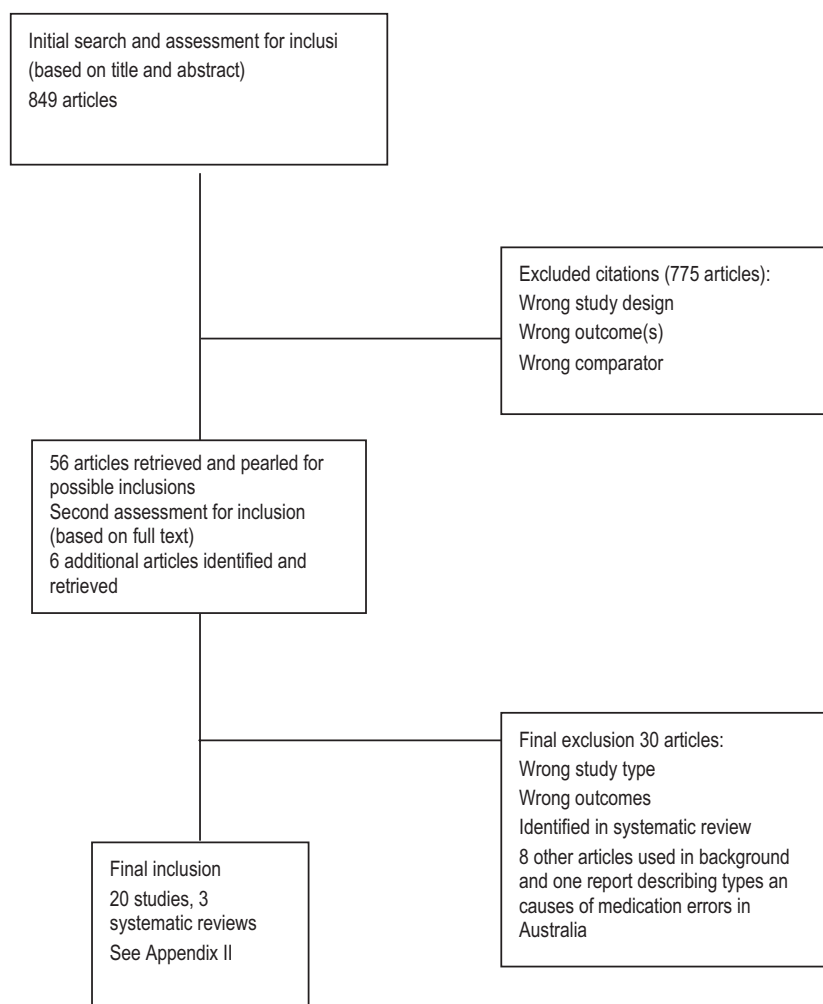
### *Types of studies*

This review considered any systematic reviews or randomised controlled trials (RCTs) that evaluate strategies to reduce or prevent medication incidents (Appendices II and III). However, in the absence of any RCTs, other research methods such as non-RCTs, longitudinal studies, cohort or case-control studies, or descriptive studies were used. Qualitative studies, grounded theory and ethnographic studies were included in a narrative summary. Only studies written in the English language were included in the review. For the purposes of the review, medication referred to medication that has been prescribed by a medical practitioner, not over-the-counter or herbal or vitamin preparations.

### *Types of participants*

Those people who are involved in the prescribing, dispensing or administering of medication to the older persons (aged 65 years and older) in the acute, subacute or residential care settings were included in the review, namely:

- registered nurses;
- enrolled nurses (or equivalent, e.g. licensed practical nurses);



**Figure 1** Schema of the stages of searching and inclusion/exclusion of references for the review.

- pharmacists;
- physicians/medical practitioners (or equivalents); and
- personal care attendants/ancillary staff (or equivalent).

In the absence of articles relating the older persons specifically to medication incidents (errors) in the acute, sub-acute or residential care settings, articles were reviewed that did not specify the age of the client/patient, using the same criteria as described previously.

#### *Types of intervention*

All studies reviewing strategies to prevent medication incidents (errors) in the acute, subacute and residential settings were considered.

#### *Types of outcomes*

The main outcome measure of interest to be considered was the number of medication errors or adverse drug events

**Table 3** PubMed search strategy management of medication errors in older adults

| Search category         | Search terms   |
|-------------------------|--|
| MeSH                    | Medication errors, aged, prescriptions, drug                               |
| Title or abstract terms | Medication errors, adverse event, aged, elderly, adults, drugs, medication |

after intervention (and before in studies without parallel control groups). In the absence of primary outcome measures, studies with surrogate measures such as test scores and number of distractions were also considered.

#### **Search strategy**

The search terms in Table 3 were identified for a PubMed search (Appendix IV). Similar terms and strategies were used for the different bibliographic databases, with the same text

words being used along with the relevant alternatives to MeSH (i.e. EmTree headings in EMBASE).

#### *Bibliographic databases*

- PubMed (NLM): 1986–February 2005
- Embase: 1986–February 2005
- CINAHL (SilverPlatter): 1986–February 2005
- Current Contents: 1993–February 2005
- Cochrane Library: 1986–February 2005
  - Cochrane Database of Systematic Reviews (CDSR)
  - Database of Abstracts of Reviews of Effectiveness (DARE)
  - The Cochrane Controlled Trials Register (CCTR)
  - The Health Technology Assessment Database (HTA)
  - NHS Economic Evaluation Database (NHS EED)
- Science Citation Index Expanded
- ProceedingsFirst: 1993–February 2005
- Social Science Index
- International Pharmaceuticals Abstracts

Health Technology Assessment (HTA) websites were also searched for relevant systematic reviews and studies (see Appendix V).

#### *Search phases*

The initial search was through the aforementioned electronic databases. Articles for inclusion were first assessed from titles and abstracts only. Articles identified as potential inclusions were collected and assessed for inclusion based on the full text. The reference lists of all studies determined to match the inclusion criteria for effectiveness or safety were then perused for any possible inclusions (Figure 1).

### **Methodological quality**

The evidence presented in the selected studies was assessed and classified using the dimensions of evidence defined by the National Health and Medical Research Council.<sup>7</sup>

These dimensions (Table 4) consider important aspects of the evidence supporting a particular intervention and

include three main domains: strength of the evidence, size of the effect and relevance of the evidence. The first domain is derived directly from the literature identified as informing a particular intervention. The last two require expert clinical input as part of their determination.

The three subdomains (level, quality and statistical precision) are collectively a measure of the strength of the evidence.

#### **Level of evidence**

Levels of evidence differ in terms of the hierarchy, depending on the type of research question being asked. Studies assessing the effectiveness of interventions were assessed using the National Health and Medical Research Council levels of evidence (Table 5).

#### **Quality of evidence**

The appraisal of systematic reviews was performed using a checklist developed by the National Health Service Centre for Reviews and Dissemination.<sup>8</sup> This is a generic checklist that allows for the appraisal of systematic reviews that incorporate study designs other than RCTs (Appendix VI). A 'quality score' will be approximated from this checklist by attaching a point to each criterion that is met by the systematic review.

The appraisal of intervention studies was undertaken using a checklist developed by the Joanna Briggs Institute for Evidence Based Nursing and Midwifery.

A checklist of the quality of observational studies developed by the Joanna Briggs Institute for Evidence Based Nursing and Midwifery was also used where appropriate (Appendix VI).

#### **Data collection and analysis**

Study design and quality were tabulated and relative risks, odds ratios, mean differences and associated 95% confidence intervals were calculated from individual comparative

**Table 4** Evidence dimensions

| Type of evidence         | Definition  |
|--------------------------|---|
| Strength of the evidence |   |
| Level                    | The study design used, as an indicator of the degree to which bias has been eliminated by design  |
| Quality                  | The methods used by investigators to minimise bias within a study design  |
| Statistical precision    | The <i>P</i> value or, alternatively, the precision of the estimate of the effect. It reflects the degree of certainty about the existence of a true effect |
| Size of effect           | The distance of the study estimate from the 'null' value and the inclusion of only clinically important effects in the confidence interval                  |
| Relevance of evidence    | The usefulness of the evidence in clinical practice, particularly the appropriateness of the outcome measures used  |

**Table 5** Designations of levels of evidence for assessing intervention studies

| Level of evidence | Study design   |
|-------------------|--|
| I                 | Evidence obtained from a systematic review of all relevant randomised controlled trials  |
| II                | Evidence obtained from at least one properly designed randomised controlled trial  |
| III-1             | Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other methods)  |
| III-2             | Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls and allocation not randomised, cohort studies, case-control studies or interrupted time series with a control group |
| III-3             | Evidence obtained from comparative studies with historical control, two or more single-arm studies, or interrupted time series without a parallel control group  |
| IV                | Evidence obtained from case series, either post-test or pre-test/post-test   |

Modified from National Health and Medical Research Council (2000).<sup>7</sup>

studies containing count data where possible. All other data were presented in a narrative summary.

### Size of effect and relevance of evidence

For intervention studies, rank scoring methods were used to determine the clinically important benefit of the effect size, as well as the clinical relevance of the outcome being assessed.<sup>7</sup> A clinically important benefit will be set as a 20% difference between the confidence limit closest to the measure of no effect and the no effect line (Appendix VI).

## Results

### Are interventions effective at reducing medication errors in older persons?

Are interventions that are designed to reduce medication errors during the ordering, transcribing, dispensing and administering of prescription drugs to patients 65 years and over effective?

Three systematic reviews,<sup>6,8-10</sup> one review<sup>4</sup> and 20 studies<sup>11-30</sup> were identified that attempted to answer this question. One systematic review provided very general information on the results of trials and therefore any studies not identified in the other reviews that addressed interventions to reduce medication errors were individually identified and assessed<sup>10</sup> and are included in the count of the number of studies in the beginning of the paragraph.

Before the discussion of the results of included studies, several points should be highlighted. First, the majority of studies did not direct interventions to patients in the older persons category ( $\geq 65$  years) but rather to patients within their unit or hospital in general. Because of the paucity of research specifically addressing the older persons, studies that involved general patients were included. Second, the

definition of a medication error varied and the severity of medication errors (i.e. life threatening vs. minor) was not always reported.

### Computerised systems

Analyses of medication errors have revealed that targeting error prevention strategies at procedures and not individuals is likely to be more effective.<sup>6</sup> The following discussion addresses the use of computer-based interventions at some phase of the prescribing to administration pathway to reduce medication errors.

*Computerised physician ordering entry and clinical decision support systems.* Systems such as computerised physician ordering entry (CPOE) and clinical decision support systems (CDSS) were designed to target stages of ordering, and administration and dispensing stages, respectively.

*CPOE is described as a computer-based system whereby the physician writes all orders online. Within this system the physician is provided with a menu of medications available from the formulary displayed with the default doses and a list of the potential range of doses. The system attempts to improve legibility, completeness and safety of orders.*

*CDSS provides computerised advice on drug doses, routes and frequencies. CDSS can also perform drug allergy and drug-drug interaction checks as well as prompt for corollary orders (such as glucose levels after insulin has been ordered).*

A systematic review of studies evaluating CPOE and CDSS in the reduction of adverse drug events and medication errors was identified.<sup>9</sup> Included study designs consisted of RCTs, non-RCTs and observational studies with controls. No patient group was specified. Definitions of medication errors and adverse drug events as defined in the systematic review are provided in the following box.

*Medication error:* errors in the process of ordering, prescribing, dispensing, administering or monitoring medications.

*Potential adverse drug events:* medication errors with significant potential to harm a patient that may or may not actually reach a patient.

Results were not combined in a meta-analysis but provided as narrative summaries and are summarised as follows.

**Medication errors and adverse events.** In two studies<sup>31,32</sup> significant reductions in non-intercepted serious medication errors (medication errors that either have the potential to or actually cause harm to a patient) of 55% and 86% were identified, with one study showing a 17% decrease in adverse drug events; however, this was not significant.

**Other outcomes.** The remaining studies evaluated more specific outcomes. A single study reported a significant improvement in the rate corollary orders using computerised reminders<sup>33</sup> whereas another demonstrated an improvement in five prescribing practices<sup>34</sup> and a third study identified a 13% and 24% decrease in inappropriate dose and frequency, respectively, of nephrotoxic drugs in patients with renal insufficiency.<sup>35</sup>

Three studies examined the effectiveness of computerised advice for antibiotic dosing on adverse drug events, rates of toxic drug levels or pathogen susceptibility.<sup>36–38</sup> In a prospective before and after trial, use of CDSS was associated with a 70% decrease in adverse drug events compared with control, whereas an RCT found a 17% greater pathogen susceptibility to the antibiotic drug regimen suggested by CDSS.

In two RCTs evaluating CDSS guidance of theophylline dosing, results between studies were contradictory.<sup>39,40</sup> In the larger of the two studies, the treatment group displayed significantly lower rates of theophylline toxicity than the control group. The smaller study found no such difference and is likely underpowered.

Finally, two studies examining CDSS guidance of anticoagulant dosing<sup>41,42</sup> found no significant differences in bleeding outcomes; however, given the small sample sizes, it is likely that these studies are underpowered.

In a recent controlled trial, the effect of CPOE on medication errors was evaluated in a university hospital setting.<sup>30</sup> After 8- and 11-month pre-intervention periods, two general medicine units were provided with a CPOE system for a further 7 and 4 months, respectively. During both pre- and post-intervention periods, the number of reported medication errors was recorded. Other hospital units that continued

to use handwritten physician orders were also monitored for medication errors and acted as control units.

*Medication error was defined as an error in the process of ordering, dispensing or administering a medication regardless of whether the potential for injury was present.*

Medication errors and potential errors were voluntarily reported on a form by nurses, pharmacists and physicians to the University's Centre for Medication Safety. Each error was investigated and the severity of the error was rated by medication safety team member on a scale from 0 to 6 (no actual incident occurred; potential error to incident resulted in death).

Results showed that individually, the units receiving CPOE systems showed no significant change in the number of reported medication errors before and after the implementation of CPOE (Table 6). Pooled results of both units showed an increase in the number of reported errors per discharge. During the same period, control units displayed a reduction in reported errors per discharge. Examination of the stage at which errors occurred showed an increase in reported error rates involving entry into the pharmacy computer system (pharmacy order processing category) on units using CPOE, but at no other stage.

Anecdotal evidence suggests that implementation of the CPOE system in two US hospitals has reduced medication errors by 37% and more than 50% since inception.<sup>43</sup>

**Automated dispensing.** A systematic review identified five studies that examined the effectiveness of automated dispensing systems on reducing medication error rates.<sup>6</sup> This review concluded that the available evidence was generally poor and did not support the suggestion that automated dispensing systems improved outcomes.

Not included in the Shojania review was a single study that evaluated an automated point-of-use dose system (Medstation Rx) in a 26-bed adult general medicine unit.<sup>28</sup>

The system involves the location of controlled and secure medicine storage units at nursing stations with patient medication profiles downloaded in the Pharmacy and transferred to the appropriate nursing unit.

To dispense the desired medication the nurse selects the patient of interest using the computer.

Nurse selects desired medication and the storage unit releases the specific drawer and pocket containing the medication.

Drug inventory required in each storage unit determined through historical usage data.

Measurement of the incidence of dispensing error was determined by comparing the technician error rate for filling



**Table 6** Effect of computerised physician ordering entry (CPOE) on the number of medication errors

| Study                                      | Level of evidence               | Quality  | Population             | Measure                            | Results |       |          |
|--|---------------------------------|--|------------------------|------------------------------------|---------|-------|----------|
|  |                                 |  |                        |                                    | Before  | After | <i>P</i> |
| Spencer <i>et al.</i> , 2005 <sup>30</sup> | III-3<br>Before and after study | QS 7/11<br>Clinical importance not estimable<br><i>R</i> not estimable | General medicine units | <i>Unit monitored</i>              |         |       |          |
|  |                                 |  |                        | Unit 1 with CPOE                   | 0.079   | 0.092 | NS       |
|  |                                 |  |                        | Unit 2 with CPOE                   | 0.06    | 0.083 | NS       |
|  |                                 |  |                        | Pooled CPOE                        | 0.068   | 0.088 | 0.011    |
|  |                                 |  |                        | Control units                      | 0.133   | 0.079 | <0.001   |
|  |                                 |  |                        | <i>Point of error</i> <sup>†</sup> |         |       |          |
|  |                                 |  |                        | Prescribing                        | 0.014   | 0.008 | NS       |
|  |                                 |  |                        | Unit order processing              | 0.014   | 0.018 | NS       |
|  |                                 |  |                        | Pharmacy order processing          | 0.027   | 0.053 | <0.01    |
|  |                                 |  |                        | Dispensing                         | 0.003   | 0.001 | NS       |
|  |                                 |  |                        | Delivery                           | 0.005   | 0.002 | NS       |
| Administration                             | 0.019                           | 0.025  | NS                     |                                    |         |       |          |
| Clinical monitoring                        | 0.001                           | 0.001  | NS                     |                                    |         |       |          |

<sup>†</sup>CPOE units only.

NS, not significant; *P*, probability; QS, quality score; *R*, relevance.

**Table 7** Effectiveness of an automated point-of-use dose system

| Study                                  | Level of evidence               | Quality  | Population                        | Outcomes                          | Results  |
|--|---------------------------------|--|-----------------------------------|-----------------------------------|--|
|  |                                 |  |                                   |                                   | % of doses dispensed   |
| Ray <i>et al.</i> , 1995 <sup>28</sup> | III-3<br>Before and after study | QS 6/11<br>Clinical importance 2/4<br><i>R</i> 3/5 | Patients on a 26-bed medical unit | Technician error rate for filling | 0.89% before implementation<br>0.61% after implementation<br><i>P</i> = 0.04<br>Relative difference (95% CI):<br>28.7% (3.6–53.8%) |

CI, confidence interval; *P*, probability; QS, quality score; *R*, relevance.

**Table 8** Effectiveness of a bedside terminal system (BTS)

| Study                                    | Level of evidence               | Quality  | Population                         | Outcomes   | Results                                   |
|--|---------------------------------|--|------------------------------------|--|---|
| Brown <i>et al.</i> , 1995 <sup>14</sup> | III-3<br>Before and after study | QS 7/11<br>Clinical importance not estimable<br><i>R</i> not estimable | Patients on a 35-bed surgical unit | Medical error rate <sup>†</sup> (40-h observation) | 0.7/1000 before BTS<br>0.7/1000 after BTS |

<sup>†</sup>Total number of medical errors/1000 doses dispensed.

QS, quality score; *R*, relevance.

storage units 6 weeks before and 6 weeks after the introduction of the Medstation Rx system.

Results are described in Table 7. The use of an automated point-of-use dose system significantly reduced the rate of error in filling of dosage carts by technicians.

**Bedside terminal system.** One study examined the effectiveness of a portable bedside terminal documentation system on nursing practice and medication error rate.<sup>14</sup> A medication error was defined as a variation from standard practice and was to be recorded on an incidence report.

Bedside terminal systems involve the use of touch screen handheld portable terminals to enter and access data on individual patients. These portable computers communicate via radio frequency to a terminal server located on the unit.

Results are summarised in Table 8. The use of a bedside terminal system had no effect on the reported medication error rate.

In a 6-month study in three US hospitals in which full-function clinical information systems were moved from nurs-

ing stations to the patient bedside, the authors claim a reduction in medication errors of 34%.<sup>15</sup>

Computer-generated medication administration records. One before and after study (Level III-3) in a 584-bed hospital converted their handwritten 14-day medical administration records (MAR) to a 24-h computer-generated MAR in an attempt to increase the accuracy of medication administration, avoid discrepancies between the pharmacy and the nursing staff and providing neat, legible documentation.<sup>11</sup>

The MAR is initially generated by order entry in the pharmacy. The computer-generated MAR is then reconciled by the 11 PM to 7 AM shift nurses. If a discrepancy exists, a variance report is filled out and any corrections are made by the pharmacy.

*The definition of a medication error was not defined in this report.*

The authors claim that a decrease in medication errors of 18% was obtained after the first year of the new protocol.

**Computer alert system.** Five studies were identified in a systematic review that examined the use of computer alerts to prevent adverse drug events.<sup>6</sup> However, the evidence for the effectiveness of such systems is weak. Only one study demonstrated significant decreases in adverse drug events using the alert system in a before and after study. One other study found no significant benefit of an alert system on the incidence of adverse drug events and three others only saw improvements in the response times to obtaining laboratory values. A final study demonstrated a significant change in physician behaviour and their modification of patient therapy based on the alerts and subsequent recommended actions.

One other uncontrolled trial evaluated the incorporation of 37 adverse drug event alerts into the existing computerised hospital information system of a 650-bed teaching hospital.<sup>27</sup>

*An example of an adverse drug event alert was the following:*

#### Primary prevention alert

##### Cardiac

Arrhythmia-digoxin – patient receiving digoxin and has a serum potassium level <3.2 mmol/L, a serum magnesium level <0.75 mmol/L or a digoxin level >2.5 nmol/L. Recommendation: electrolyte replacement or digoxin dose reduction.

Based on the patient information entered into the system, a prescription could generate an adverse drug event alert that is printed out and evaluated within the pharmacy. If necessary, the alert is discussed with the appropriate nurse regarding the patient's clinical condition. The pharmacist may contact the attending physician when the recommendations made by the alert seem appropriate.

The study collected data on consecutive alerts for 6 months after inception of the program. A total of 9306 non-obstetrical patients flowed through the system with 1116 alerts recorded. Of these, 596 alerts (53%) were deemed to be true positives requiring action. In 44% of these true positives (265/596), the physician stated they were unaware that a potentially dangerous clinical situation existed.

**Bar codes.** A systematic review found one observational study in which a hospital used hand-held scanners to identify the patient, nurse and the medication being administered.<sup>6</sup> The study found that the medication error rate in the hospital decreased from 0.17% before the system was instituted to 0.05% after (*P* value not reported). Although this result was encouraging, the use of the bar coding device was 'easily and frequently circumvented', bringing into question the real contribution of the device to the overall error rate decrease.

In a recent ethnographic study nurse, physician and pharmacist interaction with a newly instituted computerised system of bar code medication administration (BCMA) was observed in three veterans hospitals in the USA.<sup>26</sup> The aim of incorporating this technology was to reduce the incidence of adverse drug events.

One observer, trained in ethnographic field observations, conducted all observations before and after the implementation of BCMA. Observations occurred during all parts of day, evening and night shifts for a duration of between 1 and 7 h.

BCMA involved the incorporation of software installed on a laptop permanently attached to the wheeled medication chart.

Physicians were observed performing computerised order entry followed by verification by the inpatient pharmacists.

Nurses scanned bar coded wristbands on individual patients and 'DUE' medications would be indicated for that patient. The medication bar code was then scanned and if it matched the displayed information then the system recorded the medication as given and recorded the time. If there was any discrepancy, a pop-up alert was displayed.

Five negative themes (side-effects) were identified in this study:

- 1 nurse confusion over automated removal of medications by the BCMA;
- 2 degraded coordination between the nursing staff and the physicians;
- 3 nurses dropped activities to reduce workload during busy periods;
- 4 increased prioritisation of monitored activities during busy periods; and
- 5 decreased ability to deviate from routine sequences.

It was suggested that these observed side-effects might 'create new paths to adverse drug events'.

Therefore, the study authors recommended that the software undergo design revisions and the hospitals institute best practice training.

General conclusions: computerised systems

Some evidence suggests that:

CPOE combined with CDSS may be effective in reducing medication errors in a general hospital population.

Lower-level evidence for the effectiveness of:

Computer-generated MAR.

Computer adverse drug event detection and alerts.

No evidence to suggest that:

Automated dosing systems reduce medication error incidence.

Only reduce errors in filling of drawers by technicians.

The use of bedside terminal systems reduces medication error incidence.

Bar coding patients or medications reduce medication error incidence.

General conclusions: individual patient medication supply  
Individual medication supply systems have been shown to reduce medication error rates compared with other dispensing systems such as ward stock approaches.

#### Education and training

One study examined the effect of a compulsory medication examination on the rate of medication error in a 376-bed community medical centre.<sup>24</sup>

Unit dosages for each patient prepared in the pharmacy and administered by registered nurses only.

During Phase I nurses were required to pass an annual written medication examination consisting of 22 multiple-choice and 12 matching questions and 5 dosage calculation questions.

Phase II was instituted after policy was changed to eliminate the annual examination as a requirement.

The study followed the number of reported medication errors over a 6-month period for each phase.

#### Individual patient medication supply

Individual patient medication supply refers to the practice of dispensing medications in a package that is ready to administer to the patient. One systematic review<sup>6</sup> and two Australian studies<sup>44,45</sup> were identified.

In the Australian studies,<sup>44,45</sup> the use of individual patient supply was found to significantly reduce the medication error rate compared with a ward stock system of medication supply with studies showing a decrease in the medication error rate from 15.4% (76/494) to 4.8% (24/502)<sup>45</sup> or missed medications from 5.7% (223/3931 doses) to 4.1% (136/3287 doses), respectively.<sup>44</sup>

In the systematic review,<sup>6</sup> results suggested that there is a positive impact of error reduction using an individual patient supply system. Five studies met the review inclusion criteria (four cross-sectional studies and one before and after study). The majority of these studies reported reductions in medication errors using this system compared with alternative dispensing methods such as the ward stock approach, primarily in errors of omission and commission (erring in a task).

A medication error was defined as administering:

- the wrong medication;
- an extra dose;
- a medication to the wrong patient;
- a medication via the wrong route;
- a medication >30 min before or after the scheduled time;
- a medication from an expired order;
- an intravenous fluid at the wrong rate by >10%;
- or by omitting a medication.

Results showed no difference in the incidence of medication errors between the two time periods (Table 9).

One RCT evaluated the effectiveness of a 3-h educational intervention compared with control (no education) on the ability of nurses to calculate appropriate drug dosages.<sup>12</sup> Errors in calculating medication dosages and flow rates were assumed to be a surrogate outcome for medication errors.

Sixty-seven registered nurses were randomised into one of four groups (three intervention, one control). Before intervention, all participants completed a medication calculation test.

Medication calculation test included:

**Table 9** Effectiveness of medication examination

| Study  | Level of evidence               | Quality   | Population                        | Outcomes   | Results   |
|--|---------------------------------|---|-----------------------------------|--|---|
| Ludwig Beymer <i>et al.</i> , 1990 <sup>24</sup> | III-3<br>Before and after study | QS 5/11<br>Clinical importance not estimable<br>R not estimable | Community medical centre patients | Incidence of medication errors over a period of 6 months | With testing: 142 errors/6 months<br>Without testing: 137 errors/6 months |

QS, quality score; R, relevance.

- 10 items on calculating oral dosages
- 4 items on intramuscular and subcutaneous dosages
- 6 items involving calculation of intravenous medication dosages and flow rates

Intervention groups then underwent 3-h training via one of:

- 1 self-study workbook
- 2 computer-assisted instruction
- 3 group classroom instruction

Nurses re-tested 4–5 months after intervention.

Results showed an increase in post-test scores for all groups (Table 10). However, analysis of covariance revealed no significant difference in post-test medication calculation test scores between any of the experimental groups and controls (not shown).

General conclusions: education and training

There is no evidence to suggest that education addressing medication calculation, or a yearly medication examination is effective in reducing medication errors.

### Pharmacists

A systematic review summarised the results of one systematic review and one RCT evaluating the role of clinical pharmacists in preventing adverse drug events in outpatients, and one systematic review and three other studies of hospitalised patients.<sup>6</sup> In the inpatient setting, this review identified one prospective before and after study that demonstrated a statistically significant 66% decrease in preventable adverse drug events caused by medication ordering. In a retrospective before and after study, the use of a clinical pharmacist to check on new orders entering the pharmacy resulted in a 40–50% overall reduction in medication errors. In a meta-analysis of primarily controlled observational studies and non-randomised trials, the use of a pharmacist to follow up with patients resulted in patients being more likely to have a therapeutic peak and trough and less likely to have a toxic peak and trough. In the outpatient setting, a system-

atic review of over 16 000 outpatients determined that the use of a pharmacist for consultation, patient education and follow-up resulted in improvements in outcomes for patients with hypertension, hypercholesterolaemia, chronic heart failure and diabetes. Other outpatient studies determined that the use of pharmacist at discharge of geriatric patients resulted in significantly fewer medication errors. Finally, in an RCT of 181 patients with heart failure, patients in the intervention group received clinical pharmacist evaluation, which included medication evaluation, therapeutic recommendations to the attending physician, patient education and follow-up telemonitoring. The control group received usual care. This study found all-cause mortality and heart failure events were significantly lower in the intervention group compared with the control group (4 vs. 16;  $P = 0.005$ ).

The involvement of a pharmacist at the point of prescription (ordering) of a drug by the physician was evaluated by three further studies.<sup>17,22,46</sup> In two studies the pharmacist either made rounds with the medical team to provide immediate consultation<sup>22</sup> or made rounds to each designated unit every half hour to check on the accuracy of orders and to provide consultation to the medical staff.<sup>46</sup> The results of these studies are summarised in Table 11.

Both studies displayed a decrease in the number of medication errors per 1000 patient days with the improved availability of a pharmacist for consultation. When the number of errors per number of patients in each study group was examined, the use of a pharmacist with the rounding team showed significant improvement compared with the rounding team only.<sup>22</sup>

In a single study the process of reactive pharmacy intervention was evaluated in a single-arm study.<sup>17</sup> The objective was, within the pharmacy, to identify prescriptions that may have defects to prevent a possible impact on the patient (i.e. an adverse event).

**Table 10** Effectiveness of 3-h education interventions

| Study                                 | Level of evidence | Quality   | Population             | Outcomes                           | Results   |      |            |      |
|---------------------------------------|-------------------|---|------------------------|------------------------------------|-----------|------|------------|------|
|                                       |                   |   |                        |                                    | Pre-score |      | Post-score |      |
|                                       |                   |   |                        |                                    | Mean      | SD   | Mean       | SD   |
| Bayne and Bindler, 1997 <sup>12</sup> | II                | QS 7/11<br>Clinical importance 3/4<br>R not estimable | 67 registered nurses   | Medication test calculation scores |           |      |            |      |
|                                       |                   |   |                        | Control ( $n = 18$ )               | 74.7      | 15.6 | 81.1       | 13.0 |
|                                       |                   |   |                        | Workbook ( $n = 18$ )              | 80.0      | 15.2 | 78.3       | 16.7 |
|                                       |                   |   |                        | CAI ( $n = 14$ )                   | 78.2      | 9.7  | 82.1       | 11.9 |
|                                       |                   |   | Classroom ( $n = 17$ ) | 70.3                               | 17.5      | 78.8 | 17.1       |      |

CAI, computer-assisted instruction; QS, quality score; R, relevance; SD, standard deviation.

## Prescription considered by pharmacists

If prescription considered defective, the pharmacist recorded the following:

- relevant drug details
- summary and categorisation of the problem
- coding of outcomes
- total time taken to initiate a response and resolve the problem
- grade of the prescribing doctor

The potential for medical harm graded separately by a single physician.

The study found that approximately 3% of prescriptions written over the period of 28 days were flagged as faulty (Table 12). A high proportion of interventions were considered justified (83%) during review, with 75% of interventions resulting in altered prescriptions.

## General conclusions: pharmacists

There is some evidence to suggest a role for clinical pharmacists in preventing adverse drug events in the inpatient setting.

**Table 11** Effect of pharmacist intervention on a number of medication errors

| Study  | Level of evidence               | Quality   | Population  | Outcomes  | Results  | OR (95% CI)  |
|--|---------------------------------|---|---|---|--|--|
| Kucukarslan <i>et al.</i> , 2003 <sup>22</sup> | III-2<br>Control study          | QS 8/11<br>Clinical importance<br><br>1/4<br>R 2/5              | <i>Experimental group:</i><br>86 patients from general medical unit<br><br>Mean age:<br>54 ± 19 years.<br><i>Control:</i> 79 patients from general medical unit<br>Mean age:<br>56 ± 20 years | Preventable ADE <sup>†</sup>                          | Rounding team plus pharmacist<br><br><i>No. of errors/1000 patient days</i><br>5.7<br><i>No. of errors per population of study group (%)</i><br>2/86 (2.5) | Rounding team only<br><br>26.5<br>9/79 (10)<br>0.19 (0.02, 0.94) |
| Shah <i>et al.</i> , 1994 <sup>46</sup>        | III-3<br>Before and after study | QS 6/11<br>Clinical importance not estimable<br>R not estimable | 303-bed acute care facility   | Reported medication incidents (per 1000 patient days) | Year before intervention<br>3.03   | Year after intervention<br>1.12<br>NA                            |

<sup>†</sup>Preventable adverse drug event (ADE) defined as undesired reaction to medication that may have been prevented by appropriate drug selection or management. CI, confidence interval; NA, not applicable; OR, odds ratio; QS, quality score; R, relevance.

**Table 12** Effect of reactive pharmacy intervention on improvement in prescription quality

| Study                                     | Level of evidence                    | Quality | Population   | Outcomes  | Results   |
|---|--------------------------------------|---------|--|---|---|
| Hawkey <i>et al.</i> , 1990 <sup>17</sup> | IV<br>Prospective uncontrolled study | NA      | All inpatients and outpatients in acute care, mental illness, or elderly | Interventions in prescribing process over a 28-day period, alterations to prescription, quality of the prescription | Intervention in 769 (2.9%) of all prescriptions over 28 days. 639 (83%) cases warranted intervention. 575 (75%) of intervention resulted in altered prescriptions most notably because of: <ul style="list-style-type: none"> <li>• 280 wrong dosage</li> <li>• 50 dosage not stated</li> <li>• 48 over prolonged prescription.</li> </ul> In 246 interventions (32%), alteration resulted in an appreciable improvement in the quality of the prescription |

NA, not applicable.

**Table 13** Effectiveness of dedicated medication nurses

| Study  | Level of evidence | Quality                           | Population  | Outcomes                                   | Results           |                 | P     |
|--|-------------------|-----------------------------------|---|--|-------------------|-----------------|-------|
|  |                   |                                   |   |  | Medication nurses | General nurses  |       |
| Greengold <i>et al.</i> , 2003 <sup>16</sup> | II<br>RCT         | QS 8/11                           | 16 nurses ≥1 year of acute care nursing. Inpatients in 4 units each of 1 academic community hospital and 1 university teaching hospital | Total error rates <sup>†</sup>             | 912/5792 (15.7)   | 545/3661 (14.9) | <0.84 |
|  |                   | Clinical importance not estimable |   | Medication error rates <sup>‡</sup>        | 651/5792 (11.2)   | 253/3661 (6.9)  | <0.15 |
|  |                   | R 2/5                             |   | Process variation error rates <sup>§</sup> | 281/5792 (4.9)    | 306/3661 (8.4)  | <0.06 |

<sup>†</sup>Total error rates = medication error rates + process variation error rates.

<sup>‡</sup>Medication error = wrong drug, dose, route, form, rate, dose preparation, administration technique or omission of drug.

<sup>§</sup>Process variation error = not checking patient wristband, borrowing medication, dosing from unlabelled dispenser (e.g. unlabelled syringe).

P, probability; QS, quality score; R, relevance; RCT, randomised controlled trial.

### Nursing care models

**Dedicated nurses.** Three studies examined the effectiveness of using dedicated nurses to dispense medication to patients.<sup>14,16,25</sup>

In one RCT, 16 nurses from four nursing units of two hospitals were designated to be either medication nurses, administering medications to assigned patients, or general nurses providing care in the 'usual manner'.<sup>16</sup>

Medication nurses participated in a medication safety program (1 day, 8 h).

Nurses were observed during medication administration 5 days a week (medication nurses for 2 days) for a period of 12 weeks.

The results of the study are presented in Table 13. This study suggests that the use of dedicated medication nurses does not reduce the incidence of total, medication and process-variation error rates.

In a pilot project of before and after design (Level III-3) involving four units in a 950-bed hospital, licensed practical nurses were used as designated medication nurses.<sup>13</sup>

Licensed practical nurses used as designated medication nurses from Monday to Friday on the day and evening shifts.

Regular nursing staff provided medications on night shifts and weekends.

The number of reported medication errors was evaluated before trial and 3 months after inception.

The authors report that at the end of the trial the number of reported medication errors was reduced to less than 50%

of pre-trial levels in three of the units whereas a fourth showed a 300% increase (4 reports to 12). The cause of this apparent aberration was explained as low reporting pre-trial and high staff turnover on this unit.

In a recent study, distractions during medication administration were used as a surrogate measure for the potential for medication errors.<sup>25</sup> The study of registered nurses in a medical surgical unit during medication administration 'cycles' evaluated the use of two different interventions compared with customary medication administration procedures to reduce the number of distractions.

Medication administration cycle: encompasses commencement of administration of all assigned patient medications through to completion of documentation of all administered medications.

**Control:** 8 cycles where nurses used customary medication administration procedures (i.e. no designated nurse to deliver medications).

**Focused protocol:** 8 cycles where a 'special nurse' designated and staff asked not to interrupt or distract unless the interruption is related to medications being administered.

**Medsafe protocol:** 8 cycles. Nurse required to wear a special vest that identified nurse as performing medication administration cycle and 'Do Not Disturb'. Staff asked to intercept all phone calls or other distractions during the cycle.

Distractions were measured using a medication administration distraction observation sheet that was validated for this study. The number of distractions per cycle was measured.

Results of this study suggest that the use of a designated nurse for medication administration can lead to a reduction in the number of distractions that a nurse may encounter during a medication administration cycle (Table 14).

**Table 14** Effect of designated nurses on the number of distractions during medication cycles

| Study                    | Level of evidence      | Quality   | Population        | Study group      | Number of distraction during cycle |      |   |                 |
|--------------------------|------------------------|---|-------------------|------------------|------------------------------------|------|---|-----------------|
|                          |                        |   |                   |                  | Mean (of 8 cycles)                 | SD   | Mean difference (95% CI)  | P               |
| Pape, 2003 <sup>25</sup> | III-2<br>Control study | QS 7/11<br>Clinical importance not estimable<br>R 2/5 | Registered nurses | Control          | 60.5                               | 12.9 |   |                 |
|                          |                        |   |                   | Focused protocol | 22.5                               | 8.5  | 38 (26.3, 49.7) <sup>†</sup>                                    | <0.001          |
|                          |                        |   |                   | Medsafe protocol | 8.0                                | 4.5  | 52.5 (42.1, 62.9) <sup>†</sup><br>14.5 (7.2, 21.8) <sup>‡</sup> | <0.001<br>0.001 |

<sup>†</sup>Result compared with control.

<sup>‡</sup>Result comparing Medsafe protocol with focused protocol.

CI, confidence interval; P, probability; QS, quality score; R, relevance; SD, standard deviation.

**Table 15** Effect of one or two nurses for medication administration

| Study                                    | Level of evidence                    | Quality                                     | Population         | Outcomes             | Results   |            | OR (95% CI)    |
|--|--------------------------------------|---|--------------------|----------------------|-----------|------------|----------------|
|  |                                      |   |                    |                      | 2 nurses  | 1 nurse    |                |
| Kruse <i>et al.</i> , 1992 <sup>21</sup> | III-1<br>Cross-over controlled trial | QS 8/11<br>Clinical importance 2/5<br>R 2/5 | Geriatric patients | Errors/opportunities | 92/43 428 | 120/40 275 | 0.7 (0.5, 0.9) |

CI, confidence interval; OR, odds ratio; QS, quality score; R, relevance.

#### General conclusions: dedicated nurses

There is no evidence to suggest that providing designated nurses to dispense medication significantly reduces the incidence of medication errors.

Use of the focused or Medsafe protocols in which nurses are identified as 'not to be disturbed' can reduce distractions to nurses during medication administration.

*Checking (single vs. double).* Two Australian studies evaluated the effectiveness of single versus double checking of medication by nurses for the reduction of medication errors.<sup>20,21</sup>

In a single cross-over controlled trial in three wards of a geriatric assessment and rehabilitation unit, the effectiveness of two nurses versus one for reducing medication errors was evaluated.<sup>21</sup>

Ward A selected for two-nurse medication administration for 23 weeks.

Ward B selected for one-nurse medication administration for 23 weeks.

Cross-over and:

Ward A selected for one-nurse medication administration for 23 weeks.

Ward B selected for two-nurse medication administration for 23 weeks.

Ward C selected for two-nurse medication administration for whole period of study (control).

*A medication error was defined as administering:*

- a medication to the wrong patient;
- the wrong medication;
- an extra dose;
- a medication to patient with a known allergy to that medication;
- a medication from an expired order;
- or by omitting a medication;
- or the medication chart not signed.

The results are summarised in Table 15. The point estimate illustrates that the use of two nurses to administer medications results in 30% lower odds of a medication error being made compared with using one nurse.

In a lower-quality study (Level of evidence III-3), the impact on nursing practice and the number of reported medication errors were evaluated when standard practice of double checking of medications before administration was replaced with a single-checking protocol.<sup>20</sup>

*Medication errors were identified by those reported on the medication incident records over a period of 7 months for each arm of the study (i.e. double and single checking).*

Only five reported medication incidents were identified over the 7-month period of standard practice (double checking) compared with four reported incidents during 7 months of the single-checking protocol. This difference was not significant and was suggestive that single checking was as safe as double checking in this institution.

**General conclusions: nurse double checking**

There is some evidence to suggest that having two nurses check medication orders before dispensing medication significantly reduces the incidence of medication errors.

*Partners in patient care.* This nursing practice model aims to extend nurse time by introducing the use of nursing partners. A single study that met inclusion criteria has examined the 'partner in patient care' (PIPC) model on nursing units of a Florida hospital.<sup>19</sup> A description of the model is provided in a previous paper.<sup>23</sup>

The PIPC nursing practice model involves five major components:

- 1 Participation in decision-making by staff (staff involved in the design of the practice model).
- 2 Use of a multiskilled technician in partnership with the nurse as a patient care extender (nurse extender).
- 3 Education provided on the change process (three formal classes).
- 4 Education on proper delegation of tasks to the nurse extender (one class).
- 5 Bedside computers installed as a point of care system (in each care room and at the central nursing station)

Pilot and control nursing units in a single hospital were randomly selected:

*Control* units used a total patient care nursing model.  
*Pilot* units implemented the new PIPC model.  
 Medication errors were derived from official incident reports.  
 Data were sampled at three time points, before the intervention, 6 months into the implementation and at 1 year after implementation.

*A medication error was determined by a single researcher as any incident that deviated from standard procedure and was clearly the responsibility of nursing.*

Medication error rates ranged from 1/1000 to 4/1000 patient days; however, the comparison data from each study group (control and pilot) were not provided. The study found a significant difference in the medication error ratio (errors/patient day,  $P = 0.008$ ).

**General conclusions: PIPC**

There is limited evidence to suggest that introducing the PIPC model significantly reduces the incidence of medication errors.

*Medication Administration Review and Safety.* A before and after study examined the effect of developing an interdisciplinary Medication Administration Review and Safety (MARS) committee to reduce the number of medication

administration documentation errors reported in a general hospital.<sup>29</sup>

*Control* period before implementation involved present practice. The hospital utilised a clinical information computer system alongside an automated medication administration system.

MARS involved the introduction of an interdisciplinary committee of staff nurses, nurse managers, pharmacists, information systems analysts, a risk manager and a nursing educator. This committee reviewed all reported errors and then attempted to identify potential causes of the errors. If necessary, medication administration policies were revised. This information was then shared with staff through a publication called a 'Hot Spots' brief.

A concurrent chart review analysed medication administration documentation. Ten patients from each of every nursing unit were audited for 7 days.

*A medication error was defined as mistake made during the transcription, preparation, dispensation or distribution phases of drug administration. Specifically, physician orders were reviewed for accuracy of transcription and timeliness of implementation. Documented medications were reviewed for accuracy of right patient, medication, dose, route and time. Timely administration of Stat, prn (as needed) and routine medications was also evaluated.*

Before the introduction of the MARS committee, medication administration documentation errors were reported a frequency of 0.193 per patient day. One year after introduction of the MARS committee, the rate of errors had dropped 36.3% to 0.123 per patient day.

**General conclusions: MARS**

There is limited evidence to suggest that introducing MARS committee can significantly reduce the incidence of medication administration documentation errors.

*Process change.* One before and after study looked at the effect a process change and education would have on the ability of nurses to deliver insulin doses within a 60-min time frame from point of blood glucose testing.<sup>18</sup> Before implementation, the procedure for ordering and administering insulin was not clearly defined or consistently followed. Three nursing units were evaluated (a cardiac, thoracic and neurosurgical ward, an orthopaedic ward and a cardiac progressive ward), for a period of 1 month before intervention and 6 months after implementation of the changes.

*Control:* standard practice. This involved a physician filling out a pre-printed insulin order form. A computerised MAR was generated by the pharmacist each evening to be used to record the times of administration of insulin to each patient the following



**Table 16** Number of cases receiving insulin within 1 h of blood glucose testing

| Study                       | Level of evidence               | Quality                                     | Population        | Unit   | Insulin delivered $\leq 60$ min (%) |                | OR (95% CI)    |
|-----------------------------|---------------------------------|---|-------------------|--------|-------------------------------------|----------------|----------------|
|                             |                                 |   |                   |        | Control                             | Treatment      |                |
| Heatlie, 2003 <sup>18</sup> | III-3<br>Before and after study | QS 6/11<br>Clinical importance 1/4<br>R 2/5 | Nurses on 3 units | 1      | 86/176 (48.9)                       | 132/185 (71.4) | 2.6 (1.7, 4.0) |
|                             |                                 |   |                   | 2      | 142/190 (74.7)                      | 163/192 (84.9) | 1.9 (1.1, 3.2) |
|                             |                                 |   |                   | 3      | 113/131 (86.3)                      | 110/120 (91.7) | 1.8 (0.8, 4.0) |
|                             |                                 |   |                   | Pooled | 361/497 (72.6)                      | 405/497 (81.5) | 2.2 (1.6, 3.0) |

CI, confidence interval; OR, odds ratio; QS, quality score; R, relevance; Unit 1, cardiac progressive; Unit 2, cardiac, thoracic and neurosurgical; Unit 3, orthopaedic.

**Table 17** Time interval between blood glucose determination and insulin administration (min)

| Study                       | Level of evidence      | Quality                                     | Population        | Unit | Time from blood glucose test to insulin delivery (min) |               |                  |               | P               |             |
|-----------------------------|------------------------|---|-------------------|------|--|---------------|------------------|---------------|-----------------|-------------|
|                             |                        |   |                   |      | Control  |               | Treatment        |               |                 |             |
|                             |                        |   |                   |      | n  | Mean $\pm$ SD | n                | Mean $\pm$ SD |                 |             |
| Heatlie, 2003 <sup>18</sup> | III-2<br>Control study | QS 7/11<br>Clinical importance 1/4<br>R 2/5 | Nurses on 3 units | 1    | Breakfast  | 26            | 125.5 $\pm$ 49.5 | 41            | 46.1 $\pm$ 23.0 | <b>0.00</b> |
|                             |                        |   |                   |      | Lunch  | 50            | 53.4 $\pm$ 28.4  | 50            | 56.9 $\pm$ 34.0 | 0.58        |
|                             |                        |   |                   |      | Dinner   | 50            | 70.0 $\pm$ 46.8  | 50            | 50.0 $\pm$ 31.9 | <b>0.01</b> |
|                             |                        |   |                   |      | Bedtime  | 50            | 60.7 $\pm$ 41.6  | 44            | 38.1 $\pm$ 32.6 | <b>0.01</b> |
|                             |                        |   |                   | 2    | Breakfast  | 40            | 52.4 $\pm$ 24.8  | 47            | 38.1 $\pm$ 20.8 | <b>0.01</b> |
|                             |                        |   |                   |      | Lunch  | 50            | 57.1 $\pm$ 29.0  | 50            | 46.7 $\pm$ 36.1 | 0.12        |
|                             |                        |   |                   |      | Dinner   | 50            | 55.6 $\pm$ 28.2  | 49            | 57.4 $\pm$ 37.7 | 0.79        |
|                             |                        |   |                   |      | Bedtime  | 50            | 37.2 $\pm$ 31.7  | 49            | 31.7 $\pm$ 23.8 | 0.33        |
|                             |                        |   |                   | 3    | Breakfast  | 24            | 56.4 $\pm$ 43.4  | 30            | 43.2 $\pm$ 37.8 | 0.24        |
|                             |                        |   |                   |      | Lunch  | 32            | 38.8 $\pm$ 21.5  | 30            | 27.1 $\pm$ 22.4 | <b>0.04</b> |
|                             |                        |   |                   |      | Dinner   | 49            | 45.1 $\pm$ 31.5  | 31            | 39.8 $\pm$ 25.8 | 0.44        |
|                             |                        |   |                   |      | Bedtime  | 26            | 30.6 $\pm$ 35.9  | 30            | 22.6 $\pm$ 33.7 | 0.39        |

P, probability (bold indicates significance); QS, quality score; R, relevance; SD, standard deviation; Unit 1, cardiac progressive; Unit 2, cardiac, thoracic and neurosurgical; Unit 3, orthopaedic.

day. The dose of insulin to be delivered was determined according to a sliding scale based on a result from the patients blood glucose test. No single method of blood glucose determination was used by staff.

Treatment involved three changes to standard practice:

- 1 A nursing education program discussing the prevention of insulin administration errors and the importance of the timing between determination of a blood glucose and the subsequent administration of insulin to a patient.
- 2 Introduction of bedside blood glucose monitors to all units.
- 3 The computerised MAR was changed so that time and dose of insulin were not recorded and therefore had to be recorded by the nurse at time of administration.

All MAR records from 1 month were examined for the month before the change and at 6 months after the implementation of the quality improvement plan. Insulin dose was compared with time of blood glucose time entered.

Data were analysed to determine the number of occasions where insulin was administered within 60 min of blood glucose determination, and the mean time between blood

glucose determination and insulin delivery for four times (breakfast, lunch, dinner and bedtime) for each unit. The results for each unit and pooled results are shown in Tables 16 and 17.

Overall, the number of cases that received insulin within 60 min of a blood glucose test improved significantly (Table 16). However, individually this improvement was only seen on Units 1 and 2. Examination of time periods in which a significant reduction in time interval between time of blood glucose test and insulin administration was seen at breakfast, dinner and bedtime in Unit 1 but only at breakfast in Unit 2 and lunch in Unit 3 (Table 17).

General conclusions: process change for insulin administration

There is limited evidence to suggest that providing education on diabetes management to nurses and the provision of bedside blood glucose monitors can significantly reduce the time between blood glucose measurement and insulin administration.

*Quality of medication instruction to patients in the community*  
During the finalisation of this review, a single prospective cohort study was identified concerning the quality of instructions given to older adults taking warfarin, digoxin and phenytoin when filling a prescription in the community.<sup>47</sup> Patients receiving these drugs were selected because of the narrow therapeutic window of these medications and the resulting higher risk of severe adverse events. This report discusses only the baseline survey data from telephone interviews of over 4955 persons on the receipt of information and quality of that information concerning their prescription drugs at time of filling. The survey results suggested that almost one-third of responders reported not receiving any instruction on the use of these medications.

## Discussion

The original goal of this systematic review was to evaluate interventions to improve medication error incidence rates in geriatric settings. However, it soon became apparent that little research had been performed in strictly this environment. Persons aged 55 years and over account for a large proportion of admitted patients and 49.6% of separations.<sup>48</sup> Therefore, it was considered appropriate to include studies from all clinical environments.

### Types and causes of medication errors

Studies examining the types and causes of medication errors occurring in older adults ( $\geq 65$  years) are limited. However, evidence is available on the general population and is taken to be representative of those issues that would arise in the geriatric setting.

Medication errors in the hospital setting have been studied extensively and the most common types of errors have been identified generally as prescription/medication ordering errors, dispensing errors, errors in administration of medicines and errors in the medication record. Specifically these errors can most often be categorised as omissions ( $>25\%$ ), overdoses (20%), wrong medicines (10%), drug of addiction discrepancy ( $<5\%$ ), incorrect labelling ( $<5\%$ ) or an adverse drug reaction ( $<5\%$ ). However, little is known as to why medication errors occur in Australian hospitals. Failure to read, or misreading the chart, and a lack of robust systems for prescribing and ordering were suggested as the reasons for most of these errors.<sup>4</sup>

Based on limited Australian data on prescription errors, approximately 2% of all prescriptions have the potential to cause an adverse event with the most common causes being the wrong or ambiguous dose, missing dose, or the direc-

tions for use were unclear or absent. This can be compared with other countries in which the medication error rates have been reported to be between 2% and 7%.<sup>6</sup>

Among the most common errors and their causes related to medication that are encountered in community practice (i.e. community pharmacies and general practices) are inappropriate drugs, prescribing errors, administration errors, and inappropriate dose errors.<sup>4</sup> The factors contributing to these errors were forwarded by the doctors surveyed and not from empirical evidence. Most commonly cited reasons for medication errors in a community setting are poor communication between patient and health professionals, action of others (not GP or patient), error of judgement, poor communication between health professionals, patient consulted another medical officer and failure to recognise signs and symptoms.

The most common types of dispensing errors reported by pharmacists are the selection of the incorrect strength, incorrect product or misinterpretation of a prescription. The major reason for selecting the incorrect strength or product has been described as the result of 'look alike' or 'sound alike' error.

In an Australian survey of 209 community pharmacists, the major factors cited for contributing to dispensing errors were high prescription volume, overwork, fatigue, interruptions to dispensing, 'look alike, sound alike' drug names.

Other factors that have been suggested as contributing to medication errors are inadequate continuity of care between the hospital and the community after discharge of a patient, multiple healthcare providers where medicines can be prescribed by more than one doctor, keeping unnecessary medications, generic names/trade names and misunderstanding the label instructions. However, the effect of these factors on medication error and adverse drug events has not been studied.

### Effectiveness

Numerous interventions to reduce the incidence of medication errors were identified that evaluated all steps in the pathway of delivery of medication to the patient. Included in this review are evaluations of computerised ordering by physicians, drug order checking by pharmacists, supply and delivery of drugs to the respective medical units, and administration of drugs to the patients by nursing staff. Within each step of the process, different types of interventions were evaluated, such as the use of single versus double checking by nurses before administration of a drug, or the use of a dedicated nurse with a distinctive 'jacket' to identify them as performing drug administration and not to be

disturbed. Overall, however, for a number of the interventions discussed in this review, the level of evidence was low (small sample sizes, before and after studies) or the results were poorly reported or inconclusive.

It was stressed in many of the researches reviewed here that medication errors do not necessarily translate into adverse drug events that could result in harm to patients. It was apparent from this literature that once a definition of a medication error was created the ease of determination of an error was dependent primarily on the level of reporting (i.e. the ease and willingness of clinicians to report an error). However, the resulting effect of a medication error, if any, on the patient was much harder to establish and therefore many studies did not extend their outcomes to include this eventuality.

In a number of studies, the number of reported medication errors was actually seen to increase after implementation of an intervention. This may have been the result of increased vigilance and improved reporting systems rather than an increase in the incidence of errors. Therefore, in some studies it was impossible to accurately determine the effectiveness of the specified intervention.

#### *Computerised systems*

Computerised systems consisted of a variety of interventions including CPOE, automated dispensing, bedside terminals, computer-generated MAR, alert systems and bar coding.

In summary, there was good evidence that CPOE system combined with CDSS is effective in reducing medication errors in a general hospital population.<sup>6</sup> However, there was lower-level evidence for the effectiveness of computer-generated MAR, computer adverse drug event detection and alerts. Finally, there was no evidence to suggest the use of bedside terminal systems, or bar coding patients or medications reduces medication error incidence, or that automated dosing systems reduce medication error incidence but only reduce errors in filling of drawers by technicians.

The majority of the research was in the use of CPOE to reduce medication errors and ultimately adverse drug events. Although CPOE was shown to significantly decrease the incidence of medication errors, it was noted that there was little evidence for CPOE and/or CDSS reducing adverse drug events and actual patient harm.<sup>6</sup>

A single report on the introduction of a computerised MAR reported only that medication errors decreased from one year to the next by 18%.<sup>11</sup> It was assumed from the report that medication errors were defined as a discrepancy between the MAR and the pharmacy order, but this was not

implicitly stated. A positive of the new MAR was its readability over handwritten documents.

The use of a computer alert system in one study showed that in 44% of cases where the system alerted the physician to a potential risk of an adverse drug event-related injury, the physician was unaware of the risk.<sup>27</sup> This suggests that the system may be able to prevent a significant number of potentially harmful medical errors. However, the system consisted of only 37 drug-specific adverse drug events and therefore would need to be expanded and updated to encompass a greater variety of risk.

Providing bedside terminal systems in one community hospital was evaluated for its effect on registered nurse time spent in direct care activities, overtime, attitudes towards the technology and unit medication error rate.<sup>14</sup> No difference in unit error rates was noted. However, the study duration for pre- and post-intervention observation was short at 40 h each and the errors were counted from reports on incident forms.

Identification of a single study in one systematic review<sup>6</sup> found that nurse use of bar codes in a point of care information system decreased the medication error rate in the hospital from 0.17% before the system was instituted to 0.05% after (*P* value not reported). Although this result was encouraging, the use of the bar coding device was 'easily and frequently circumvented', bringing into question the real contribution of the device to the overall error rate decrease. The reasons for this were not described.

However, a recent ethnographic study of nurse, physician and pharmacist interaction with a newly instituted computerised system of BCMA identified five negative themes (side-effects) that may elucidate the reason for the under-use of the bar coding system reported in the review:<sup>26</sup>

- 1 nurse confusion over automated removal of medications by the BCMA;
- 2 degraded coordination between the nursing staff and the physicians;
- 3 nurses dropped activities to reduce workload during busy periods;
- 4 increased prioritisation of monitored activities during busy periods; and
- 5 decreased ability to deviate from routine sequences.

The available evidence from a systematic review for the use of automated dispensing was found to be generally poor and did not support the suggestion that automated dispensing systems improved outcomes.<sup>6</sup> In a single study the use of an automated point-of-use dose system significantly reduced the rate of error in filling of dosage carts by technicians only.<sup>28</sup>

*Individual patient medication supply*

Individual medication supply systems have been shown to reduce medication error rates compared with other dispensing systems such as ward stock approaches. However, one systematic review suggested that the use of these systems shifts the chances for error from the nursing ward into the pharmacy, where distractions are also common and errors will occur.<sup>6</sup>

*Education and training*

Few studies were identified that examined the effectiveness of nursing education or training programs on the prevention of adverse drug events. From the two studies that were included, there is no evidence to suggest that education addressing medication calculation, or a yearly medication examination is effective in reducing medication errors.<sup>12,24</sup> Looked at another way, neither written medication examinations nor education on medication calculation could improve nurse competence to prevent errors beyond the skills they had already accrued.

*Pharmacists*

There is good evidence to suggest a role for clinical pharmacists in preventing adverse drug events in the inpatient setting. From a systematic review, pharmacist intervention in one study resulted in a 66% decrease in preventable adverse drug events because of medical ordering and a study of geriatric patients at the time of discharge found statistically significant decreases in medication errors.<sup>6</sup> The value of the presence of a pharmacist during medication rounds was also determined in two other studies.<sup>22,46</sup> Both studies displayed a decrease in the number of medication errors per 1000 patient days with the improved availability of a pharmacist for consultation.

Evidence for the effectiveness of pharmacists in reducing adverse drug events in the outpatient setting is less compelling.

*Nursing care models*

The strongest evidence suggests that having two nurses check medication orders before dispensing medication significantly reduces the incidence of medication errors.<sup>21</sup> However, the authors question the clinical advantage of this policy and do not recommend it. Weaker evidence suggested that single checking could be as safe as double checking, but was reliant on the number of medication errors reported in the medication incident records and might be a conservative estimate of the actual number of medication errors that actually occurred.<sup>20</sup> It has been demon-

strated that actual error rate could be 33% higher than reported rates.<sup>49</sup>

There is no evidence to suggest that providing designated nurses to dispense medication significantly reduces the incidence of medication errors.<sup>14,16,25</sup> However, the use of the focused or Medsafe protocols in which nurses are identified as 'not to be disturbed' can reduce distractions to nurses during medication administration.<sup>25</sup> Distractions were used as a surrogate measure of the potential for a medication error. Although these strategies did not eliminate distractions during the medication 'cycle', these interventions were shown to reduce them by as much as 87% compared with customary medication rounds. The weakness of this study may lie in the method of collection of distractions using a previously unvalidated collection tool and the unavoidable use of an unblinded observer.

Employment of a MARS committee was shown to have a positive effect on reducing the number of medication administration documentation errors over a period of 1 year.<sup>29</sup> This is likely due to the heightened awareness of medication error prevention and reporting.

There is limited evidence from one study to suggest that introducing the PIPC model significantly reduces the incidence of medication errors.<sup>23</sup> This model was instituted in an attempt to reduce the workload on registered nurses by delegating less clinical tasks to a multiskilled technician. Despite the claim that the PIPC model was effective at significantly reducing the medication error ratio (errors/patient day,  $P = 0.008$ ), the data for before the institution of the PIPC model and after were not presented and therefore could not be verified.

As an example of the implementation of process change to improve the delivery of a specific drug and reduce the likelihood of an adverse event, diabetes education to nurses and the installation of blood glucose testing units in all wards were assessed.<sup>18</sup> Overall, the number of cases that received insulin within 60 min of a blood glucose test improved significantly. However, when individual units were evaluated this improvement was not universal. Examination of time periods in which a significant reduction in time interval between time of blood glucose test and insulin administration was seen at three time periods (breakfast, dinner and bedtime) for one unit but at only one time period (breakfast or lunch) in the other two units. The unit showing greatest improvement showed consistently higher mean time intervals between blood glucose testing and insulin delivery during the control phase of the study at all measurement periods (means of 53–125 min) whereas the mean times of the other units were all below 60 min.

## Recommendations

### Implications for practice

#### Computerised systems

- CPOE should be considered as this strategy may reduce the risk of misreading medication orders.

#### Individual patient medication supply

- Individual patient medical supply should be considered for use wherever possible.

#### Pharmacists

- Where possible, pharmacists should be made available for double checking medication orders and for consultation.

#### Nursing care models

- Double checking of medication orders by nurses before administration of medicines can reduce the number of medication errors.
- Identifying a dedicated nurse for medication administration may reduce the number of medication errors through the reduction of distractions.
- The use of a MARS committee may have a positive effect on reducing medication errors, likely because of the heightened awareness of medication error prevention and reporting.

### Implications for research

More research is needed to determine:

- the effectiveness of MAR, bedside terminals, computer alert systems and bar codes to reduce medication errors;
- the effectiveness of educational interventions to reduce medication errors;
- whether the use of multiskilled technicians partnering with nurses to reduce their workload (PIPC model) can reduce the incidence of medication errors; and
- whether the use of dedicated nurses or double checking can reduce the incidence of medication errors.

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## Appendix I

### Supporting committee for medication management

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|  |   |
|--|---|
| Associate Professor Susan Koch (Chair) | ACEBAC Director, Collaboration                                    |
| Professor Helen Baker                  | (Professor of Nursing) Victoria University                        |
| Mr David Cooper                        | Aged Care Standards & Accreditation Agency                        |
| Mrs Lisa Derndorfer                    | (ACEBAC administrator)  |
| Ms Cathie Edgar                        | (Nurse Educator) Bundoora Extended Care Centre (BECC)             |
| Mrs Mandy Heather                      | (Director of Nursing) Bundoora Extended Care Centre (BECC)        |
| Ms Susan Hunt,                         | Nurse Consultant and Educator                                     |
| Dr Kwang Lim                           | (Geriatrician) Broadmeadows Health Service                        |
| Dr Michael Murray                      | (Geriatrician) St George's Health Service                         |
| Ms Karen O'Keefe                       | (Director of Nursing) Caulfield General Medical Centre            |
| Professor Kenn Raymond                 | (Professor of Pharmacology) La Trobe University Bendigo           |
| Mr Dipak Sanghvi                       | (Pharmacist) The Pharmacy Guild of Australia                      |
| Dr Michael Whishaw                     | (Geriatrician) Melbourne Extended Care and Rehabilitation Service |

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ACEBAC, Australian Centre for Evidence Based Aged Care.

## Appendix II

### Studies included in the review

#### Systematic reviews

| Study                                     | Level of evidence | Appraisal score  | Location        | Databases searched  | Inclusion criteria   | Method  | Outcomes assessed   | Length of follow-up |
|---|-------------------|--|-----------------|---|--|---|---|---------------------|
| Kaushal <i>et al.</i> , 2003 <sup>a</sup> | I                 | <p><i>Review objective:</i><br/>Review the cumulative evidence on the effects of CPOE and CDSS on medication safety.</p> <p><i>Sources used:</i> See 'Databases searched' column.</p> <p><i>Inclusion criteria:</i><br/>Studies evaluating CPOE observational studies or above, surrogate clinical outcomes or better.</p> <p><i>Quality assessed by:</i><br/>Hierarchy of study design and outcome measures.</p> <p><i>Data extraction:</i><br/>Bibliographic details, study description, design, outcomes and results.</p> <p><i>Data synthesis:</i><br/>Narrative summaries</p> | Boston, MA, USA | <ul style="list-style-type: none"> <li>MEDLINE</li> <li>Cochrane Library</li> </ul> | <ul style="list-style-type: none"> <li>Studies evaluating CPOE with CDSS, or CDSS alone.</li> <li>Observational studies with controls, controlled trials, and randomised controlled trials.</li> <li>Surrogate clinical outcomes, clinical outcomes</li> </ul> | <p>Database search and retrieval. Two-person determination of study quality using prospectively determined elements of quality.</p> <p>Studies grouped into two categories: CPOE with CDSS, or CDSS alone</p> | <p>Medication errors. Defined as errors in the process of ordering, transcribing, dispensing, administering or monitoring medications</p> | NA                  |



| Study  | Level of evidence | Appraisal score  | Location               | Databases searched   | Inclusion criteria  | Method   | Outcomes assessed | Length of follow-up |
|--|-------------------|--|------------------------|--|---|--|-------------------|---------------------|
| Shojania et al., Mortality 2001 <sup>6</sup> | I                 | <p><i>Review objective:</i><br/>Identification and evaluation of patient safety practices.</p> <p><i>Sources used:</i><br/>See 'Databases searched' column.</p> <p><i>Inclusion criteria:</i><br/>Observational study designs or higher. Surrogate or clinical outcomes.</p> <p><i>Quality assessed by:</i><br/>Hierarchy of study design and outcome measures.</p> <p><i>Data extraction:</i><br/>10 extraction elements</p> <ol style="list-style-type: none"> <li>1. Bibliographic information</li> <li>2. Level of study design</li> <li>3. Description of intervention</li> <li>4. Study population</li> <li>5. Outcome</li> <li>6. And level of outcome</li> <li>7. Main results</li> <li>8. Adverse events</li> <li>9. Costs</li> <li>10. Information on implementation.</li> </ol> <p><i>Data synthesis:</i><br/>Narrative summaries</p> | San Francisco, CA, USA | <ul style="list-style-type: none"> <li>• MEDLINE</li> <li>• Cochrane Library</li> <li>• CINAHL</li> <li>• PsycINFO</li> <li>• INSPEC</li> <li>• ABI/INFORM</li> <li>• Institute for Scientific Information's Science Citation Index</li> <li>• Social Sciences Citation Index</li> </ul> | <ul style="list-style-type: none"> <li>• Any practice that can be applied to the hospital setting or to the inpatient/outpatient interface AND can be applied to a broad range of healthcare conditions or procedures.</li> <li>• Study design of at least observational study with controls or above.</li> <li>• Outcome measure must be at least surrogate or clinical</li> </ul> | <p>Morbidity</p> <p>Mortality</p> <p>Adverse events</p> <p>Observed errors</p> | NA                |                     |

CDSS, clinical decision support system; CPOE, computerised physician ordering entry; NA, not applicable.

## Randomised control trials

| Study  | Level of evidence | Appraisal score                                       | Location  | Study design                            | Study population  | Intervention   | Outcomes assessed  | Length of follow-up                       |
|--|-------------------|---|---|---|---|--|--|---|
| Greengold <i>et al.</i> , 2003 <sup>16</sup> | II                | QS 8/11<br>Clinical importance not estimable<br>R 2/5 | Two university hospitals in the USA: California and Ohio  | Multicentre randomised controlled trial | RNs with at least 1 year of acute care nursing experience and a minimum of 6-month full-time employment at respective hospitals | Nurses randomised to a role as either a medication nurse or a general nurse. <i>Medication nurses:</i> received a 1-day 8-h medication safety program. Nurses assigned between 15 and 18 patients each. Administered all scheduled medications to their assigned patients unless unable to administer time critical medications such as insulin, in which case asked for assistance from staff nurses on the unit. Did not administer Stat medicines, total parental nutrition, hydration or bolus medications. These handled by unmonitored staff nurses. <i>General nurses:</i> provided nursing care in the usual manner, covering 6 patients each. Observed only when providing medication. Study conducted simultaneously at the 2 hospitals in two 6-week blocks, 5 days per week excluding the weekends | Medication error rates (errors/opportunities). Calculated for wrong: <ul style="list-style-type: none"> <li>• Medication</li> <li>• Dose</li> <li>• Dose form</li> <li>• Route</li> <li>• Rate</li> <li>• Dose preparation</li> <li>• Administration technique</li> <li>• And drug omission</li> </ul> | 12 weeks                                  |
| Bayne and Bindler 1997 <sup>12</sup>         | II                | QS 7/11<br>Clinical importance 3/4<br>R not estimable | Three healthcare facilities in the USA: <ul style="list-style-type: none"> <li>• Teaching hospital</li> <li>• Tertiary care hospital</li> <li>• Home healthcare agency</li> </ul> | Randomised controlled trial             | 69 RNs  | Nurses randomly assigned to 1 of 4 intervention groups: <p><i>Control:</i> (<math>n = 18</math>), nurses were instructed not to update their calculation skills in any manner other than normally necessary for their work situation.</p> <p><i>Computer-assisted instruction:</i> (<math>n = 14</math>), nurses instructed to use a program (NURS PROCALC, Professional Development Software, Chapel Hill, NC, USA) for at least 3 h.</p> <p><i>Self-study workbook:</i> (<math>n = 18</math>), nurses instructed to work on the workbook for a minimum of 3 h.</p> <p><i>Classroom instruction:</i> (<math>n = 17</math>), nurses provided with a 3-h class concerning medication calculation taught by a nurse educator.</p> <p>No other descriptions of the intervention were given</p>                    | Pre- and post-instruction test scores<br>Mean % $\pm$ SD   | Post-test given 4–5 months after pre-test |

| Study                                | Level of evidence | Appraisal score | Location   | Study design                            | Study population   | Intervention  | Outcomes assessed   | Length of follow-up                          |
|--------------------------------------|-------------------|-----------------|--|---|--|---|---|--|
| Heinemann et al., 1996 <sup>19</sup> | III-1             | QS 7/11         | Nursing units of a private non-for-profit community medical centre, FL, USA  | Pseudo-randomised (by ward)             | Control group: 34-bed surgical trauma unit.<br>Pilot treatment group: 36-bed orthopaedic trauma unit | Control group: use the total patient care model.<br>Pilot treatment group: use the PIPC model. This protocol included the concurrent introduction of:<br><ul style="list-style-type: none"> <li>• Participative decision-making by staff throughout the development, design, implementation and testing.</li> <li>• Use of a partner in patient care extender under the direction of an RN.</li> <li>• Classes to educate staff to the dynamics of change in the practice environment.</li> <li>• Classes in delegation to help the RNs to delegate appropriate tasks to their PIPC extender</li> </ul> | Medication errors. Defined as those incidents that deviated from standard procedure and were clearly the responsibility of nursing. Errors derived from official incident reports. Described by number of incidents per patient day | 6-month observation period                   |
| Kruse et al., 1992 <sup>21</sup>     | III-1             | QS 8/11         | Three ward of a geriatric assessment and rehabilitation unit, NSW, Australia | Pseudo-randomised (by ward). Cross-over | RNs  | <p>Ward A: Control for first 23 weeks: 2 nurses administering medications. Trial for second 23 weeks: 1 nurse administering medications.</p> <p>Ward B: Trial for first 23 weeks: 1 nurse administering medications. Control for second 23 weeks: 2 nurses administering medications.</p> <p>Ward C: Control for first and second 23 weeks: 2 nurses administering medications.</p> <p>Audit of charts by an independent observer</p>   | Medication errors measured by errors per number of medications dispensed. Errors defined by:<br>Wrong: Patient Medication Dosage<br>Omitted medication<br>Medication chart not signed   | 23 weeks for each segment. 46 weeks in total |

PIPC, partner in patient care; QS, quality score; R, relevance; RN, registered nurse.

## Controlled trials

| Study  | Level of evidence | Appraisal score                                       | Location  | Study design     | Study population   | Intervention   | Outcomes(s) assessed  | Length of follow-up                        |
|--|-------------------|---|---|------------------|--|--|---|--|
| Kucukarslan <i>et al.</i> , 2003 <sup>22</sup> | III-2             | QS 8/11<br>Clinical importance 1/4<br>R 2/5           | General hospital, MI, USA                             | Controlled trial | Six clinical pharmacists and inpatients admitted to 1 of 2 internal medicine units.<br><i>Control group:</i><br>n = 79<br>Mean age: 56.5 ± 19.6 years<br>36 male, 43 female.<br><i>Study group:</i><br>n = 86<br>Mean age: 53.9 ± 19.8 years<br>36 male, 50 female | <i>Control:</i> patients in this group received standard care from pharmacists with a ratio of 1 pharmacist for every 30 patients.<br><i>Study:</i> 2 clinical pharmacists assigned to patient care at bedside including rounds, documentation of pharmacotherapy history and providing discharge counselling  | Preventable drug events. Events/1000 patient days. Events/total patients  | 87 days, from 5 September to 30 November   |
| Pape, 2003 <sup>25</sup>                       | III-2             | QS 7/11<br>Clinical importance not estimable<br>R 2/5 | Medical surgical unit of acute care hospital, TX, USA | Controlled trial | Convenience sample of registered nurses on a medical surgical unit of 30 patients  | <i>Control:</i> total of 8 cycles. Nurses used customary medication administration procedures.<br><i>Focused protocol:</i> total of 8 cycles. A 'special nurse' designated and staff asked to not interrupt or distract the special nurse unless related to medications being administered.<br><i>Medsafe protocol:</i> total of 8 cycles. Nurse administering medications asked to wear a special vest that identified them as in the process of administering medications. Vest labelled with a 'Medsafe Nurse, do not disturb'. Other nurses instructed to not interrupt Medsafe nurse and to intercept all phone calls or other distractions | <i>Number of distractions</i> measured by number per cycle and total distractions over measurement period. A cycle was defined as beginning when the nurse initiated administration of all assigned patient medications and end when documentation of administered medications is completed | 24 total cycles. 8 cycles per intervention |

QS, quality score; R, relevance.

## Other experimental designs

| Study  | Level of evidence | Appraisal score  | Location   | Study design  | Study population                        | Intervention  | Outcomes(s) assessed   | Length of follow-up  |
|--|-------------------|--|--|---|---|---|--|--|
| Cerne, 1989 <sup>15</sup>                        | III-3             | QS not estimable<br>Clinical importance not estimable<br>R not estimable | Three states in the USA: Nebraska, Georgia, Pennsylvania | Little information. Likely a before and after trial | Nursing staff in nursing units          | <i>Pre:</i> standard care.<br><i>Post:</i> bedside computer terminals provided containing full clinical information of patients in unit   | Medication errors as % of previous time period   | Not stated   |
| Ludwig Beymer <i>et al.</i> , 1990 <sup>24</sup> | III-3             | QS 5/11<br>Clinical importance not estimable<br>R not estimable          | Community medical centre, USA                            | Before and after trial                              | All RNs in the medical center           | <i>Pre:</i> all RNs required to pass a yearly medication examination. Number of medication errors reported on incident forms recorded for an 8-month period.<br><i>Post:</i> no medication examination errors reported on incident forms recorded for an 8-month period in the following year after requirement for medication examinations abolished | Medication error: total errors/8-month period. A medication error was defined as: wrong medication or extra dose; wrong patient, route or rate of intravenous fluid; omitting a medication; providing a medication from an expired order; or administering a medication $\geq 30$ min before or after the scheduled time | 8 months before and 8 months after change in policy          |
| Shah <i>et al.</i> , 1994 <sup>46</sup>          | III-3             | QS 6/11<br>Clinical importance not estimable<br>R not estimable          | General hospital, NJ, USA                                | Before and after trial                              | All clinical staff                      | <i>Pre:</i> no roving pharmacist.<br><i>Post:</i> roving pharmacist employed between 8 AM and 4 PM. Carrying out rounds every 0.5 h on all designated units<br>Performing medication order entry and providing a resource to nursing staff and physicians. Dealt with any ordering problems   | Medication incidents reported.<br>Errors/patient days  | Data collected for 4 years before 3 years after intervention |
| Hawkey <i>et al.</i> , 1990 <sup>17</sup>        | IV                | QS not estimable<br>Clinical importance not estimable<br>R not estimable | Six hospitals in the Nottingham area, UK                 | Observational trial                                 | All hospital inpatients and outpatients | Recording of every important intervention made by pharmacists to all prescriptions and administration of medicines for a period of 28 days  | Number of interventions.<br>Number of warranted interventions.<br>Number of cases where prescription was altered.<br>Number of cases where appreciable changes were made   | 28 days  |

|   |       |   |  |                        |   |  |  |   |
|---|-------|---|--|------------------------|---|--|--|---|
| Schaubhut and Jones, 2000 <sup>29</sup> | III-3 | QS 6/11<br>Clinical importance not estimable<br>R not estimable | General hospital, LA, USA                  | Before and after trial | All inpatients  | <p><i>Interdisciplinary committee</i> formed.</p> <p>Consists of:<br/>           Staff nurses<br/>           Nurse managers<br/>           Pharmacists<br/>           Information systems Analysts<br/>           Risk manager<br/>           Nursing educator.<br/>           Committee to review all reported errors and then the potential causes of error identified. This information was then shared with staff with regular 'Hot Spots' briefs.<br/>           All nursing units reviewed by selecting 10 patients per unit per month with each selected patients chart reviewed for 7 consecutive days of medication documentation</p> | No. of documentation errors per patient day  | 1-year period of follow-up after intervention   |
| Heatlie, 2003 <sup>18</sup>             | III-3 | QS 6/11<br>Clinical importance 1/4<br>R 2/5                     | Nursing units of a study hospital, MI, USA | Before and after trial | Diabetic patients on 3 nursing units: a cardiac, thoracic and neurosurgical unit, a cardio-progressive unit and an orthopaedic unit | <p><i>Control:</i> standard practice before the institution of the intervention.<br/> <i>Treatment:</i> nursing education program highlighting the importance of the timing of blood glucose determinations and the subsequent administration of insulin.<br/>           Provision of capillary blood glucose monitors for all units to allow bedside testing.<br/>           Time and dose notations removed from MAR forcing nurse administering the insulin to write in the time and dose when the procedure was performed</p>  | Interval between blood glucose test and insulin administration (in min).<br>Proportion of cases where insulin provided $\geq 60$ min after blood glucose test (in %) | 1-month pre intervention data collection period, followed by a 6-month changeover period and further 1-month data collection period |

| Study                                    | Level of evidence | Appraisal score   | Location                                  | Study design           | Study population  | Intervention   | Outcomes(s) assessed                     | Length of follow-up                                     |
|--|-------------------|---|---|------------------------|---|--|--|---|
| Ray <i>et al.</i> , 1995 <sup>28</sup>   | III-3             | QS 7/11<br>Clinical importance 2/4<br>R 3/5                     | University hospital, San Diego, CA, USA   | Before and after trial | General medical patients and medical cart filling technicians | <p><b>Control:</b> unit-dose cart fill system. Involves 24 medication cassette change. In anticipation of the following day medication administration for each patient. Unit doses are produced in the pharmacy and delivered to the unit every 24 h.</p> <p><b>Medstation Rx:</b> an inventory is established for each Medstation cart based on the specific needs of the unit. The medication profile for each patient is established by the pharmacy and downloaded to the central terminal (in real time, i.e. it happens as quickly as it is processed, no lag time) and transferred to the appropriate console on the ward. The nurse can then select the patient's name and the prescribed medication. The medication is then released from the medication drawer on the cart</p> | Technician error rate in filling         | <p><b>Pre:</b> 6 weeks.</p> <p><b>Post:</b> 6 weeks</p> |
| Brown <i>et al.</i> , 1993 <sup>13</sup> | III-3             | QS 7/11<br>Clinical importance not estimable<br>R not estimable | Four units of a 950-bed hospital, NC, USA | Before and after trial | Licensed practical nurses                                     | <p><b>Pre:</b> nurses provide medication to assigned patients.</p> <p><b>Post:</b> designated medication nurses provide medication to all patients on respective units from Monday to Friday, day and evening shifts. On weekend and night shifts nurses provide medication to assigned patients</p>   | Number of medication errors in each unit | 3 months  |

|  |       |  |  |                            |   |   |  |  |
|--|-------|--|--|----------------------------|---|---|--|--|
| Jarman<br><i>et al.</i> ,<br>2002 <sup>20</sup>  | III-3 | QS 7/11<br>Clinical importance<br>not estimable<br>R not estimable | Adult<br>inpatient<br>units of<br>hospital,<br>Geelong,<br>Australia | Before and<br>after trial  | Convenience<br>sample of all<br>RNs who<br>were checked<br>as competent<br>for single<br>checking of<br>medications   | Pre: standard practice of double<br>checking of medications before<br>administration.<br>Post: single checking<br>performed   | Reported medication errors<br>Derived from medication<br>incident records  | Pre:<br>7 months.<br>Post:<br>7 months   |
| Raschke<br><i>et al.</i> ,<br>1998 <sup>27</sup> | IV    | QS 7/11<br>Clinical importance<br>not estimable<br>R not estimable | Community<br>hospital,<br>AZ, USA                                    | Prospective<br>case series | Consecutive<br>sample of 9306<br>non-obstetrical<br>patients seen<br>over a period<br>of 6 months   | A <i>computer alert system</i> was<br>created that targeted 37 drug-<br>specific adverse drug events.<br>An alert was generated in<br>clinical situations where there<br>was increased risk of an adverse<br>drug event-related injury  | True-positive alerts<br>Defined as a written order<br>by a physician being<br>consistent with the<br>recommendations of the<br>computer-generated alert  | 6 months                                 |
| Brown<br><i>et al.</i> ,<br>1995 <sup>14</sup>   | III-3 | QS 7/11<br>Clinical importance<br>not estimable<br>R not estimable | Community<br>hospital,<br>NH, USA                                    | Before and<br>after trial  | RNs working in<br>a 35-bed surgical<br>unit with a high<br>concentration<br>of orthopaedic<br>patients.<br>RNs working for<br>an average of<br>10 years and at<br>this hospital for<br>an average of<br>9 years.<br>77% were full<br>time | <i>Control</i> : regular care 40 h of<br>observation on day and<br>evening shifts of week days and<br>1 day on the weekend.<br><i>Intervention: bedside terminal<br/>system</i> . The bedside terminal<br>system includes order entry,<br>nursing care planning,<br>laboratory and X-ray result<br>reporting. One hand-held<br>portable terminal installed in<br>each patient room and 2 in the<br>central nursing station. These<br>terminals communicate with a<br>terminal server located on each<br>unit. 40 h of observation on<br>day and evening shifts of week<br>days and 1 day on the weekend | Medication error rate<br>measured by medication<br>errors per 1000 doses<br>dispensed.<br>Errors identified from<br>reports on incident<br>reporting forms.<br>Errors defined as variation<br>from standard practice | 40 h before<br>and after<br>intervention |
| Adams,<br>1989 <sup>11</sup>                     | III-3 | QS 5/11<br>Clinical importance<br>not estimable<br>R not estimable | Regional<br>medical<br>centre,<br>SC, USA                            | Before and<br>after trial  | Clinical staff<br>throughout<br>hospital<br>involved with<br>drug delivery<br>(physicians,<br>pharmacists,<br>nurses)   | Pre: 14-day handwritten<br>MAR. Required manual<br>MAR. Required manual<br>colours of ink. A separate MAR<br>was required for<br>chemotherapy, anticoagulants<br>and insulin. Respiratory therapy<br>drugs were not located on an<br>MAR. No procedure to match<br>the Patient Profile in the<br>Pharmacy with the Nursing<br>MAR.<br>Post: 24-h computer-generated<br>MAR. This MAR was generated<br>directly in the pharmacy  | Medication errors.<br>Nurses on the 11 PM to<br>7 AM shift would check<br>the order against the MAR.<br>Discrepancies were<br>considered errors  | 1 year                                   |



| Study  | Level of evidence | Appraisal score | Location  | Study design  | Study population                | Intervention   | Outcomes(s) assessed                      | Length of follow-up   |
|--|-------------------|-----------------|---|---|---------------------------------|--|---|---|
| Patterson <i>et al.</i> , 2002 <sup>26</sup> | Ethnography       | QS 10/10        | Three Veterans affairs hospitals (acute care, oncology and nursing home), USA | Ethnography. Observation of medication passes and human-computer interaction before and after introducing BCMA technology | RNs, physicians and pharmacists | <p><i>Pre: observation of standard medication passes</i><br/> <i>Post: BCMA software accessed using a laptop fixed to a wheeled medication chart. This laptop linked to a central electronic database via a wireless network. Scanning a patient bar code on a wristband prompts the computer to list the medications that are due. The bar codes of these medications are then scanned to verify that the correct patient is getting the correct medication in the correct dose at the correct time. If the scanned information on the medication does not match, the nurse is alerted by a pop-up dialogue box.</i></p> <p>Observation of this interaction was performed for 1–7 h on day, evening and night shifts</p> <p>Interesting interaction sequences were analysed as mini-cases and then grouped by emerging themes</p> <p>Observer also watched computerised order entry by physicians and order verification by pharmacists</p> | Negative side-effects of instituting BCMA | 21-h observation before intervention. 60 h after intervention |

|  |       |   |                                   |                           |   |  |  |   |
|--|-------|---|-----------------------------------|---------------------------|---|--|--|---|
| Spencer<br><i>et al.</i> ,<br>2005 <sup>30</sup> | III-3 | QS 7/11<br>Clinical<br>importance not<br>estimable<br>R not estimable | Teaching<br>hospitals,<br>NC, USA | Before and<br>after trial | Patients from<br>general medical<br>units and critical<br>care step-down<br>units | <i>Pre: standard ordering<br/>procedure.</i> Handwritten orders<br>by the physician entered into<br>the pharmacy computer system<br>by the pharmacy staff.<br><i>Post: CPOE system</i> | Medication errors<br>categorised by errors in<br>the process of ordering,<br>dispensing or<br>administering a medication<br>regardless of whether the<br>potential for injury was<br>present | 15 months.<br><i>Pre:</i> 8 and<br>11 months<br>on 2 units<br>designated<br>for CPOE<br>and<br>8 months<br>for all other<br>units not<br>designated<br>for CPOE.<br><i>Post:</i> 2<br>units using<br>CPOE<br>followed<br>for 7 and<br>4 months<br>with all<br>other units<br>without<br>CPOE<br>followed for<br>a further<br>7 months |
|--|-------|---|-----------------------------------|---------------------------|---|--|--|---|

BCMA, bar code medication administration; CPOE, computerised physician ordering entry; QS, quality score; R, relevance; RN, registered nurse.

## Appendix III

### Studies excluded from the review

| Study   | Reason for exclusion                        |
|---|---|
| Alemagno <i>et al.</i> , 2004 <sup>50</sup>     | Wrong outcome                               |
| Aufseeser Weiss and Ondeck, 2001 <sup>51</sup>  | Discussion paper                            |
| Ayuthya <i>et al.</i> , 2003 <sup>52</sup>      | Wrong outcome                               |
| Bates <i>et al.</i> , 1998 <sup>31</sup>        | Described in systematic review <sup>9</sup> |
| Bates <i>et al.</i> , 1999 <sup>32</sup>        | Described in systematic review <sup>9</sup> |
| Bolton <i>et al.</i> , 2004 <sup>53</sup>       | Wrong outcome                               |
| Boyle <i>et al.</i> , 1998 <sup>44</sup>        | Described in review <sup>4</sup>            |
| Briggs, 2002 <sup>43</sup>                      | Discussion paper                            |
| Burton <i>et al.</i> , 1991 <sup>37</sup>       | Described in systematic review <sup>9</sup> |
| Casner <i>et al.</i> , 1993 <sup>40</sup>       | Described in systematic review <sup>9</sup> |
| Chertow <i>et al.</i> , 2001 <sup>35</sup>      | Described in systematic review <sup>9</sup> |
| Dhalla <i>et al.</i> , 2002 <sup>54</sup>       | No intervention                             |
| Dimant, 2001 <sup>55</sup>                      | No intervention                             |
| Evans <i>et al.</i> , 1994 <sup>38</sup>        | Described in systematic review <sup>9</sup> |
| Evans <i>et al.</i> , 1998 <sup>36</sup>        | Described in systematic review <sup>9</sup> |
| Hurley <i>et al.</i> , 1986 <sup>39</sup>       | Described in systematic review <sup>9</sup> |
| Larrabee <i>et al.</i> , 1991 <sup>49</sup>     | No intervention                             |
| McNally <i>et al.</i> , 1997 <sup>45</sup>      | Wrong outcome                               |
| Meredith <i>et al.</i> , 2001 <sup>56</sup>     | Wrong outcome                               |
| Mungall <i>et al.</i> , 1994 <sup>42</sup>      | Described in systematic review <sup>9</sup> |
| Mutter, 2003 <sup>57</sup>                      | Wrong outcome                               |
| Nelson, 2004 <sup>58</sup>                      | Descriptive, no intervention                |
| Overhage <i>et al.</i> , 1997 <sup>33</sup>     | Described in systematic review <sup>9</sup> |
| Papastrat and Wallace, 2003 <sup>59</sup>       | Wrong outcome                               |
| Roark, 2004 <sup>60</sup>                       | Discussion paper                            |
| Strohecker, 2003 <sup>5</sup>                   | Discussion paper                            |
| Teich <i>et al.</i> , 2000 <sup>34</sup>        | Described in systematic review <sup>9</sup> |
| Van den Bemt <i>et al.</i> , 2002 <sup>61</sup> | Wrong outcome                               |
| Westwood <i>et al.</i> <sup>10</sup>            | References assessed separately              |
| White <i>et al.</i> , 1987 <sup>41</sup>        | Described in systematic review <sup>9</sup> |
| Whitman <i>et al.</i> , 2002 <sup>62</sup>      | Wrong outcome                               |

## Appendix IV

### Example search strategies

Search strategy for PubMed (contains MEDLINE and pre-MEDLINE)

| Search number | Search                                     | Number of citations |
|---------------|--|---------------------|
| #1            | Search 'medication errors'[MeSH Terms]     | 5 207               |
| #2            | Search 'aged'[MeSH Terms]                  | 1 431 569           |
| #3            | Search 'prescriptions, drug'[MeSH Terms]   | 13 485              |
| #4            | Search 'medication errors'[Title/Abstract] | 1 050               |
| #5            | Search 'aged'[Title/Abstract]              | 182 861             |
| #6            | Search 'elderly'[Title/Abstract]           | 99 191              |
| #7            | Search 'adults'[Title/Abstract]            | 154 948             |
| #8            | Search 'drug'[Title/Abstract]              | 429 370             |
| #9            | Search 'adverse event'[Title/Abstract]     | 3 891               |
| #10           | Search 'medication'[Title/Abstract]        | 61 164              |
| #11           | Search (((#1)) OR (#4)) OR (#9)            | 9 306               |
| #12           | Search (((#2)) OR (#5)) OR (#6)) OR (#7)   | 1 673 459           |
| #13           | Search (((#3)) OR (#8)) OR (#10)           | 486 510             |
| #14           | Search (((#11)) AND (#12)) AND (#13)       | 960                 |

## Appendix V

### Health Technology Assessment (HTA) websites

#### Australia

- Australian Safety and Efficacy Register of New Interventional Procedures – Surgical (ASERNIP-S) <http://www.surgeons.org/open/asernip-s.htm>
- Centre for Clinical Effectiveness (Monash University, Australia) <http://www.med.monash.edu.au/healthservices/cce/evidence/>
- Health Economics Unit, Monash University <http://chpe.buseco.monash.edu.au>

#### Austria

- Institute of Technology Assessment/HTA unit <http://www.oeaw.ac.at/ita/e1-3.htm>

#### Canada

- Agence d'Evaluation des Technologies et des Modes d'Intervention en Santé (AETMIS) <http://www.aetmis.gouv.qc.ca/en/index.htm>
- Alberta Heritage Foundation for Medical Research (AHFMR) <http://www.ahfmr.ab.ca/publications.html>
- Canadian Coordinating Office for Health Technology Assessment (CCHOTA) <http://www.ccohta.ca/newweb/pubapp/pubs.asp>
- Canadian Health Economics Research Association (CHERA/ACRES) – Cabot database <http://www.mycabot.ca>
- Centre for Health Economics and Policy Analysis (CHEPA), McMaster University <http://www.chepa.org>
- Centre for Health Services and Policy Research (CHSPR), University of British Columbia <http://www.chspr.ubc.ca>
- Health Utilities Index (HUI) <http://www.fhs.mcmaster.ca/hug/index.htm>
- Institute for Clinical and Evaluative Studies (ICES) <http://www.ices.on.ca>

#### Denmark

- Danish Institute for Health Technology Assessment (DIHTA) [http://www.dihta.dk/publikationer/index\\_uk.asp](http://www.dihta.dk/publikationer/index_uk.asp)

#### Finland

- Finnish Office for Health Technology Assessment (FINOHTA) <http://www.stakes.fi/finohta/e/>

#### France

- L'Agence Nationale d'Accréditation et d'Evaluation en Santé (ANAES) <http://www.anaes.fr/>

*Germany*

- German Institute for Medical Documentation and Information (DIMDI)/HTA <http://www.dahta.dimdi.de/>
- German Scientific Working Group of Technology Assessment [http://www.epi.mh-hannover.de/\(eng\)/hta.html](http://www.epi.mh-hannover.de/(eng)/hta.html)

*The Netherlands*

- Health Council of the Netherlands Gezondheidsraad <http://www.gr.nl/engels/welcome/frameset.htm>

*New Zealand*

- New Zealand Health Technology Assessment (NZHTA) <http://nzhta.chmeds.ac.nz/>

*Norway*

- Norwegian Centre for Health Technology Assessment (SMM) <http://www.oslo.sintef.no/smm/Publications/Engsmdrag/FramesetPublications.htm>

*Spain*

- Agencia de Evaluación de Tecnologías Sanitarias, Instituto de Salud 'Carlos III'/Health Technology Assessment Agency (AETS) <http://www.isciii.es/aets/cdoc.htm>
- Catalan Agency for Health Technology Assessment (CAHTA) <http://www.aatm.es/cgi-bin/frame.pl/ang/pu.html>

*Sweden*

- Swedish Council on Technology Assessment in Health Care (SBU) <http://www.sbu.se/admin/index.asp>

*Switzerland*

- Swiss Network on Health Technology Assessment (SNHTA) <http://www.snhta.ch/>

*United Kingdom*

- Health Technology Board for Scotland <http://www.htbs.org.uk/>
- National Health Service Health Technology Assessment (UK)/National Coordinating Centre for Health Technology Assessment (NCCHTA) <http://www.hta.nhsweb.nhs.uk/>
- University of York NHS Centre for Reviews and Dissemination (NHS CRD) <http://www.york.ac.uk/Institute/crd/>
- National Institute for Clinical Excellence (NICE) <http://www.nice.org.uk/index.htm>

*United States*

- Agency for Healthcare Research and Quality (AHRQ) <http://www.ahrq.gov/clinic/techix.htm>

- Harvard Center for Risk Analysis – Cost-Utility Analysis Database Project (comprehensive league table) <http://www.hcra.harvard.edu/tablesdata.html>
- US Department of Veterans Affairs Technology Assessment Program (VATAP) [http://www.va.gov/resdev/prt/pubs\\_individual.cfm?webpage=pubs\\_ta\\_reports.htm](http://www.va.gov/resdev/prt/pubs_individual.cfm?webpage=pubs_ta_reports.htm)

**Appendix VI****Critical appraisal checklists***Systematic review critical appraisal checklist*Source: Khan *et al.*, 2001<sup>8</sup>

Title of assessment:

Title of systematic review:

Author(s):

Year:

Comparators:

Score: /6

1. What is the review's objective?

What were the population/participants, interventions, outcomes and study designs?

2. What sources were searched to identify primary studies?

What sources (e.g. databases) were searched and were any restrictions by date, language and type of publication used? Were other strategies used to identify research?

3. What were the inclusion criteria and how were they applied?

4. What criteria were used to assess the quality of primary studies and how were they applied?

5. How were the data extracted from the primary studies?

6. How were the data synthesised?

How were differences between studies investigated?

How were the data combined? Was it reasonable to combine the studies?

What were the summary results of the review?

Do the conclusions flow from the evidence reviewed?

*Rank scoring for appraising the clinical importance of benefit/harm*Source: NHMRC, 2000<sup>7</sup>

Title of review:

Title of study:

Author(s):

Year:

Comparators:

Clinically important effect:

Rank Score: /4

| Ranking | Clinical importance of benefit/harm   |
|---------|---|
| 1       | A clinically important benefit for the full range of plausible estimates.<br>The confidence limit closest to the measure of no effect (the 'null') rules out a clinically unimportant effect of the intervention.     |
| 2       | The point estimate of effect is clinically important BUT the confidence interval includes clinically unimportant effects.   |
| 3       | The confidence interval does not include any clinically important effects.  |
| 4       | The range of estimates defined by the confidence interval includes clinically important effects BUT the range of estimates defined by the confidence interval is also compatible with no effect, or a harmful effect. |

*Rank scoring for classifying the relevance of evidence*Source: NHMRC, 2000<sup>7</sup>

Title of review:

Title of study:

Author(s):

Year:

Comparators:

Rank Score: /5

| Ranking | Relevance of the evidence   |
|---------|---|
| 1       | Evidence of an effect on patient-relevant clinical outcomes, including benefits and harms, and quality of life and survival.              |
| 2       | Evidence of an effect on a surrogate outcome that has been shown to be predictive of patient-relevant outcomes for the same intervention. |
| 3       | Evidence of an effect on proven surrogate outcomes but for a different intervention.  |
| 4       | Evidence of an effect on proven surrogate outcomes but for a different intervention and population.                                       |
| 5       | Evidence confined to unproven surrogate outcomes.   |

*Checklist for appraising the quality of intervention studies*

## JBI Critical Appraisal Checklist for Experimental Studies

Reviewer \_\_\_\_\_ Date \_\_\_\_\_

Author \_\_\_\_\_ Year \_\_\_\_\_ Record Number \_\_\_\_\_

|   | Yes                      | No                       | Unclear                  |
|---|--------------------------|--------------------------|--------------------------|
| 1. Was the assignment to treatment groups random?                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Were participants blinded to treatment allocation?                               | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Was allocation to treatment groups concealed from the allocator?                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Were the outcomes of people who withdrew described and included in the analysis? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Were those assessing outcomes blind to the treatment allocation?                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Were the control and treatment groups comparable at entry?                       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Were groups treated identically other than for the named interventions?          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Were outcomes measured in the same way for all groups?                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Were outcomes measured in a reliable way?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Was there adequate follow-up (>80%)?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Was appropriate statistical analysis used?                                      | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Overall appraisal:    Include     Exclude     Seek further info.

Comments (Including reasons for exclusion)

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## JBI QARI Critical Appraisal Checklist for Interpretive & Critical Research

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Reviewer \_\_\_\_\_ Date \_\_\_\_\_  
 Author \_\_\_\_\_ Year \_\_\_\_\_ Record Number \_\_\_\_\_

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|  | Yes                      | No                       | Unclear                  |
|--|--------------------------|--------------------------|--------------------------|
| 1. Is there congruity between the stated philosophical perspective and the research methodology?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Is there congruity between the research methodology and the research question or objectives?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Is there congruity between the research methodology and the methods used to collect data?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Is there congruity between the research methodology and the representation and analysis of data?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Is there congruity between the research methodology and the interpretation of results?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Is there a statement locating the researcher culturally or theoretically?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is the influence of the researcher on the research, and vice versa, addressed?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Are participants, and their voices, adequately represented?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Is the research ethical according to current criteria or, for recent studies, is there evidence of ethical approval by an appropriate body? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?                                    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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Overall appraisal:    Include     Exclude     Seek further info.

Comments (Including reasons for exclusion)

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## JBI Data Extraction Form for Experimental/Observational Studies

Reviewer \_\_\_\_\_ Date \_\_\_\_\_  
 Author \_\_\_\_\_ Year \_\_\_\_\_  
 Journal \_\_\_\_\_ Record Number \_\_\_\_\_

**Study Method**      RCT       Quasi-RCT       Longitudinal   
                          Retrospective       Observational       Other \_\_\_\_\_

**Participants**

Setting \_\_\_\_\_

Population \_\_\_\_\_

Sample size \_\_\_\_\_

Intervention 1 \_\_\_\_\_      Intervention 2 \_\_\_\_\_      Intervention 3 \_\_\_\_\_

**Interventions**

Intervention 1 \_\_\_\_\_  
 \_\_\_\_\_

Intervention 2 \_\_\_\_\_  
 \_\_\_\_\_

Intervention 3 \_\_\_\_\_  
 \_\_\_\_\_

**Clinical outcome measures**

| Outcome Description | Scale/Measure |
|---------------------|---------------|
|                     |               |
|                     |               |
|                     |               |
|                     |               |
|                     |               |
|                     |               |



**10.5.2 Appendice E2 : Article n° 2 – Registered nurses' medication management of the elderly in aged care facilities**

|              |  |
|--------------|--|
| Article n° 2 | <b>Registered Nurses' medication management of the elderly in aged care facilities</b>   |
| Auteurs      | Lim, L. M., Chiu, L. H., Dohrmann, J., & Tan, K.-L. (2010).  |
| Titre        | La gestion des médicaments par les infirmiers dans les établissements pour personnes âgées.<br><br>Le concept de polymédication n'est pas mis en avant.  |
| Résumé       | <p>Le résumé synthétise clairement les différents points de la recherche, ou l'on retrouve :</p> <ul style="list-style-type: none"> <li>• <b>Background</b> : Précise qu'il y a une augmentation des réactions néfastes pour le patient de plus de 65 ans, due à de multiples médicaments.</li> <li>• <b>Objectifs</b> : Identifier les connaissances des infirmiers dans la gestion des médicaments et sur les réactions néfastes chez les personnes âgées (plus de 65 ans). De plus, ils veulent évaluer si un programme de cours sur la pharmacologie pourrait prévenir les risques d'effets indésirables.</li> <li>• <b>Méthode</b> : Dans leur étude, ils prennent un groupe d'infirmiers pour le pré-test qui comprend un questionnaire de 23 questions, 1 heure de cours et des éléments de révisions. Les infirmiers travaillent dans un établissement pour personnes âgées et sont volontaires pour la recherche.</li> <li>• <b>Résultats</b> : Le nombre de participants (infirmiers) au pré-test était de 58 infirmiers et de 40 infirmiers pour le post-test, soit un taux d'abandons de 31% des infirmiers. Le taux de réponses incorrectes était de 40% lors du pré-test et de 27% lors du post-test. Soit une amélioration.</li> <li>• <b>Conclusions et discussion</b> : Le pré-test montre les mauvaises connaissances sur la médication, ainsi que la réaction des médicaments sur la personne âgée. Le post-test montre une amélioration significative des connaissances des infirmières. Cela montre l'intérêt dans l'actualisation des connaissances des infirmiers.</li> </ul> |

| INTRODUCTION                               |  |
|--|--|
| Problème de la recherche                   | <p>Le problème est bien expliqué. Il démontre que la gestion des traitements médicamenteux est définie comme un vrai challenge car le processus de vieillissement peut altérer la personne et l'élimination des médicaments. De ce fait, la personne âgée est plus à risque d'effets indésirables. Cela est devenu une cause habituelle d'admission dans les hôpitaux et aussi de décès.</p>   |
| Recension des écrits<br>Cadre de recherche | <p>De nombreuses recherches ont été recensées pour une bonne compréhension de l'ampleur du problème :</p> <ul style="list-style-type: none"> <li>• Il y a eu beaucoup d'études sur la gestion des médicaments et des effets indésirables par de pharmaciens et des praticiens médicaux (Pirmohamed et al. 2004 ; Routledge et al. 2003 ; Tulner et al. 2008). Les recherches se limitent au rôle des infirmiers dans la gestion des médicaments dans les établissements pour personnes âgées.</li> </ul> <p>Plusieurs écrits ont été publiés :</p> <ul style="list-style-type: none"> <li>• Une étude canadienne a renforcé le besoin de mettre un focus sur l'ordonnance et la surveillance des médicaments pour prévenir des effets indésirables. L'étude a relevé 815 effets indésirables, dont 42% auraient pu être évité.</li> <li>• Manias et Buloc (2002) ont évalué la perception et l'expérience des infirmiers en pharmacologie. L'étude montre que la majeure partie d'entre eux a des lacunes en pharmacologie.</li> <li>• Griffiths (2004) a examiné l'efficacité des infirmiers à améliorer leurs connaissances dans la gestion des médicaments pour un groupe de personnes âgées. L'étude montre que les infirmiers ont un potentiel et jouent un rôle important dans une équipe pour améliorer la qualité de l'utilisation des médicaments pour les personnes âgées.</li> <li>• Baker et Napthine (1994) disent que les infirmiers responsables dans la gestion des médicaments doivent connaître les risques et les bénéfices des médicaments.</li> <li>• Ces recensions présentent une base solide pour l'étude, Elles définissent bien l'ensemble du problème et du rôle qu'a l'infirmier dans la gestion des médicaments. L'étude est pertinente pour la discipline infirmière.</li> </ul> |

|                                      |   |
|--------------------------------------|---|
| <p>Buts et question de recherche</p> | <p>L'étude cherche à :</p> <ul style="list-style-type: none"> <li>• Examiner les connaissances des médicaments et sur les effets indésirables dans les établissements pour les personnes âgées.</li> <li>• Evaluer si l'introduction de cours à options va permettre d'améliorer la connaissance des infirmiers à reconnaître et à prévenir les effets indésirables dans les établissements pour les personnes âgées</li> <li>• Développer un programme d'apprentissage dans le but d'étendre la prévention des effets indésirables.</li> </ul>   |
| <p><b>METHODE</b></p>                |   |
| <p>Population et échantillon</p>     | <p>La population visée est les infirmiers dans un établissement pour personnes âgées. L'étude définit 2 types d'échantillons :</p> <p>Les infirmiers RN division 1 et RN division 2 :</p> <ul style="list-style-type: none"> <li>• RN division 1 = infirmiers de niveau 1, qui ont les habilités pour travailler dans tous les secteurs de soins.</li> <li>• RN division 2 = infirmiers de niveau 2, qui n'ont pas les même habiletés que les niveaux 1 et qui sont sous la responsabilité des niveaux 1.</li> <li>• Echantillon pour le pré-test : <ul style="list-style-type: none"> <li>○ RN division 1 = 48 participants et RN division 2 = 9 participants. Soit 51 femmes et 7 hommes.</li> </ul> </li> <li>• Echantillon pour le post-test : <ul style="list-style-type: none"> <li>○ RN division 1 = 34 participants et RN division 2 = 6 participants. Soit 33 femmes et 7 hommes.</li> </ul> </li> <li>• (Age des participants : de 20 à 60 ans)</li> </ul> <p>Nous remarquons qu'il y a eu une baisse des participations lors du post-test. Cela est expliqué dans les limitations de l'étude dans les discussions.</p> |
| <p>Considérations éthiques</p>       | <p>Il n'y avait pas de taille limite à l'échantillonnage. Les questionnaires étaient anonymes et confidentiels.</p>   |
| <p>Devis de recherche</p>            | <p>Dans un premier temps, ils ont proposé un pré-test, puis les infirmiers ont eu un cours d'une heure après avoir réalisé le pré-test. Ensuite, l'équipe d'étude a fourni des documents d'apprentissage (pas précisé). Puis, il y a eu 4 semaines de battement et ils ont effectué le post test.</p> <p>La première partie du pré-test comprend 6 questions personnelles. La seconde partie du pré-test permet d'évaluer les connaissances des infirmiers sur la</p>   |

|   |  |
|---|--|
|   | <p>médication, elle comprend 23 questions (17 questions avec réponse à choix et 6 questions vrai-faux).</p> <p>Pour le post test, les questions étaient les mêmes, mais mis sous une autre forme. Cela afin de vérifier l'acquisition des connaissances par les infirmiers.</p>  |
| <p>Modes de collectes de données -<br/>Conduite de la recherche -<br/>Analyse des données</p> | <p>La fiabilité et la validité des tests ont été contrôlées et corrigées par des pharmaciens et des infirmiers expérimentés (nous ne savons pas ce qui différencie ces infirmiers expérimentés par rapport aux autres).</p> <p>Il s'agit d'une recherche de type essai non randomisé.</p> <p>Microsoft Excel a été utilisé pour l'analyse des données.</p>   |
| <b>RESULTATS</b>  |  |
| <p>Présentation des résultats</p>   | <p>Le taux de réussite aux tests est clairement présenté au travers d'un tableau d'analyse. Ce tableau présente le nombre d'erreurs par questions, ainsi que le pourcentage d'erreurs. Un second tableau démontre la comparaison entre la totalité des réponses correctes et incorrectes du pré-test et du post-test :</p> <ul style="list-style-type: none"> <li>• Total des réponses correctes pour le pré-test = 799</li> <li>• Total des réponses incorrectes pour le pré-test = 535</li> <li>• Total des réponses correctes pour le post-test = 674</li> <li>• Total des réponses incorrectes pour le post-test = 246</li> </ul> <p>Les résultats sont résumés par un texte narratif.</p> |
| <b>DISCUSSION</b>   |  |
| <p>Interprétations des résultats</p>  | <p>Un rappel de l'importance de la gestion et de la prévention des effets indésirables est présenté.</p> <p>La proportion des réponses incorrectes du pré-test était élevée. Cela révèle un manque de connaissances des infirmiers concernant la gestion et l'administration ceux-ci auprès des personnes âgées.</p> <p>La proportion des réponses incorrectes du post-test a été plus basse que le pré-test. Cela démontre que les connaissances des infirmiers sur la gestion des médicaments se sont améliorées grâce aux apprentissages réalisés.</p>  |

|  |   |
|--|---|
|  | <p>Cette étude a révélé le besoin de continuer la formation professionnelle dans ce secteur d'activité (gestion de médication).</p> <p>Avant cette étude, 87% des infirmiers n'avaient pas connaissance que les personnes âgées qui ont un effet indésirable à un médicament particulier sont susceptibles d'en développer un autre lors de l'administration d'une autre substance.</p> <p>Le résultat révèle que 74% des infirmiers sont incapables de reconnaître les symptômes des effets secondaires des effets indésirables.</p>   |
| <p>Conséquences et recommandations</p> | <p>Dans la discussion, ils donnent des informations et de recommandations concernant la gestion des médicaments :</p> <ul style="list-style-type: none"> <li>• Les médicaments non-stéroïdiens et les anticoagulants oraux ont une haute toxicité. Ils nécessitent une surveillance importante de leur utilisation et sont souvent utilisés dans les établissements pour les personnes âgées. Le risque d'effets indésirables est donc augmenté.</li> <li>• Les interactions pharmacodynamiques peuvent se produire quand les effets des médicaments modifient les résultats d'un autre médicament, même si les 2 types ne sont pas liés.</li> <li>• Les patients qui prennent des agents anti-psychothotique, anti-coagulant, diurétique et anti-épileptique sont soumis à plus d'effets indésirables.</li> <li>• Les médicaments avec un effet anti-colinergique peuvent causer des effets indésirables aux personnes âgées comme : confusion, rétention urinaire, sécheresse buccale, vision floue.</li> <li>• Le Valium (benzodiazépine) est considéré comme inapproprié pour les personnes âgées.</li> <li>• Les infirmiers devraient continuer à faire évoluer leurs connaissances dans la médication.</li> </ul> |

# Registered nurses' medication management of the elderly in aged care facilities

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LIM L.M., CHIU L.H., DOHRMANN J. & TAN K.-L. (2010) Registered nurses' medication management of the elderly in aged care facilities. *International Nursing Review* 57, 98–106

**Background:** Data on adverse drug reactions (ADRs) showed a rising trend in the elderly over 65 years using multiple medications.

**Aim:** To identify registered nurses' (RNs) knowledge of medication management and ADRs in the elderly in aged care facilities; evaluate an education programme to increase pharmacology knowledge and prevent ADRs in the elderly; and develop a learning programme with a view to extending provision, if successful.

**Method:** This exploratory study used a non-randomized pre- and post-test one group quasi-experimental design without comparators. It comprised a 23-item knowledge-based test questionnaire, one-hour teaching session and a self-directed learning package. The volunteer sample was RNs from residential aged care facilities, involved in medication management. Participants sat a pre-test immediately before the education, and post-test 4 weeks later (same questionnaire). Participants' perceptions obtained.

**Findings:** Pre-test sample  $n = 58$ , post-test  $n = 40$ , attrition rate of 31%. Using Microsoft Excel 2000, descriptive statistical data analysis of overall pre- and post-test incorrect responses showed: pre-test proportion of incorrect responses = 0.40; post-test proportion of incorrect responses = 0.27; Z-test comparing pre- and post-tests scores of incorrect responses = 6.55 and one-sided  $P$ -value =  $2.8E-11$  ( $P < 0.001$ ).

**Conclusion and implications:** Pre-test showed knowledge deficits in medication management and ADRs in the elderly; post-test showed statistically significant improvement in RNs' knowledge. It highlighted a need for continuing professional education. Further studies are required on a larger sample of RNs in other aged care facilities, and on the clinical impact of education by investigating nursing practice and elderly residents' outcomes.

**Keywords:** Adverse Drug Reactions, Aged Care, Continuing Education, Medication Management, Pharmacology, RNs' Knowledge

## Introduction

Safe, effective medication management of the elderly in aged care facilities remains a great challenge. An adverse drug reaction

(ADR) is defined as any noxious and unintended response in a patient or a research subject to a medication administered related to any dose [International Conference on Harmonisation (ICH) 1996; Jordan 2007)]; while an adverse drug event is any noxious and unintended response in a patient or a research subject to a medication administered, as well as other responses that are not necessarily caused by or related to that administered medication

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(ICH 1996; Jordan 2007). According to Jordan (2008, p. 3), 'some of the rarest and most serious adverse events are unpredictable, idiosyncratic and may occur at any situation.'

The ageing process can alter how a person metabolizes and eliminates certain medications. For those suffering from diseases, responses to drug therapy are difficult to predict, and therefore, this can increase the risk of ADRs (Bressler & Bahl 2003). The elderly, being more prone to chronic and multiple diseases, have higher uses of medicines; consequently, they have a higher risk of ADRs. Adverse drug reactions in the elderly are a common cause of hospital admissions, a common occurrence among people who are in hospital, and also a common cause of morbidity and death (Howard et al. 2006). Data on ADRs show a rising trend; particularly, in the elderly over 65 years using multiple medications (Roughead 2005). A Western Australian study found that the rate of ADRs associated with hospitalizations had more than doubled from 2.5 per 1000 person-years in 1981 to 12.9 per 1000 person-years in 2002, especially in people aged 60 years and above (Burgess et al. 2005, p. 267).

Australia's *National Strategy for Quality Use of Medicines*, which was inaugurated in 1992, aims to improve knowledge of best practice and communicating information to health-care providers (Department of Health and Ageing 2003). The Australian Pharmaceutical Advisory Council (APAC) and the Pharmaceutical Health and Rational Use of Medicines committee identified medication misadventure in residential aged care facilities as a priority issue. They put forward recommendations which led to the government funding the development of best practice guidelines and research activities, and the *Guidelines for Medication Management in Residential Aged Care Facilities* (APAC 2002). Within these guidelines, several recommendations were made: (1) aged care facilities in Australia should set up medication advisory committees to address issues concerning medication management, (2) the Commonwealth Government should fund the *Residential Medication Management Review* programme, which involves accredited pharmacists reviewing resident's medications and alerting the medical practitioner to potential risks of drug-drug interactions, inappropriate medication prescribing and risks for ADRs, and (3) nurses should detect ADRs, as they work with the elderly residents on a daily basis, evaluate all medicine use for appropriateness, unwanted side effects, allergies, toxicity, medicine intolerance, medicine interactions and adverse reactions and respond appropriately, document and report this information. Nurses should also be required to have knowledge of pharmacokinetics, pharmacodynamics and pharmacogenetics in the elderly, along with maintaining contemporary knowledge and skills in relation to pharmacology and health assessment (APAC 2002). Despite these guidelines, the outcome report of the national indicators of

the '*Measurement of the Quality Use of Medicines Component of Australia's National Medicines Policy*' revealed significant problems with ADRs and adverse drug events (Department of Health and Ageing 2003). Therefore, new strategies are required to tackle and minimize their occurrences.

## Literature review

Whilst there are numerous studies on medication management and ADRs by medical practitioners and pharmacists (Pirmohamed et al. 2004; Routledge et al. 2003; Tulner et al. 2008), there is limited research on the role of nurses in medication management of the elderly in residential aged care facilities. In relation to the nursing studies, these were focused on exploring graduate nurses' pharmacological knowledge, attitudes, experience and perceptions of medication management and medication errors (Manias et al. 2004a), decision-making (Manias et al. 2004b) and communication (Manias et al. 2005), and facilitating patient adherence to medication regimes (Happell et al. 2002).

Several papers were published in the United Kingdom by Jordan (2002, 2007) and Jordan et al. (2003, 2004) on ADRs. One most relevant paper was on an observational study that explored the effectiveness of a nurse-administered evaluation checklist, in relation to nurse-prescribing initiatives and division of professional responsibilities for medication management (Jordan 2002). Although the study was specifically on patients who received long-term antipsychotic medications, results showed that the evaluation checklist was able to guide nurse-client interactions, increase nurses' awareness of client's health problems and provide guidance on actions available to address clients' issues. Interestingly, the study identified a 'care-gap' related to the monitoring and alleviating adverse effects of medication.

Similarly, a Canadian study reinforced the need for special focus on the ordering and monitoring of medication to prevent ADRs in long-term care settings (Gurwitz et al. 2005). The study found 815 adverse drug events of which 42% were considered preventable. The overall rate of adverse drug events was 9.8 per 100 residents-months, with a rate of 4.1 preventable adverse drug events per 100 residents-months (p. 251).

Manias & Bullock (2002) explored Australian clinical nurses' perceptions and experience of graduate nurses' pharmacology knowledge, by collecting qualitative data using focus interviews. The results showed that: (a) graduate nurses had an overall lack of pharmacology knowledge, and (b) all other nurses also experienced difficulties in understanding and demonstrating pharmacological concepts in the clinical practice setting. This highlighted a significant need to improve pharmacology knowledge in order to improve practices to optimize the effective use of medication in patients.

Griffiths et al. (2004) examined the effectiveness of community nurses in improving knowledge and medication self-management in a group of elderly receiving community nursing care. The research showed that nurses had the potential to play an effective role in the multidisciplinary team to improve the quality use of medicines in the elderly community clients. Furthermore, a Swedish study investigated whether a specific education programme could improve nurses' knowledge of ADRs and ADRs reporting system (Bäckström et al. 2007). The programme led to significant improvement in nurses' performance and knowledge. Although, the study was focussed pharmaceutically to improve the ADRs reporting system, it illuminated a need for education programmes to address issues relating to pharmacology knowledge.

As far back as 1994, Baker and Napthine stated that nurses' responsibilities in drug management should include the ability to identify the risks and benefits of medicines. Indeed, registered nurses (RNs), as licensed and authorized health-care professionals, have a key role and a professional responsibility in ensuring the quality use of medicines. They are also responsible and accountable for medicines, under the drugs and/or poisons legislation of the state or territory in which they work. Furthermore, they must maintain contemporary knowledge and skill to utilize medicines appropriately (Australian Nursing Federation 2005). Therefore, it is the RNs' role and responsibility in aged care facilities to manage medication, by adhering to safe practices. These include accessibility to current information relating to therapeutic substances used in the facility where they are employed. RNs caring for the elderly should be aware of high-risk medications and be able to identify susceptible residents in order to prevent, detect and report ADRs. Given the high risk of ADRs in the elderly, as shown in the literature review, there is a need to explore the knowledge of RNs working in aged care facilities.

## Aim

The aims of the study were to:

- examine RNs' knowledge of medication management and ADRs in elderly residents in aged care facilities,
- evaluate whether the introduction of an educational programme would increase RNs' knowledge to recognize and prevent adverse drug reactions in elderly residents in aged care facilities, and
- develop a learning programme with a view to extending provision, if successful.

## Definition of RNs

For the purpose of this study, the RNs in this study were RN Division 1 and RN Division 2 (medication endorsed). Nurses

and nursing were first regulated by statute in 1923 in Victoria, Australia. In 1993, the legislation was revised and all nurses are now termed registered nurses, classified according to their educational preparation by the Nurses Board of Victoria (NBV), Australia (1993). The Health Professions Registration Act 2005 has governed all Victorian health registration boards (including the NVB) since July 2007:

- Registered Nurse Division One (RN Div 1) are first level nurses comprehensively trained with potential ability work in any branch of nursing.
- Registered Nurse Division Two (RN Div 2) are second level nurses that work under the direction of a division one, equivalent to an enrolled nurse in other Australian states.

RN Div 2 (medication endorsed) are RN division 2 nurses who have undertaken a course of study in medicines administration and have an endorsement of their registration granted by the NBV and can, and does administer medicines to patients that have been prescribed by a doctor or nurse practitioner. The endorsement indicates the range of medicines that can be administered. Some division 2 nurses can administer oral, enteral and topical medicines, and some can also administer medicines by subcutaneous and intramuscular routes. The NBV practicing certificate/card carried by each nurse has the specific endorsement on it and can also be verified on the NBV register of nurses online.

## Method

This exploratory study was a non-randomized pre- and post-test one group quasi-experiment without a comparator group, using a factual-based test questionnaire and an education programme (intervention) which comprised a one-hour teaching session and a self-directed learning package (Appendix 1). The education programme was based on effective medication management and administration, pharmacokinetics, pharmacodynamics, drug interactions, and ADRs in the elderly. The study was carried out in late 2007.

## Setting

Several residential aged care facilities in Victoria were asked if they would be interested in participating and seven responded with their approval and consent. In Australia, the residential aged care facilities are formerly known 'nursing homes'. The defining characteristic of residential aged care is the combined provision of care and accommodation to an older person by paid (and sometimes unpaid) workers in a setting other than the older person's own home (Department of Human Services, Victoria 2000).



### Sample

The participants were a volunteer sample from a target of RNs (Div1 and Div2) currently working in residential aged care facilities and who were involved with the administration and management of medication. The sample in the pre-test was  $n = 58$ , but in the post-test was  $n = 40$  with an attrition rate of 18 (31%).

### Sampling process

The University Human Ethics Committee granted Ethics approval. The aged care facilities were given a brochure to invite the RNs who were involved with administration and management of medication to meet with the researchers in each of the facilities to explain their involvement, the study purpose and aim. Each RN was given an information sheet and was informed that they would remain anonymous with no identifiable code on each questionnaire. Matched pairs were not obtainable because participants had to be reassured that their job would not be jeopardized and that this study was only examining improvements in group knowledge and not individual knowledge after the intervention of an educational programme. Confidentiality was maintained at all times. Participation was voluntary and written informed consent was obtained from individual RNs who agreed to participate in the study.

### Measurement

The pre- and post-test questionnaire comprised two sections. The first was a 6-item questionnaire related to demographic data on sex, age, level of RN division, qualification, years of nursing experience and post graduate or nursing specialization. The second section was a self-administered questionnaire consisting of 23 items of factual-based questions: 17 multiple choice knowledge questions and 6 true/false statements requiring participants to choose the correct answer. The questions measured the acquisition of recent knowledge and level of assessment skills in medication administration in aged care facilities; nurses' role in aged care facilities; pharmacokinetics and pharmacodynamics in the elderly; drug interactions; adverse drug reactions; and the reasons why the elderly are at greater risk of experiencing ADRs. A summarized version of the questions is presented in Table 2. Additionally, the post-test questionnaire had 5 open-ended questions for participants to express their perceptions of the effectiveness of the education session and self-directed learning package.

### Data collection method

#### *Phase one*

The participating RNs completed the test questionnaire prior to attending the educational programme. Adequate time was pro-

vided for participants to complete the questionnaire. Immediately after the pre-test, the education programme was taught to participants in a classroom presentation lasting an hour. The education programme was conducted in an environment conducive for learning, and participants were encouraged to actively participate. The teaching session included several examples of real case studies, which stimulated interest and sound discussions. At completion of the lecture, participants were each provided with a self-directed learning package based on the education session they had attended to enhance learning. Participants were encouraged to use the self-directed learning package to revise and consolidate their learning in their own time. Participants were also informed of the date to return 4 weeks later to undertake the post-test. The reason for the four-week period was to allow participants adequate time to assimilate the information with the aid of the learning package.

#### *Phase two*

Post-test took place 4 weeks later when participants returned to undertake the post-test to re-assess their level of knowledge and assessment skills with the same set of questionnaire. The slight difference in the post-test questionnaire was the inclusion of five open-ended questions requiring participants to self-report on their perceptions of the effectiveness of the in-service education and self-directed learning package.

### Reliability and validity

A couple of aged care nurses and a pharmacist were invited to review the questionnaire for face validity and modifications were made where suggested. All these factual-based knowledge questions were carefully selected by references to the literature (see Table 2). As different aged care facilities were very far apart from one another, and also for the convenience of the working RNs, it was necessary to run the educational programmes at these different aged care facilities' venues to attract as many participants as possible. Therefore, the same data collection process was repeated seven times at the seven different facilities. To ensure consistency of teaching and to avoid compromising the study rigor, an experienced nurse clinician delivered all the teaching sessions.

### Data analysis

Statistical analysis of incorrect responses were calculated for pre- and post-tests results using Microsoft Excel 2000. The statistician recommended this statistical package because the study was about population proportions, as we were unable to obtain pairing information (Schork & Remington 2000; Weiss 2005). Because there is no matching-pairs information on the participants in the pre- and post-test data, we could not construct a

**Table 1** Comparing overall pharmacology knowledge level before and after education programme: Z-test and P-value based on the 23-item test questionnaire

|                                     | Pre-test n = 58 | Post-test n = 40 | Z-Test   | P-value  |
|-------------------------------------|-----------------|------------------|----------|----------|
| Total number of correct responses   | 799             | 674              |          |          |
| Total number of incorrect responses | 535             | 246              |          |          |
| Total number of responses           | 1334            | 920              |          |          |
| Proportion of incorrect responses   | 0.40            | 0.27             | Z = 6.55 | 2.8E.11* |

\* $P < 0.001$ .

contingency table, and the Z-test procedure for two proportions was appropriate (Schork & Remington 2000; Weiss 2005). This test does not require information on means and standard deviations. Descriptive statistics were used to present demographic characteristics of the study sample and data of incorrect responses to the 23-item factual-based test questions.

### Interpretation of results

Altogether, 58 RNs participated in the pre-test vs. 40 in the post-test, showing an attrition rate of 18. RN's demographic characteristics data from both pre and post are summarized in Table S1. There were 49 vs. 34 RNs (Div 1) and 9 vs. 6 RNs (Div2-medication endorsed); 51 vs. 33 females and 7 males. The ages ranged from 20–60 years. The years of working experience ranged from 1–50 years.

The RNs (Div2) held the Associate Diploma Certificate IV, while the RNs (Div1) were either hospital-trained or held tertiary qualifications; 2 masters in gerontic nursing; 1 master in neuroscience nursing; 6 vs. 5 graduate diploma in gerontic nursing; 15 vs. 8 other post graduate certificate qualification in different specialities; and 27 vs. 20 had no extra post-qualification studies.

Statistically, the overall result showed a high significant difference in the RNs' knowledge: proportion of incorrect responses of the pre-test = 0.40, proportion of incorrect responses of the post-test = 0.27, Z-test = 6.55, and one-sided P-value = 2.8E-11 ( $P < 0.001$ ) (Table 1).

The results of incorrect responses from the pre- and post-test questionnaire for each of the 23-item factual-based knowledge questions are presented in Table 2. The post-test responses showed improvements in all aspects of the knowledge questions, some more significant than others. The individual questions which showed high statistical significant differences in the reduction of incorrect responses between the pre- and post-test scores are marked with asterisks in Table 2.

### Participants' perceptions of education programme

The participants were requested to describe their perceptions of the teaching session and self-directed learning package when

they returned for the post-test. All the participants thought the teaching session was beneficial. They said that it gave them more information about drugs that should not be used, their usage and their side effects in the elderly residents. For example, one participant wrote: *'It has increased my understanding of medication and awareness of the dangers of prescription and drug–drug interactions in the elderly.'*

All participants except one expressed that the self-directed learning package was useful and easy to understand, and had expanded their knowledge about ADRs in the elderly. All felt that their attitude had changed toward medications of the elderly. They became more careful and vigilant when giving medications and observing for any adverse reactions experienced by the elderly residents. When asked about their thoughts while administering medication to the elderly, most wrote that they became more aware of the need to monitor reactions and report them, if necessary. For example, one participant wrote: *'My professional responsibility and the needs of the resident and also observing for the positive and negative effects of the medication administered.'* Another stated: *'I would be less inclined to take for granted doctors prescribing Xs medication and instead would question more.'* Generally, most wrote that they had a clearer picture regarding ADRs and the risks of drug–drug interactions associated with polypharmacy in the elderly.

### Limitations of the study

Several limitations should be considered when interpreting the findings of this study. The attrition rate was a problem. Unfortunately, not all participants returned to undertake the post-test 4 weeks later. Absence of a control group is a limitation (Grimes & Schulz 2002; Jordan 2000). This was an exploratory study. Another limitation was not being able to obtain identifiable code or matched pairs' data for further statistical analysis to investigate the value of the education programme. Furthermore, the RNs who returned for the post-test could be nurses who were more committed to learning and might skew the result.

**Table 2** Question wise – comparing pharmacology knowledge level before and after education programme: number of incorrect responses in percentages, Z-test and P-values

| N  | Questions/subjects  | Pre-test<br>n = 58 |      | Post-test<br>n = 40 |      | Z-Value | P-value |
|----|---|--------------------|------|---------------------|------|---------|---------|
|    |   | N                  | %    | N                   | %    |         |         |
|    |   |                    |      |                     |      |         |         |
| 1  | Duty of care for nurses in aged care facilities (APAC 2002).  | 1                  | 1.7  | 2                   | 5.0  | -0.93   | 0.82    |
| 2  | 80% of ADRs that occur in the elderly are type A in nature. (Routledge et al. 2003).  | 38                 | 65.5 | 11                  | 27.5 | 3.70    | <0.001* |
| 3  | The ageing process involves increase body fat, decreased muscle mass and decreased body water (Bressler & Bahl 2003).   | 39                 | 67.2 | 11                  | 27.5 | 3.87    | <0.001* |
| 4  | Renal flow in the elderly decreases by 1% per year after the age of 50. (Bressler & Bahl 2003).   | 11                 | 19.0 | 6                   | 15.0 | 0.51    | 0.31    |
| 5  | The absorption phase of pharmacokinetics is generally not a problem in the elderly (Mangoni & Jackson 2004).  | 42                 | 72.4 | 18                  | 45.0 | 2.74    | <0.01*  |
| 6  | Pharmacodynamics can be defined as the time course and effect of drugs on cellular and organ function (Merck Manual of Diagnosis and Therapy 2005).   | 16                 | 27.6 | 9                   | 22.5 | 0.57    | 0.29    |
| 7  | Due to altered pharmacokinetics and pharmacodynamics, the elderly often need less medication (Bressler & Bahl 2003).  | 12                 | 20.7 | 4                   | 10.0 | 1.41    | 0.08    |
| 8  | In the elderly, the dosage of drugs that are renally excreted, such as digoxin, need to be reduced (Mangoni & Jackson 2004).  | 21                 | 36.2 | 6                   | 15.0 | 2.31    | 0.01*   |
| 9  | When an elder is prescribed greater than eight medications research suggested that the likelihood of an adverse drug reaction occurring approaches 100% (Rollason & Vogt 2003).   | 51                 | 87.9 | 21                  | 52.5 | 3.90    | <0.001* |
| 10 | When an elder takes two concurrent medications for more than 60 days, it is a possible indicator of polypharmacy (Rollason & Vogt 2003).  | 30                 | 51.7 | 23                  | 57.5 | -0.56   | 0.71    |
| 11 | Nausea and vomiting are the common complaints for digoxin toxicity in an elder (Williams & Kim 2003).   | 43                 | 74.1 | 29                  | 72.5 | 0.18    | 0.43    |
| 12 | Having a previous ADR to a particular medication means that a person is at increased risk of developing an ADR with the commencement of another unrelated drug. (True) (Atkin et al. 1999).   | 51                 | 87.9 | 17                  | 42.5 | 4.80    | <0.001* |
| 13 | Importance of knowledge when administering warfarin (Williams & Kim 2003).  | 12                 | 20.7 | 4                   | 10.0 | 1.41    | 0.08    |
| 14 | With administration of oral hypoglycaemics the main cause for ADR is as result of the resident not eating meals (Stahl & Berger 1999).  | 13                 | 22.4 | 12                  | 30.0 | -0.85   | 0.80    |
| 15 | Residents with Lewy body dementia are known to have severe antipsychotic sensitivity reactions (Finkel 2004).   | 25                 | 43.1 | 8                   | 20.0 | 2.38    | <0.01*  |
| 16 | Valium is a benzodiazepine and is a highly lipid soluble drug, and considered inappropriate for use in the elderly as its half life may be increased up to 300 hours (Tanaka 1999).   | 37                 | 63.8 | 14                  | 35.0 | 2.80    | 0.002*  |
| 17 | Medications that have an anticholinergic effect, such as haloperidol, can cause ADR in the elderly such as increased confusion, urinary retention, dry mouth and blurred vision (Bhana & Spencer 2000).   | 30                 | 51.7 | 19                  | 47.5 | 0.41    | 0.34    |
| 18 | Being elderly and male can increase the risk of adverse drug reactions. (True) (Wiffen et al. 2002).  | 17                 | 29.3 | 13                  | 32.5 | -0.34   | 0.63    |
| 19 | Olanzapine (zyprexa) is recommended for use in elderly people with a history of obesity or diabetes. (False) (Finkel 2004).   | 9                  | 15.5 | 6                   | 15.0 | 0.07    | 0.47    |
| 20 | Conventional antipsychotics are no longer recommended for use in the elderly. (True) (Bhana & Spencer 2000).  | 20                 | 34.5 | 8                   | 20.0 | 1.56    | 0.06    |
| 21 | ADRs are continuing problem for the elderly and registered nurses are in the position to increase vigilance to help improve health outcomes in this vulnerable population. (True) (Gurwitz et al. 2005).  | 4                  | 6.9  | 0                   | 0.0  | 1.70    | 0.04*   |
| 22 | A pharmacodynamic interaction occurs when the pharmacological effects of one drug alters the response to another drug even though the two types are not themselves directly related. (True) (Bressler & Bahl 2003).   | 6                  | 10.3 | 3                   | 7.5  | 0.48    | 0.32    |
| 23 | A pharmacokinetic drug interaction can alter the concentration of drug in the systemic circulation through interactions occurring at any stage: that is during absorption, distribution, metabolism or excretion (True) (Merck Manual of Diagnosis and Therapy 2005). | 7                  | 12.1 | 2                   | 5.0  | 1.19    | 0.12    |

\*Significant difference.

ADR, adverse drug reactions.

## Discussion

Effective, successful medication management of the elderly requires safe administration, vigilant assessment, monitoring of residents and sound knowledge of pharmacokinetics, pharmacodynamics, ADRs and risks of drug interactions associated with polypharmacy. RNs have a professional role responsibility to be vigilant for ADRs, particularly in people who are vulnerable such as the elderly who often are unable to eliminate drugs efficiently (Jordan 2008). Burgess et al. (2005) maintained that although it was important to identify ADRs, it was equally important to detect it early and prevent it. The increasing ageing population highlights the importance of nurses' responsibility in aged care facilities to care for the elderly who require special attention. The majority of previous nursing studies have used experiential qualitative design or opinion-based questionnaire seeking agreement responses rather than specific responses to factual-based questions on pharmacokinetics and pharmacodynamics. Therefore, in this study, these 23 items of factual-based knowledge questions were specifically developed to elicit information that could ascertain RNs' level of knowledge and the accuracy of their knowledge in relation to medication management and drug reactions experienced by elderly residents in aged care facilities.

The proportion of incorrect responses of the pre-test was high; it revealed a lack of knowledge by RNs in regards to safe medication management and administration in the aged care facilities. The proportion of incorrect responses of the post-test (after the introduction of the education session and self-directed learning package) was significantly lower than the pre-test. This demonstrated that RNs' knowledge of medication management had improved substantially. Statistically, the difference was highly significant with  $Z = 6.55$  and one-sided  $P < 0.001^*$  (Table 1). Overall, there was an improvement of knowledge in all the questions with some showing more improvement than others. Significant difference was indicated in various important aspects of the questionnaire as shown by asterisks in Table 2.

This study has, however, raised an issue of concern in regard to the need for the continuing professional education in this area. Prior to the education programme, 87.9% of RNs were unaware that the elderly, who had a previous ADR to a particular medication, would be more likely to develop an ADR with the commencement of another unrelated drug. Nausea and vomiting are two most common complaints in suspected *digoxin* toxicity. As a result of the ageing process, the elderly are at a high risk of developing toxicity (Williams & Kim 2003), yet the result revealed that 74% of RNs were unable to recognize symptoms of side effects. A pharmacodynamic interaction can occur when pharmacological effects of one drug alter the response to another drug, even though the two types are not themselves directly related (Bressler & Bahl 2003). Also, any pharmacokinetic drug

reaction can alter the concentration of drugs in the systemic circulation, due to drug interactions, which can occur at any stage during absorption, distribution, metabolism or excretion (Merck Manual of Diagnosis and Therapy 2005). All these are the fundamentals of pharmacology taught to RNs, but the result of the study showed that not all participants were aware of these fundamentals.

Patients taking antipsychotic agents, anticoagulants, diuretics and antiepileptic are at increased risk to ADRs (Jordan 2008). Over 50% of participants did not know that medications that have an anticholinergic effect, e.g. Haloperidol, can cause ADR in the elderly such as, increased confusion, urinary retention, dry mouth and blurred vision (Bhana & Spencer 2000). In spite of the education, 47.5% gave incorrect responses. Non-steroidal anti-inflammatory drugs (NSAIDs) and oral anticoagulants have a high innate toxicity; both groups require close monitoring for their safe use and are often used for elderly residents who are more susceptible to ADRs (Howard et al. 2006). Warfarin is a commonly prescribed anticoagulant, yet some participants were unaware that the use of NSAIDs with Warfarin is associated with an increased risk of severe ADRs.

When the elderly are prescribed greater than eight medications, research studies suggest that the likelihood of ADRs occurring approaches 100% (Rollason & Vogt 2003). It raises concerns that not all of the study participants were cognizant of this fact, despite the education session and learning package. *Valium* is a benzodiazepine and is a highly lipid soluble drug. It is considered inappropriate for use in the elderly as its half-life may be increased up to 300 h (Tanaka 1999), but 63.8% in the pre-test group did not give the correct answer. The knowledge improved with a significant drop of incorrect responses to 35%, but not enough for providing quality care to elderly residents. RNs need to be aware that having a previous ADR to a particular medication means that a person is at an increased risk of developing an ADR with the commencement of another unrelated drug (Atkin et al. 1999). Although there is significant improvement in knowledge after the education programme, there is still a need for further continuing education.

This study has demonstrated that the education session and learning package did improve RNs' level of knowledge in medication and medication management, even though there were several aspects where improvement were only marginal. A parallel can be drawn between Jordan's (2002) study, which revealed a need for further development by nurses in the management of ADRs for those suffering long term psychotic issues, and this study, which reaches the same conclusion in terms of elderly care, as both studies involved classes of individuals who require special attention. A previous study by Manias et al. (2004a) found that although graduate nurses attempted to demonstrate safe medica-

tion practices, especially during medication administration, they did not regularly monitor medication effects following administration. In contrast, in this study, participants wrote that they would be more vigilant in monitoring medication effects during and following medication administration. Nevertheless, with the current world emphasis on evidence-based practice, the effectiveness of education programmes cannot be based solely on testing participants' knowledge and satisfaction, but also need to be linked to improved clinical outcomes (Jordan 2000).

## Conclusion

This pilot study set out to evaluate an education programme aimed to increase awareness of and knowledge in pharmacology to improve nursing practice in aged care facilities. It is arguable that this education programme has benefited the participants. Inadvertently, this study has highlighted an area of concern relating to the lack of knowledge in medication management among RNs caring for the elderly residents in aged care facilities. However, the findings cannot be generalized to a wider population of RNs working in aged care facilities. Further studies are required on a larger sample of RNs in other aged care facilities within the region, as well as on the clinical impact of an education programme by evaluating nursing practice and elderly residents' outcomes in aged care facilities.

The nursing implication is that the study has identified a need for intervention to improve RNs pharmacological knowledge, medication administration and management in aged care facilities. Despite the limitations of this study, the result gives some weight to the importance of providing an appropriate continuing professional education programme. It seems that an intervention such as continuing education is mandatory in order to improve nursing practice that will minimize the risk of ADRs.

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## Author contributions

Lee Meng Lim was involved in the study conception, design, analysis/interpretation of data and critical revisions for important intellectual content, and review of the content. Lee Huang

Chiu was involved in the study conception, design, acquisition of data, analysis/interpretation of data, drafting of the manuscript and review of the content. Jayne Dohrmann was involved in the study conception, design, material support and review of the content. Kim Lai Tan was involved in the study design, acquisition of data, provision of statistical technical support and review of the content.

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## Supporting information

Additional Supporting Information may be found in the online version of this article:

**Table S1** Demographics of participants.

**Appendix 1** Key elements of the education programme

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### 10.5.3 Appendice E3 : Article n° 3 – Polypharmacy :

#### Misleading, but manageable

|                               |  |
|-------------------------------|--|
| Article n° 3                  | <b>Polypharmacy misleading but manageable</b>  |
| Auteurs                       | Bushardt, R. L., Massey, E. B., Simpson, T. W., Ariail, J. C., & Simpson, K. N. (2008).  |
| Titre                         | Le concept clé de polymédication est mentionné   |
| Résumé                        | Ici sont ciblés la population et les risques associés avec la polymédication et l'utilisation d'un outil pour la contrôler. L'objectif est énoncé mais la méthode n'est pas décrite ici, elle apparaît plus loin dans l'article.   |
| <b>INTRODUCTION</b>           |  |
| Problème de la recherche      | Les auteurs essayent d'identifier une définition de la polymédication et sa prévalence chez les personnes âgées et de trouver un outil pour que les professionnels de la santé puissent la diminuer.   |
| Recension des écrits          | Une revue de la littérature à travers la banque de données OVID a été faite dans une première phase puis les auteurs ont adapté une liste des drogues inappropriées basées sur deux sources primaires dans cette étude.  |
| Cadre de recherche            | Pas de références philosophiques ou théoriques.  |
| Buts et question de recherche | Le but est de trouver des moyens pour contrer la polymédication chez les personnes âgées de plus de 65ans. L'article essaye de déterminer une définition pour le mot polymédication et comment trouver un équilibre entre les bénéfiques et risques liés à ce phénomène.   |
| <b>METHODE</b>                |  |
| Population et échantillon     | OVID a été consulté et une revue de la littérature des articles originaux publiés pendant 1997 et 2007 a été interrogée. Les mots clés utilisés inclus « polypharmacy, geriatrics, inapropriate médication » et correspondent à notre questionnement pour ce travail. Les textes étaient en langue anglaise. La population des personnes âgées de plus de 65ans a été investiguée, plus spécifiquement en ambulatoire. |
| Considérations éthiques       | Les noms des participants n'ont pas été dévoilés dans l'article. Son objectif est minimiser les risques pour cette population face à une polymédication.   |

|                                 |   |
|---------------------------------|---|
| Devis de recherche              | La méthode a permis de trouver une définition pour la polymédication dans le sens d'une médication inappropriée.  |
| Modes de collectes de données   | Les auteurs ont cherché les articles originaux publiés entre 1/1997 et 5/2007 sur le moteur de recherche OVID.  |
| Conduite de la recherche        | Les étapes ne sont pas clairement définies.   |
| Analyse des donnés              | L'analyse n'est pas clairement décrite. Les résultats sont par contre, compréhensibles avec un résumé des différentes définitions de la polymédication, les drogues dites inappropriées et un outil d'évaluation pour les professionnels de la santé.   |
| <b>RESULTATS</b>                |   |
| Présentation des résultats      | En forme de texte narratif et tables qui montrent les différentes définitions de la polymédication et une liste des médicaments le plus associés avec des prescriptions inappropriées et le pourcentage des patients recevant la prescription. Les auteurs ont inclus un tableau qui montre un outil (hyperpharmacotherapy assessment tool) qui pourrait être utilisé par les professionnels de la santé. |
| <b>DISCUSSION</b>               |   |
| Interprétations des résultats   | D'autres définitions du mot « polypharmacy » sont proposées y compris les drogues qui posent un risque élevé pour la population cible. La polymédication peut être comprise dans le sens négatif mais aussi dans le sens positif, c'est cette dualité qui pose problème dans la recherche.  |
| Conséquences et recommandations | Les auteurs suggèrent de ne plus utiliser le terme polymédication. Ils proposent des alternatives comme « hyperpharmacotherapy » ou « multiple medication ». Ils conseillent aux professionnels de la santé de prendre plus de temps lors des entretiens médicaux afin d'analyser et évaluer les traitements médicamenteux des patients.  |



# Polypharmacy: Misleading, but manageable

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**Abstract:** The percentage of the population described as elderly is growing, and a higher prevalence of multiple, chronic disease states must be managed concurrently. Healthcare practitioners must appropriately use medication for multiple diseases and avoid risks often associated with multiple medication use such as adverse effects, drug/drug interactions, drug/disease interactions, and inappropriate dosing. The purpose of this study is to identify a consensus definition for polypharmacy and evaluate its prevalence among elderly outpatients. The authors also sought to identify or develop a clinical tool which would assist healthcare practitioners guard against inappropriate drug therapy in elderly patients. The most commonly cited definition was a medication not matching a diagnosis. Inappropriate was part of definitions used frequently. Some definitions placed a numeric value on concurrent medications. Two common definitions (ie, 6 or more medications or a potentially inappropriate medication) were used to evaluate polypharmacy in elderly South Carolinians (n = 1027). Data analysis demonstrates that a significant percentage of this population is prescribed six or more concomitant drugs and/or uses a potentially inappropriate medication. The findings are 29.4% are prescribed 6 or more concurrent drugs, 15.7% are prescribed one or more potentially inappropriate drugs, and 9.3% meet both definitions of polypharmacy used in this study. The authors recommend use of less ambiguous terminology such as hyperpharmacotherapy or multiple medication use. A structured approach to identify and manage inappropriate polypharmacy is suggested and a clinical tool is provided.

**Keywords:** hyperpharmacotherapy, polypharmacy, geriatrics, inappropriate medication, inappropriate pharmacy, multiple medication use

## Background

The use of multiple medications, often termed polypharmacy, is recognized as an increasingly serious problem in the current healthcare system. The US General Accounting Office reports significant morbidity and mortality associated with inappropriate polypharmacy. In addition, polypharmacy is recognized as an expensive practice: the US Center for Medicare and Medicaid Services estimates that polypharmacy costs its nation's health plans more than US\$50 billion annually (Berenbeim 2002). But the issue of multiple medication use, particularly by elderly patients, is a complex one. The potential risks of polypharmacy are evident; however, so are the benefits to patients when medication therapies are combined to cure, slow the progression, or reduce the symptoms of disease. Additionally, a plethora of drug therapies for chronic disease can improve quality of life and prevent complications, including disability and unnecessary hospitalization. Balancing the risks and benefits of multiple drug therapies in older adults becomes a challenging endeavor for prescribers. Education and strategies which enable the healthcare practitioner to achieve successful polypharmacy and avoid inappropriate polypharmacy must be developed and shared.

Patients 65-years-old and older are the largest consumers of prescription and nonprescription medications in the US, and the use of prescription and nonprescription medications among this group has more than doubled since 1990 and continues

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to rise, according to the Centers for Disease Control and Prevention (CDC). Elderly Americans consume one-third of all the prescription medications prescribed each year, yet they comprise less than 13% of the population (Azad 2005; CDC 2005). The relatively high rates of drug consumption by elderly patients and numerous other factors contribute to the increased prevalence of medication-associated morbidity and mortality affecting this population. Significant contributing factors are the physiologic changes associated with aging, which may include decreased renal elimination, decreased hepatic function, decreased total body water and lean body mass, and age-related declines in vision and hearing. Several of these changes can lead to alterations in the pharmacokinetics of medications for many elderly patients, namely altered distribution, metabolism, and elimination. Other contributing factors are pathophysiologic alterations involved with disease, frequency of chronic disease and medical comorbidities, communication barriers, and healthcare delivery involving multiple prescribers (GAO 2000; Delafuente 2003).

## Purpose

Because individuals are living longer and accruing chronic diseases, practitioners have a new responsibility to prescribe appropriately the many medications available to manage concurrent disease states. The plethora of pharmaceutical options must be balanced with the potential risk of multiple medication use. These risks include, but are not limited to, adverse effects, drug/drug interactions, drug/disease interactions and inappropriate dosing regimens. Primary care health professionals such as physicians, physician assistants, and nurses have an enormous opportunity to survey patients for this risk given their accessibility and roles in the coordination of care. Nearly 45% of physician assistants, for example, practice in family medicine, general internal medicine, or internal medicine subspecialties, according to the American Academy of Physician Assistants Census Report (AAPA 2006). These providers and others have an opportunity to ensure appropriate medication management, especially in their elderly patients. Originally, the purpose of this study was to identify the consensus definition for polypharmacy and evaluate its prevalence within elderly outpatients in the state of South Carolina. A review of the literature, however, revealed that no consensus existed in the medical literature on the definition for polypharmacy. Thus, it became necessary to evaluate and clarify terminology currently used in the medical literature to describe multiple medication use in the older adult before evaluating the prevalence of polypharmacy. Additionally, the authors sought to identify or develop

a clinical tool to assist healthcare practitioners guard against inappropriate drug therapy in elderly patients.

## Methods

In the first phase of this study, a literature review was conducted within OVID for original articles published between January 1997 and May 2007, using the following search terms and phrases: 'polypharmacy,' 'elderly,' 'geriatrics,' 'inappropriate medication,' and 'multiple medication use.' English language articles available in local holding which described 'polypharmacy' or the issue of the simultaneous use of multiple medications in elderly patients were evaluated. Discrete definitions of polypharmacy were identified and recorded.

Throughout the literature, numerous articles used the term 'polypharmacy' and the phrase 'inappropriate drug use' interchangeably. The research reported that methods most often used for identifying inappropriate drug use involved the use of criteria, primarily the criteria developed, and more recently revised, by Beers and colleagues (Beers 1997; Fick et al 2003). The investigators adapted a list of inappropriate drugs from two primary sources for use in this study (Fick et al 2003; Bressler and Bahl 2003). The medications used in this research were based upon the Beers' criteria but were limited to those identified as "high risk" (see Table 2). This list is labeled as 'potentially inappropriate,' because we recognize that use of one or more of these agents in an older adult could be justified by specific circumstances, for example, if safer alternatives had been exhausted.

Two different definitions of polypharmacy were applied to the database, which consisted of outpatient medical record data randomly collected by physician assistant students at the time of patient encounters during supervised clinical training from August 2006 to May 2007. Polypharmacy was defined as either "use of at least one potentially inappropriate drug" (see Table 2) or "the presence of six or more concurrent medications". The database included patient demographics (ie, age, gender, ethnicity, educational level, and marital status), vital signs, diagnoses, prescription medications, health-related quality of life, and disease-specific markers when applicable (ie, blood pressure, urine microalbumin, hemoglobin A1c, creatinine clearance, liver transaminases, estimated left ventricular ejection fraction, and others). These outpatient data were collected from more than 500 outpatient clinical sites throughout the state of South Carolina representing the following disciplines: family medicine, general internal medicine, pediatrics, general surgery, gynecology and obstetrics, emergency medicine, and internal medicine

subspecialties. At the time of analysis the database contained 10,455 discrete patient entries, and the 1270 entries involving patients 65-years or older were selected for investigation.

## Results

The term ‘polypharmacy’ is frequently used in the medical literature; however, the definitions of polypharmacy often varied from scholar to scholar. No consensus definition for

polypharmacy was readily identified. The various definitions of polypharmacy identified in 11 publications reviewed are summarized in Table 1. The most commonly cited definition, which appeared in four articles, “was medication did not match diagnosis”. The term ‘inappropriate’ was part of definitions used in six articles. Several other different definitions, used by at least three scholars, involved one of the following concepts: many medications, duplication of

**Table 1** Definitions of polypharmacy

| Specific definitions of polypharmacy (Polypharmacy is...)   | Number of articles     | Other descriptions of inappropriate medication use   | Number of articles   |
|---|------------------------|--|----------------------|
| Medication does not match the diagnosis*  | 4 <sup>5,9,16,22</sup> | Drug/drug interactions   | 3 <sup>2,10,22</sup> |
| Many medications  | 3 <sup>10,14,22</sup>  | Excessive duration   | 3 <sup>2,10,22</sup> |
| Duplication of medication*  | 3 <sup>5,9,16</sup>    | Inappropriate drugs (ie, lack of proven benefit, drug indication, etc.)  | 2 <sup>2,10</sup>    |
| Drug/drug interactions*   | 2 <sup>9,16</sup>      | Drugs that cause adverse effects   | 2 <sup>10,22</sup>   |
| Inappropriate dosing frequency (excessive, too low, too long)*  | 2 <sup>5,16</sup>      | Drug/disease interactions  | 2 <sup>2,22</sup>    |
| Medication prescribed to treat the side effect of another medication (except for cases where there is no other option)*     | 2 <sup>5,16</sup>      | Availability of an equally effective, lower-cost alternative   | 2 <sup>2,22</sup>    |
| Two or more drugs of the same chemical class  | 1 <sup>8</sup>         | Excessive dosages  | 2 <sup>2,10</sup>    |
| Two or more meds to treat the same condition  | 1 <sup>8</sup>         | Inappropriate dosing frequency (excessive, too low, too long)  | 2 <sup>2,10</sup>    |
| Two or more agents with the same or similar pharmacologic actions to treat different conditions                             | 1 <sup>8</sup>         | Complicated drug regimen affecting compliance  | 2 <sup>2,10</sup>    |
| Minor polypharmacy = 2–4 meds. Major polypharmacy ≥5 meds.  | 1 <sup>20</sup>        | Prescription of multiple meds by different specialists for treating concurrent conditions                              | 1 <sup>2</sup>       |
| 3,5, or 6 different medications   | 1 <sup>17</sup>        | Medication does not match the diagnosis  | 1 <sup>22</sup>      |
| Two or more medications   | 1 <sup>18</sup>        | Medication prescribed to treat the side effect of another medication (except for cases where there is no other option) | 1 <sup>22</sup>      |
| Greater than 5 medications  | 1 <sup>5</sup>         | Polypills  | 1 <sup>22</sup>      |
| Excessive use of medication   | 1 <sup>16</sup>        | More than one pharmacy used  | 1 <sup>22</sup>      |
| Unnecessary use of medication   | 1 <sup>16</sup>        | Multiple prescribers of medication   | 1 <sup>22</sup>      |
| Medications prescribed greater than twice per day   | 1 <sup>5</sup>         | High risk medications  | 1 <sup>22</sup>      |
| Complicated drug regimen effecting compliance*  | 1 <sup>9</sup>         | Number of medications  | 1 <sup>22</sup>      |
| Contraindicated in the elderly  | 1 <sup>9</sup>         | Diet   | 1 <sup>22</sup>      |
| Taking an OTC medication, an herbal product or another person’s medication  | 1 <sup>9</sup>         | Frequency of medication therapy monitoring   | 1 <sup>22</sup>      |
| Availability of an equally effective, lower-cost alternative*   | 1 <sup>5</sup>         | Male Gender  | 1 <sup>22</sup>      |
| Patient misunderstanding of the use of the medication (purpose, how to take it, side effects possible, toxicity signs, etc) | 1 <sup>5</sup>         | New resident to nursing home   | 1 <sup>22</sup>      |
| Dosage does not reflect age/renal/liver status  | 1 <sup>5</sup>         | Medication is not the most effective available   | 1 <sup>22</sup>      |
| Improvement after discontinuation of medications  | 1 <sup>16</sup>        | Treatment goals unmet  | 1 <sup>2</sup>       |
| Diagnosis no longer present   | 1 <sup>5</sup>         | Duplication of medication  | 1 <sup>2</sup>       |

\*Also a description of multiple medication use.

**Table 2** Percentage of patients prescribed potentially inappropriate drugs

| Generic name                     | Patients prescribed each medicine (%) |
|----------------------------------|---------------------------------------|
| Alprazolam                       | 11.56                                 |
| Lorazepam                        | 11.1                                  |
| Amitriptyline                    | 9.1                                   |
| Nifedipine                       | 8.5                                   |
| Promethazine                     | 6.0                                   |
| Oxybutynin                       | 6.5                                   |
| Fluoxetine                       | 5.0                                   |
| Oxybutynin                       | 4.5                                   |
| Cyclobenzaprine                  | 4.0                                   |
| Temazepam                        | 3.5                                   |
| Indomethacin                     | 3.5                                   |
| Amiodarone                       | 3.5                                   |
| Hydroxyzine                      | 3.0                                   |
| Diphenhydramine                  | 3.0                                   |
| Metaxalone                       | 3.0                                   |
| Naproxen                         | 2.5                                   |
| Chlorazepate                     | 2.0                                   |
| Diazepam                         | 2.0                                   |
| Ketorolac                        | 1.5                                   |
| Belladonna alkaloids             | 1.0                                   |
| Perpheazine – amitriptyline      | 1.0                                   |
| Piroxicam                        | 1.0                                   |
| Clidinium – Chlordiazepoxide     | 1.0                                   |
| Chlorpheniramine                 | 1.0                                   |
| Oxaprozin                        | 1.0                                   |
| Meperidine                       | 1.0                                   |
| Chlordiazepoxide – amitriptyline | 0.5                                   |
| Chlordiazepoxide – amitriptyline | 0.5                                   |
| Dicyclomine                      | 0.5                                   |
| Hyoscyamine                      | 0.5                                   |
| Nitrofurantoin                   | 0.5                                   |
| Oxazepam                         | 0.5                                   |
| Doxepin                          | 0.5                                   |

**Notes:** Over the counter medications are not included; Barbiturates are not included as there is no knowledge whether or not the patient is taking them to control seizures.

medications, drug/drug interactions, and excessive duration. Some definitions for polypharmacy place a value on the number of concurrent medications; the most commonly referenced number was six medications or more. This finding is interesting especially because elderly residents of extended care facilities typically receive more than seven medications per day (Chutka et al 2004).

Because no consensus definition for polypharmacy emerged during our literature review, we applied two of the most commonly cited ones to our dataset, specifically “use of a potentially inappropriate drug” or “use of six or more concomitant drugs”. The analyses of the data collected from elderly patients demonstrate that a significant percentage of this population are, in fact, prescribed six or more concomitant

drugs and/or use a potentially inappropriate medication. Of the 1270 elderly patients evaluated, 29.4% are prescribed 6 or more concurrent drugs, 15.7%, or 199 patients, are prescribed one or more potentially inappropriate drugs, and 9.3% meet both definitions of polypharmacy used in this study (ie, “six or more concurrent medications” and “at least one potentially inappropriate drug”). The potentially inappropriate medications prescribed include medications known to produce significant central nervous system depressant or anti-cholinergic effects. For example, 32% of the patients who were prescribed a potentially inappropriate drug received at least one benzodiazepine-containing products (see Table 2).

## Discussion

Poly, of Greek origin, is simply defined by Webster as “many, several, much, multi, containing an indefinite number.” Attaching this prefix to the word ‘pharmacy’ implies many pharmacies, and is devoid of any moral value. The results presented in Table 1 clearly demonstrate the lack of consistency with the use of the term ‘polypharmacy’ in the medical literature. To further complicate the issue, the term ‘polypharmacy’ connotes a negative, inappropriate medication use in some areas of the literature, but in other publications, the term describes an appropriate combination of multiple medications. In other words, one word, polypharmacy, can be both negative and positive. This duality makes objective research difficult, to say the least. Of the 11 articles that describe polypharmacy, 24 distinctly different definitions emerge. The most common definition identified, “medication does not meet diagnosis,” is clearly synonymous with unnecessary or inappropriate. Many of the definitions identified were also quite vague, complicating any attempt to quantify or study further the issue through standardized, measurable methodologies. For example, the description, “excessive use,” can be interpreted in many ways. Excessive might refer to the frequency of the drug, the dosage, unintentional overuse, intentional misuse or abuse, or drug consumption when a nondrug alternative is more appropriate. The lack of objective terminology and precision in definition is replicated in the multiple interpretations of the descriptions, “many medications,” “unnecessary use,” and “duplication of medication”. Arguably, prescribing a single medication that does not match a diagnosis would be considered inappropriate polypharmacy. A quantity-specific definition of polypharmacy, however, is easy to construct and apply, but this method is associated with a relatively high rate of false positives, not specific for ‘inappropriate medication use.’ The vague and often dissimilar use of the term ‘polypharmacy’ within the literature supports the discontinuation of its use.

To illustrate the complexity of evaluating the prevalence of polypharmacy among older adults, we calculated the prevalence using two commonly cited definitions for polypharmacy to determine their validity and reliability. We found 13.7% more patients were identified as recipients of ‘potentially inappropriate polypharmacy’ when the quantity-specific definition was used, ‘six or more concurrent medications.’ When a drug-specific definition was applied, we found that 15.7% were recipients of ‘potentially inappropriate polypharmacy.’ These disparate results call the validity and reliability into question. If our population is reflective of our country’s geriatric population, this variance could represent approximately 4.9 million patients based on data from the US Consensus Bureau (US Department of Commerce 2004).

According to several sources, including the American Psychiatric Association, the use of potentially inappropriate drugs such as benzodiazepines is commonly associated with intellectual and cognitive impairment, psychomotor impairment, and increased risk for fall or motor vehicle accident (Bugonvic and Greenfield 2004). Differentiating age-related, disease-related, and drug-related impairment can be challenging for any provider. A targeted approach to identify potentially inappropriate medications such as screening for particular high-risk drugs or contraindicated drugs may provide a higher sensitivity. Further evaluation to validate and identify the relative sensitivity of the definitions applied to the database in this pilot project is needed. This effort will require more intensive review of individual patient profiles to identify contraindicated drugs, significant drug/drug interactions, major drug/disease interactions, apparent drug associated morbidity or mortality, and unwarranted duplications of therapy. If validated, one or both of these definitions could then be applied to claims data or managed-care patient populations for comparison. Additionally, three unanswered questions emerged during our research that require additional discussion and exploration: Does pharmacy refer to medications or the actual location where clients pick up prescriptions? Is ‘polypharmacy’ a positive term meaning that multiple medications are used to treat disease effectively? Is it a negative term denoting inappropriate

drug therapy? Or is it a neutral term simply referring to the concomitant use of more than one medications? Are the terms ‘polypharmacy’ and the phrase ‘inappropriate drug use’ mutually exclusive?

Our research supports the discontinuation of the use of the term ‘polypharmacy,’ agreeing with Preskorn and colleagues (2005) as well as Bushardt and Jones (2005). Preskorn (2005) recommends the alternative phrase ‘multiple medication use.’ However, Preskorn’s phrase has a neutral connotation because concomitant use of multiple drugs is often supported by evidence-based guidelines for various disease states (Preskorn 2005). Examples include treatment guidelines for heart failure developed by the American College of Cardiology and the American Heart Association as well as treatment guidelines for hypertension published in the seventh report of the Joint National Commission on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (Chobanian et al 2003). Bushardt and Jones (2005) propose the alternative term ‘hyperpharmacotherapy’ because it offers a different connotation. According to the American Heritage Dictionary, ‘pharmacotherapy’ refers to the treatment of disease with the use of drugs. Thus, the addition of the prefix ‘hyper-’ to ‘pharmacotherapy’ implies an excessive use of drugs for treatment of disease.

## Implications for practice

Because the elderly population has a higher prevalence of chronic diseases, multiple drug use is very common (Jorgensen et al 2001). An increase in the number of medications may pose a higher risk of hyperpharmacotherapy, and an assessment tool to ensure the safety of patients taking multiple drugs is needed (Feinberg and Simonson 2005). Many prescribers may feel overwhelmed when encountering an older adult who has been prescribed multiple drugs or whose drug therapy regimen is quite complex. The process for reviewing an individual patient’s drug therapy regimen for inappropriate polypharmacy, or ‘hyperpharmacotherapy,’ can be taught and supported by various clinical tools. Corrective actions to reduce the burden of hyperpharmacotherapy for a patient may require a considerable amount of time

**Table 3** Hyperpharmacotherapy resource guides

| Resource title  | Author             | Website   | Journal                                     |
|---|--------------------|---|---|
| 1. The 9 key questions to address polypharmacy in the elderly | Bushardt and Jones | <a href="http://jaapa.com/issues/j20050501/articles/polypharm0505.htm">http://jaapa.com/issues/j20050501/articles/polypharm0505.htm</a>         | JAAPA May 2005                              |
| 2. Beer’s criteria  | Beers et al        | <a href="http://archinte.ama-assn.org/cgi/content/full/163/22/2716">http://archinte.ama-assn.org/cgi/content/full/163/22/2716</a>               | Archives of Internal Medicine December 2003 |
| 3. Principles of drug therapy for the elderly patient         | Bressler and Bahl  | <a href="http://www.mayoclinicproceedings.com/inside.asp?AID=761&amp;UID=">http://www.mayoclinicproceedings.com/inside.asp?AID=761&amp;UID=</a> | Mayo Clinic Proceedings 2003                |

and close monitoring as some drugs require tapering and monitoring. Additionally, pitfalls may be encountered if a provider attempts to make multiple changes to a regimen at a single point in time. Zarowitz (2006) has previously discussed the potential challenges involved with careless discontinuation of medications, including disease exacerbation and hospitalization. Therefore, a more rational approach to drug discontinuation might involve tapering a single drug therapy at a time with careful monitoring for symptoms of withdrawal and disease exacerbation. Because the purpose of eliminating inappropriate polypharmacy includes enhancing quality of life for patients, it is important to pay careful attention to the discontinuation process.

Feinberg and Simonson (2005) suggest a comprehensive review of a patient’s drug regimen be performed annually, or more frequently if indicated. Several clinical tools have been published to help providers reduce hyperpharmacotherapy. Bushardt and Jones (2005) previously developed and published a series of nine questions for physician assistants to use to guide the drug therapy evaluation process (see Table 3). We have developed a comprehensive tool called the Hyperpharmacotherapy Assessment Tool (HAT), adapted from Bergman-Evans’ Medication Management Outcome Monitor (2006). It appears in Figure 1. Modifications were made to create a more concise tool as well as to include pertinent components not listed in the form developed by

**Hyperpharmacotherapy Assessment Tool (HAT)**

Patient Name: \_\_\_\_\_

*Instructions: Evaluate drug profile by using criteria below. The first two criteria require numbers. Otherwise, use Y = Yes, N = No. When question is answered “Yes,” investigate ways to improve medication regimen. Drug discontinuation or tapering should generally be engaged with a single drug at the time. When choosing among multiple medications well suited for discontinuation, consider the underlying problem and review this series in descending order of priority: safety, tolerability, efficacy, tolerability, price, and simplicity of use.*

|   | Visit 1<br>Date: | Visit 2<br>Date: | Visit 3<br>Date: | Visit 4<br>Date: | Visit 5<br>Date: | Visit 6<br>Date: |
|---|------------------|------------------|------------------|------------------|------------------|------------------|
| <b>GOAL I: Monitor Number of Medications</b>  |                  |                  |                  |                  |                  |                  |
| Total # of Prescription medications, OTC medications, vitamins or minerals, dietary supplements and herbs |                  |                  |                  |                  |                  |                  |
| Total # of Meds systemically or gastrointestinally absorbed   |                  |                  |                  |                  |                  |                  |
| <b>GOAL II: Decrease Inappropriate Drug Use</b>   |                  |                  |                  |                  |                  |                  |
| Has the disease state resolved that the drug(s) was originally prescribed for?                            |                  |                  |                  |                  |                  |                  |
| Is non-drug therapy an option?  |                  |                  |                  |                  |                  |                  |
| Is there another drug more effective for the disease?   |                  |                  |                  |                  |                  |                  |
| Is there an equally effective, lower-cost drug available?   |                  |                  |                  |                  |                  |                  |
| Is the patient taking another person's medication?  |                  |                  |                  |                  |                  |                  |
| Is the drug inappropriate for use in the elderly?   |                  |                  |                  |                  |                  |                  |
| Are treatment goals unachieved?   |                  |                  |                  |                  |                  |                  |
| <b>GOAL III: Decrease Inappropriate Pharmacology</b>  |                  |                  |                  |                  |                  |                  |
| Are there any adverse effects to the medication(s)?   |                  |                  |                  |                  |                  |                  |
| Is the patient using 2 or more drugs of the same chemical class or pharmacologic action?                  |                  |                  |                  |                  |                  |                  |
| Is the patient taking combination pill(s) in which one of the medications is inappropriate?               |                  |                  |                  |                  |                  |                  |
| Are there any drug-drug interactions? (OTC, herbal supplements, prescription meds)                        |                  |                  |                  |                  |                  |                  |
| Are there any adverse drug-disease interactions?  |                  |                  |                  |                  |                  |                  |
| Does the patient's diet interfere with pharmacologic action?  |                  |                  |                  |                  |                  |                  |
| Is there risk of addiction from the medication?   |                  |                  |                  |                  |                  |                  |
| Is the patient at risk for accumulation from long-term use?   |                  |                  |                  |                  |                  |                  |
| <b>GOAL IV: Optimize dosing regimen</b>   |                  |                  |                  |                  |                  |                  |
| Is there a lower effective dose of the medication?  |                  |                  |                  |                  |                  |                  |
| Does the patient have any medications dosed more than 2 times per day?                                    |                  |                  |                  |                  |                  |                  |

|  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|
| Does the patient have any problems with adherence to the drug regimen? (i.e. affording medications, problems reading labels, understanding instructions, identifying color of pills, breaking tablets, or using inhaler/syringes)? |  |  |  |  |  |  |
| Does the dosage need to be adjusted to reflect age, renal, and liver status?   |  |  |  |  |  |  |
| <b>GOAL V: Organize sources of medication</b>  |  |  |  |  |  |  |
| Are there any additional medications prescribed by other healthcare providers that have not been identified?   |  |  |  |  |  |  |
| Does the patient use multiple pharmacies?  |  |  |  |  |  |  |
| Does the patient use mail-order pharmacy?  |  |  |  |  |  |  |
| <b>GOAL VI: Educate Patient</b>  |  |  |  |  |  |  |
| Is the patient or his/her caregiver unable to describe the purpose, side effects, instructions for the medication?   |  |  |  |  |  |  |
| Are the IADL and ADL becoming unstable?  |  |  |  |  |  |  |
| <b>COMMENTS</b>  |  |  |  |  |  |  |
| Visit 1  |  |  |  |  |  |  |
| Visit 2  |  |  |  |  |  |  |
| Visit 3  |  |  |  |  |  |  |
| Visit 4  |  |  |  |  |  |  |
| Visit 5  |  |  |  |  |  |  |
| Visit 6  |  |  |  |  |  |  |

**Figure 1** Hyperpharmacotherapy assessment tool (Adapted with permission from Bergman-Evans B. 2006 Evidence-based guideline: Improving medication management for older adult clients. *J Gerontol Nurs*, 32:6–14).

Bergman-Evans. Additional research by physician assistants can further refine this instrument.

Health professionals, particularly those in primary care, are well positioned to impact appropriate use of medication therapies for older adults. Mid-level practitioners such as physician assistants may be able to justify spending more time with patients in today's healthcare system versus their physician supervisors. Additional time during a clinical interview could be used to conduct the medication review process.

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**10.5.4 Appendice E4 : Article n° 4 – Polypharmacy in the Elderly : A Literature Review**

|                               |  |
|-------------------------------|--|
| Article n° 4                  | <b>Polypharmacy in the Elderly : A Literature Review</b>   |
| Auteurs                       | Fulton, M. M., & Allen, E. R. (2005).  |
| Titre                         | La polymédication et la population ciblée sont citées.   |
| Résumé                        | Les auteurs énoncent brièvement l'objectif, méthode, conclusion et les implications.   |
| <b>INTRODUCTION</b>           |  |
| Problème de la recherche      | Polymédication est identifiée comme problème et augmente comme le vieillissement de la population. Les individus de plus de 65ans constitue 15% de cette population et achète un tiers de toutes les prescriptions médicamenteuses et 40% des prescriptions non médicamenteuses. Le risque de développer des effets indésirables est de 13% avec deux médicaments mais grimpe à 58% avec cinq médicaments.   |
| Recension des écrits          | Des articles scientifiques ont été recherchés dans les banques de données avec le même thème et une recherche des sites pertinents a été réalisée. Plusieurs articles dont des sources primaires sont référencés à travers le texte.   |
| Cadre de recherche            | Les concepts clés sont mis en évidence dans l'introduction.  |
| Buts et question de recherche | Les buts de l'article sont de répondre aux 3 questions suivantes : <ul style="list-style-type: none"> <li>• Comment la polymédication est définie dans la littérature ?</li> <li>• Quelles méthodes sont utilisées par les « Primary care providers » (médecins et infirmiers) pour évaluer la polymédication chez les personnes âgées ?</li> <li>• Quelles interventions sont utilisées par les Primary care providers pour réduire les traitements médicamenteux qui ne sont pas indiqués cliniquement chez les personnes âgées ?</li> </ul> |



| METHODE                       |  |
|-------------------------------|--|
| Population et échantillon     | <p>Les bases de recherches EBSCOHost, Info-Trac, OVID, FirstSearch et FirstSearch Deluxe ont été interrogées.</p> <p>Cette recherche a été enrichie par un sondage des journaux pertinents des sites sur internet.</p> <p>Les auteurs ont utilisé les mots clés « polypharmacy, elderly, research et multiple médicaments ».</p> <p>Les textes cités dans cet article sont de langue anglaise.</p> <p>La population ciblée dans cette recherche est les individus de plus de 60 ans.</p> |
| Considérations éthiques       | <p>Les auteurs essayent de trouver ce qui est fait pour minimiser les risques liés à la polymédication chez une population vulnérable. A part des considérations éthiques ils parlent des implications financières liées à la polymédication.</p>  |
| Devis de recherche            | <p>Cette étude systématique de la littérature et sa méthode de recherche a répondu aux deux premières questions formulées dans l'introduction. Pour la troisième les auteurs ont dû modifier la réponse en questionnant les prescriptions inappropriées.</p>   |
| Modes de collectes de données | <p>Les articles ont été lus et évalués. Certains d'entre eux ont été exclus car le thème de polymédication et des soins primaires n'ont pas été investigués ou que l'âge de la population cible était inférieur à 60 ans.</p> <p>Les questions de recherches sont bien posées même si la troisième n'a pas pu aboutir à une réponse adéquate.</p>  |
| Conduite de la recherche      | <p>La méthode pour conduire la recherche n'est pas clairement décrite.</p>   |
| Analyse des donnés            | <p>Les données ont été analysées même si la méthode n'est pas très détaillée.</p>  |
| RESULTATS                     |  |
| Présentation des résultats    | <p>Les résultats sont présentés en forme de texte narratif et en forme de tableau.</p> <p>Les tableaux correspondent aux 3 questions de recherche.</p> <ul style="list-style-type: none"> <li>• <b>Le premier</b> interpelle l'incidence et prévisions de la polymédication.</li> <li>• <b>la deuxième</b> demande les méthodes utilisées pour l'évaluer</li> </ul>  |

|  |  |
|--|--|
|  | <ul style="list-style-type: none"> <li>• <b>La troisième</b> questionne les prescriptions inappropriées.</li> </ul> <p>Les auteurs n'ont pas confirmé si les données ont été évaluées par des experts ou par des participants. On pourrait considérer les auteurs comme les « experts » dans leur domaine (soins infirmiers).</p>  |
| <b>DISCUSSION</b>                      |  |
| <b>Interprétations des résultats</b>   | <p>L'étude est limitée par rapport à un manque d'information pour répondre aux questions de cette recherche par exemple il n'existe pas une seule et unique définition de la polymédication selon cette étude.</p>   |
| <b>Conséquences et recommandations</b> | <p>Les auteurs estiment que plus de recherche est nécessaire pour approfondir les trois questions initiales. Ils proposent néanmoins une définition de la polymédication comme « l'usage des médicaments non indiqués cliniquement ».</p> <p>L'étude soutient une autre revue de la littérature en confirmant que la polymédication reste un problème significatif.</p> <p>Les auteurs témoignent qu'en Europe plus de recherche est faite sur la polymédication quant aux Etats Unis où elle est plus axée sur les prescriptions inappropriées.</p> |

## Polypharmacy in the Elderly: A Literature Review

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### Purpose

To review the body of literature addressing polypharmacy in individuals aged 60 years and older to (a) determine primary care providers' definition of polypharmacy, (b) explore how polypharmacy was assessed in primary care, and (c) seek tested interventions that address polypharmacy.

### Data Sources

A systematic review of electronic bibliographic databases (e.g. EBSCOHost, InfoTrac, OVID, FirstSearch, and FirstSearch Deluxe) utilizing the search terms "polypharmacy," "polypharmacy and elderly," "polypharmacy and research," and "multiple medications" for the period January 1991 to October 2003 was completed. The search was supplemented with online site searches of relevant journals and review of reference lists of each article.

### Conclusions

Results of the literature review revealed that polypharmacy continues to be a significant issue and little research has been conducted regarding the methods primary care providers utilize to assess polypharmacy. Also, there is a gap in the literature regarding the interventions implemented by primary care providers to address polypharmacy.

### Implications for Practice

The following definition of polypharmacy in clinical practice might be more practical: the use of medications that are not clinically indicated. Selecting appropriate limits for numbers of medications may be counterproductive in populations with multiple comorbidities.

### Key Words

Polypharmacy, elderly, research, multiple medications.

## INTRODUCTION

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The United States Department of Health and Human Services (USDHHS, 2001) reported that there are approximately 35 million Americans over the age of 65. It is projected that the older population will more than double to about 70 million by the year 2030. Furthermore, the population over age 85 is expected to more than double from the current 4.2 million to 8.9 million by 2030. The greatest increases in population are expected between 2010 and 2030 when the "baby boomers" reach 65 years of age.

Polypharmacy, like the older population, is increasing in the United States. The magnitude of the problem was evident in *Healthy People 2000* when polypharmacy was identified as a medication safety issue (Larsen & Hoot Martin, 1999). Werder and Preskorn (2003) identified the prevalence of polypharmacy in the elderly to be approximately 7%. Werder and Preskorn further reported that while individuals over the age of 65 constitute less than 15% of the population, they purchased one-third of all prescription medications and 40% of nonprescription medications. Williams (2002) reported that older Americans spend approximately \$3 billion on prescription medications annually. Furthermore, 61% of individuals older than age 65 take at least one prescription medication, with most taking an average of three to five medications (Williams). These numbers do not include over-the-counter medications or herbal supplements.

Chronic diseases are common among the older population. The aging process results in altered metabolism and excretion of medications, and deficits in cognition and senses. Incidence of adverse drug reaction and interactions is increased with polypharmacy. The risk for an adverse drug event is 13% with the use of two medications, but the risk increases to 58% for five medications (Prybys, Melville, Hanna, Gee, & Chyka, 2002). If seven or more medications are used, the incidence of adverse drug events increases to 82% (Prybys et al., 2002).

The purpose of this literature review was to answer the following questions. (a) How is polypharmacy defined in the literature? (b) What methods are utilized by primary care providers to assess polypharmacy in the older population? (c) What interventions do primary care providers utilize to decrease medications that are not clinically indicated in the older population? The answers to these questions are critical as there is a direct correlation between an increase in the older population and the incidence of polypharmacy.

## BACKGROUND

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The etiology of polypharmacy is multifactorial. Chronic medical conditions and age-related organ pathophysiology can dictate the necessity for multiple medications. For instance, clients diagnosed with diabetes, hypertension, and dyslipidemia are prime examples of the use of multiple

### Conflict of Interest Disclosure

The authors report no conflicts of interest related to the contents of this article.

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medications that are clinically indicated. Self-medication is another contributing factor to polypharmacy. The number of over-the-counter medications continues to increase as medications that were once prescription-only are now becoming available over the counter. Additionally, complementary and alternative therapies are more popular as demonstrated by a significant increase in sales (Prybys et al., 2002). Clients often do not consider complimentary and alternative therapies to be medications and do not disclose herbal and homeopathic use to primary care providers. Vulnerability in the older population is another consideration. Lack of knowledge regarding the prescribed medication regimen, storing medications out of original prescription containers, and similar medication names and appearance add confusion to the issue of polypharmacy.

Primary care providers may also contribute to the problem of polypharmacy. For instance, clients often come to primary care providers' offices and expect to be given a prescription for their malady. Larsen and Hoot Martin (1999) reported that an estimated 75% of all office visits end with a written prescription. One reason for this relates to direct marketing to consumers by pharmaceutical companies. For example, after exposure to clever advertising, individuals may request a specific brand name medication of their providers without an actual need for that class of medications. Prybys et al. (2002) noted that often it is easier to write a prescription than to spend time educating the client. In this age of specialty practice, older clients often have multiple providers prescribing medications without coordination between medication regimens.

### Pharmacokinetics and Pharmacodynamics in the Elderly

Altered pharmacokinetics and pharmacodynamics in older clients are major factors to consider when discussing polyphar-

macy. Responses to medications differ with advancing age; medication effects may be varied and less predictable. Pharmacokinetics relates to how the body absorbs, distributes, metabolizes, and eliminates a medication (Prybys et al., 2002). Physiologic changes related to aging impact pharmacokinetics. Aging increases the risk for drug-to-drug interactions with multiple medication use.

Pharmacodynamics describes the effect of the medication on the client and how the medication interacts at the receptor site (Prybys et al., 2002). Age-related changes at the receptor site influence the number of receptors, binding capacity, and biochemical reactions. Prybys and colleagues illustrated in their study the effects of pharmacodynamics and pharmacokinetics during surgery; older clients required one-half of the dose of fentanyl required by younger clients to achieve similar medication effect.

### Adverse Drug Events in Polypharmacy

Adverse drug effects are frequently the end result of polypharmacy. *Taber's Cyclopedic Medical Dictionary* (Venes & Thomas, 2001) defines adverse drug effect as an undesired side effect or toxicity caused by the administration of concurrent medications that may potentiate or antagonize drug effects. The degree of an adverse drug effect can range from mild to fatal. Lazarou, Pomeranz, and Corey (1998) reported that 106,000 people in the United States die annually from medications that have been properly prescribed and correctly taken. Larsen and Hoot Martin (1999) reported that 20%–25% of hospital admissions in the “over-65 age group” are because of an adverse drug event.

Drug-to-drug interactions are the result of pharmacokinetics and pharmacodynamics (Prybys et al., 2002). Pharmacokinetics produces medication interactions when one medication alters the absorption, distribution, metabolism, or excretion of another medication. Pharmacodynamic interactions occur when the effect of one medication is potentiated or inhibited by another medication. Medications that have a narrow therapeutic range (e.g., digoxin, coumadin) are of particular concern because the life-threatening drug toxicity potential is high.

### Interventions

Healthcare providers often utilize various methods to assess and decrease the incidence of polypharmacy. Some interventions include the utilization of Beers' criteria (Beers, 1997), the “brown bag” approach (Prybys et al., 2002), using mnemonics such as SAIL or TIDE (Werder & Preskorn, 2003), and the “10-step approach” (Carlson, 1996). In 1997, Beers and colleagues established criteria to determine inappropriate medications prescribed for the elderly and developed a provider-friendly list to use when determining what medication to prescribe for the older client. For example, Beers recommended using benzodiazepines in small doses in older individuals because of their increased sensitivity to these substances. Prybys et al. coined the term “brown bag syndrome” when clients arrive at the emergency room or primary care provider's office with a lunch bag filled with various prescription and

nonprescription medications. The onus falls on the provider to determine what the contents are and why the client is taking the medication.

Werder and Preskorn (2003) advocated the use of SAIL and TIDE mnemonics to avoid polypharmacy. The acronym SAIL represents keeping the prescribed regimen as *simple* as possible, be aware of the potential *adverse effects*, explore the *indication* for a prescribed medication, and *list* each drug (including name and dosage) on the chart and provide a copy to the client (Werder & Preskorn). TIDE is another helpful mnemonic for prescribers. Werder and Preskorn identify the importance of scheduling *time* during an office visit to address medications, ensure the prescriber awareness of *individual* response to medications, avoidance of potential *drug-to-drug interactions*, and most importantly, *education* of the client. Carlson (1996) advocates the “10 steps to prudent prescribing.” The 10 steps include (a) disclosing medication, (b) identifying drugs by generic name and class, (c) using the right drug for the right reason, (d) knowing the side effect profile, (e) identifying risk of an adverse reaction, (f) eliminating agents with no benefit, (g) eliminating drugs with no indication, (h) substituting a less toxic drug, (i) avoiding cycle of “double dipping,” and (j) utilizing the motto of “one disease, one cure, once-a day.” According to Carlson, skillful prescribing habits are beneficial to both the practitioner and the client. Side effects of medications can be resolved, drug-to-drug interactions can be avoided, cost-effectiveness will be improved as well as client compliance, and quality of life may improve for the client.

### **Financial Implications of Polypharmacy**

Polypharmacy has implications to healthcare costs. The obvious expenditure is for the medication itself, but additional drug costs add to the expense. Visits to specialists, emergency care, and hospital admissions contribute to polypharmacy because of multiple prescribers and account for an annual cost of \$76.6 billion (Prybys et al., 2002). Prybys et al. also reported that up to 28% of hospital admissions are secondary to an adverse drug event and the incidence of events in the over-65 age group is more than double that in 45-and-younger age group. Because there is no mandatory requirement to report adverse drug events, typically voluntary reporting is historically low. Considering the aforementioned factors, polypharmacy is more complex than just the number of medications a client is taking.

## **REVIEW OF LITERATURE**

A systematic review of electronic bibliographic databases (e.g., EBSCOHost, InfoTrac, OVID, FirstSearch, and FirstSearch Deluxe) utilizing the search terms “polypharmacy,” “polypharmacy and elderly,” “polypharmacy and research,” and “multiple medications” for the period January 1991 to October 2003 was completed. Articles addressing polypharmacy or multiple medications were identified by examining titles and abstracts of each article. The search was supplemented with

online site searches of relevant journals to include examining and reviewing the reference list of each article, online search using “Dogpile,” and the American Association of Retired Persons Web site utilizing the above search terms. Articles were then read and evaluated for inclusion into the literature review. All the research articles included had a sample population aged 60 or older. Additional inclusion criteria for research articles were as follows: a definition of polypharmacy was included in the study and the study had a primary care focus.

Of the articles evaluated, 16 research studies met the inclusion criteria for this article (see Tables 1–3). Reasons for exclusion were the research did not address polypharmacy in primary care, the sample population was less than 60 years old, and a definition of polypharmacy was not included in the study. Of the 16 research studies included, 6 studies addressed polypharmacy in countries other than the United States (i.e., Denmark, The Netherlands, Sweden, Finland, and Canada).

### **How is Polypharmacy Defined in the Literature?**

Multiple definitions are utilized in the literature to define polypharmacy such as two or more drugs for 240 days or more (Veehof, Stewart, Haaijer-Ruskamp, & Meyboom-deJong, 2000), concurrent use of two or more drugs (Bjerrum, 1998), use of four or more medications (Bikowski, Ripsin, & Lorraine, 2001), use of five or more different prescription medications (Jørgensen, Johansson, Kennerfalk, Wallendar, & Svärdsudd, 2001; Linjakumpu et al., 2002). Additional definitions include regular daily consumption of multiple medications as well as the use of high-risk medications and questionable dosing (Golden et al., 1999). Finally, Fillit et al. (1999) defined polypharmacy as the “untoward iatrogenic sequela of the use of multiple, interacting medications” (p. 587). European studies defined polypharmacy according to the number of medications taken, whereas the studies conducted in the United States defined polypharmacy according to whether a medication was clinically indicated.

*Incidence and predictors of polypharmacy.* The incidence of polypharmacy varies greatly in the literature because of the differing definitions and study sample sizes, ranging from 5% (Bjerrum, 1998) to 78% (Jørgensen et al., 2001) in patient populations (see Table 1). The incidence of polypharmacy is probably greater than reported in these studies as only two of the studies (Fillit et al., 1999; Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002) included nonprescription medication use when assessing polypharmacy.

With regard to gender, three studies reported the differences between men and women and the number of prescription medications utilized. Jørgensen et al. (2001) reported that women used more medications than men, with women using an average of 4.8 prescription medications and men using an average of 3.8. In a longitudinal study, Linjakumpu et al. (2002) also found that women used more prescription medications than men, with 81% of women using medications compared to 74% of men in 1990 (see Table 1). In 1998, 93% of women used medications compared to 82% of men (Linjakumpu et al.). Kaufman et al. (2002) reported that the highest overall medication

**Table 1 Incidence and Predictors of Polypharmacy**

| <i>Source</i>   | <i>Purpose</i>  | <i>Sample</i>   | <i>Design</i>  | <i>Instrument</i>  | <i>Results</i>   |
|---|---|---|--|--|--|
| Bjerrum (1998)  | Define polypharmacy<br>Determine polypharmacy incidence<br>Identify those at risk<br>Identify polypharmacy predictors | Random sample (10% of $n = 46,657$ ) of medication users from the Odense Pharmacoepidemiological Database (OPED)              | Descriptive  | Analysis of OPED<br>Minor polypharmacy: two to four medications<br>Major polypharmacy: utilization of five or more medications | Cardiovascular drugs prescribed (85%)<br>Analgesics (38%)<br>Asthma medications prescribed (35%)<br>Predictors for polypharmacy: cardiovascular diseases, anemia, and asthma<br>Utilization of prescription databases suggested by the researchers   |
| Jørgensen, Johansson, Kennerfalk, Wallander, & Svärdsudd (2001) | Analyze prescription drug use, diagnoses, and healthcare utilization  | Sample ( $n = 4642$ ); all individuals aged 65 years and older living in Tierp, Sweden, in 1994                               | Retrospective cohort   | Computerized research register utilized for data collection  | Average prescription items 9.9 per subject<br>Most common medications: cardiovascular (47.2%), nervous system (37%), gastrointestinal (34.2%), and respiratory (22.8%)<br>39% used five or more prescription drugs<br>Greatest number of primary care visits occurred with multiple drug use |
| Linjakumpu et al. (2002)  | Assess changes in medication use and polypharmacy in the elderly  | First survey sample, 1196 individuals. Second survey sample, 1260 individuals<br>Mean age of men: 72<br>Mean age of women: 73 | Descriptive; two cross-sectional surveys 7 years apart with health examination | Trained nurse conducted the interview. A prescription review completed   | Medications were used more frequently in the "over age 84" group. Mean number of medications increased from 3.1 to 3.8 between surveys   |
| Veehof, Haaijer-Ruskamp, & Jong (2000)                          | Investigate relationship between an increase in long-term drug use and incidence and severity of chronic disease      | Sample: 1544, age 65 or older from general practices in The Netherlands from 1997 to 1994                                     | Correlational longitudinal   | Database of morbidity and medications was utilized for data collection   | Overall incidence of polypharmacy: 42%. Incidence: major polypharmacy (five drugs or more): 4%; minor polypharmacy (two to three drugs): 69%   |

**Table 2 What Methods are Utilized by Primary Care Providers to Assess Polypharmacy in Older Individuals?**

| <i>Source</i>                        | <i>Purpose</i>   | <i>Sample</i>   | <i>Design</i>                                   | <i>Instrument</i>  | <i>Results</i>  |
|--------------------------------------|--|---|---|--|---|
| Barat, Andreasen, & Damsgaard (2001) | Examine medication adherence among elderly<br>Assess clients' knowledge of medications<br>Determine target areas for intervention    | 348 individuals aged 75 and older from a population-based registry in Aarhus, Denmark | Cross-sectional                                 | Home visit: evaluate drug storage<br>Medication regimen information collected from general practitioners | Disagreement regarding prescribing regimens: 66%<br>24% stated did not always follow prescriptions<br>66% knew purpose of medications prescribed<br>21% knew consequence of medication omission<br>Less than 6% knew toxic risks, side effects, or interactions of medications  |
| Bedell et al. (2000)                 | Assess discrepancies between drugs documented and medications taken<br>Identify types of discrepancies<br>Examine associated factors | 312 cardiology and intern patients<br>Mean age: 65 years. 48% men, 52% women          | Nonexperimental, descriptive observational      | Interview  | Discrepancies present in 76%<br>51% taking medications not recorded<br>29% were not taking medication recorded<br>20% differences were found in medication dosage   |
| Bikowski, Ripsin, & Lorraine (2001)  | Characterize degree of disparity between physician and patient perception of patients' medication regimen                            | Sample: aged 65 and older   | Pilot study<br>Prospective observational design | Chart review and home visit: compared medication regimens to medications taken                           | 74%: disparity between medication regimen<br>Complete medication regimen congruence: 60% of the medications   |
| Fillit et al. (1999)                 | Examine effects of medication reviews by primary care physicians on prescriptions written<br>Demonstrate polypharmacy prevalence     | 2615 ( <i>n</i> = 26,931) individuals aged 65 and older. Primary care physicians (56) | Prospective study                               | Follow-up survey and a pharmacy database including claims data were utilized for data collection         | Prescription medications discussed: 66%<br>Nonprescription medications discussed: 72%<br>Dosage change: 29% of the visits<br>Identified medication duplications: 18%<br>Drug interactions identified: 14%<br>Drug-to-disease interactions: 8%<br>Physicians informed of new medications: 17%<br>Medication frequency decreased: 23% |

**Table 3 Inappropriate Prescribing**

| <i>Source</i>             | <i>Purpose</i>  | <i>Sample</i>   | <i>Design</i>   | <i>Instrument</i>   | <i>Results</i>  |
|---------------------------|---|---|---|---|---|
| Aparasu, & Sitzman (1999) | Determine the frequency of inappropriate prescribing<br>Identify factors predicting inappropriate prescribing   | 4202 individuals aged 65 and older  | Cross-sectional survey<br>Four-stage probability design | Patient records<br>Hospital staff trained with instruction booklets.<br>Beers' criteria utilized to determine inappropriate medications | Referred patients: 73% more likely to be prescribed inappropriate medications<br>Odds of being prescribed inappropriate medication increased by 22% for each additional medication prescribed. Metropolitan providers less likely to prescribe inappropriate medications<br>Frequency of potentially inappropriate medications: 4.19% |
| Beers et al. (1991)       | Develop criteria defining appropriate and inappropriate use of medications in nursing home residents<br>Outline individual medications and categories to avoid in elderly<br>Outline doses, frequencies, or durations of medications that should not be exceeded in elderly | Thirteen nationally recognized experts in geriatric care and pharmacology surveyed for consensus. Experts: psychopharmacology, pharmacoepidemiology, clinical geriatric pharmacology, general clinical geriatrics, and long-term care | Two-round Delphi survey design                          | Statements and guidelines for the experts to review accuracy were constructed from a literature review                                  | Forty-eight statements describing the inappropriate use of medications were evaluated by the experts. Thirty-three different medications or categories of medications were evaluated  |
| Beers (1997)              | Update Beers' criteria, expand criteria to include new products<br>Assign a relative severity rating to medications   | Six nationally recognized experts in geriatric care and pharmacology  | A modified descriptive Delphi survey                    | A survey and face-to-face evaluation panel developed the revised criteria   | A modified Delphi approach was utilized to reach consensus on the criteria. The validity was determined on a 5-point Likert scale   |
| Golden et al. (1999)      | Report prevalence and pattern of inappropriate medications<br>Ascertain prescribing practices<br>Measure inappropriate drug use   | 2193 homebound individuals aged 60 and older (range 60–106)<br>Average age of 83. Sample was 78% Hispanic   | Cross-sectional   | Computer-generated medication profile analyzed utilizing Beers' criteria  | Average of 4.5 medications per day utilized<br>9.9%: inappropriate prescriptions found<br>Two or more inappropriate prescriptions prescribed: 10.4%<br>Total of 11,689 prescriptions were reviewed  |



|   |  |  |  |   |   |
|---|--|--|--|---|---|
| Hanlon et al. (2002)                            | Evaluate relationship between inappropriate drug use and a decline in functional status  | Medication regimens of community-dwelling elders aged 65–105 ( $n = 2451$ ) reviewed from the Duke Established Populations for Epidemiologic studies of the Elderly database | Cohort study, longitudinal prospective | Trained interviewers utilized structured questionnaires to review drug utilization. Beers' modified criteria were utilized to determine inappropriate medications | Twenty-one percent were using one or more inappropriate medications.<br>Potential drug-to-drug or drug-to-disease interactions: 13.2%<br>11.2%: potential dose duplication or duration problem  |
| Tamblin, McLeod, Abrahamowicz, & Laprise (1996) | Determine if risk of potentially inappropriate drug combinations (PIDC) increases with number of physicians involved in the clients' care<br>Determine if risk of PIDC is reduced with single primary care physician or pharmacy | Stratified random sample of individuals aged 65 and older of 51,587 elderly Medicare registrants in Quebec, Canada   | Cross-sectional, retrospective         | A retrospective computer database review was conducted  | Prevalence of PIDC for nonsteroidal anti-inflammatory medications: 4%, psychotropic medications: 20.3%, and cardiovascular medications: 22% PIDC resulted from physicians other than the primary care provider in 17.6%–25.8% of the sample |

use occurred in women. Twelve percent of women aged 65 and older took at least 10 medications, and 23% took at least five prescription medications (Kaufman et al.). Primary care providers should consider addressing polypharmacy in both men and women; however, note that polypharmacy is more common with women.

Multiple studies reported that the use of cardiovascular medications (i.e., beta blockers, angiotensin II–converting enzyme inhibitors, calcium channel antagonists, antiarrhythmics) increased the risk of polypharmacy (Bedell et al., 2000; Bjerrum, 1998; Golden et al., 1999; Jørgensen et al., 2001; Linjakumpu et al., 2002; Tamblin, McLeod, Abrahamowicz, & Laprise, 1996; Veehof et al., 2000) (see Table 1 for further information). Other common classes of medications reported to increase the risk of polypharmacy were asthma medications (Bjerrum; Jørgensen et al.), psychotropic medications (Golden et al.; Linjakumpu et al.; Tamblin et al., 1996), and sedatives (Golden et al.) (see Table 1). These results indicate that primary care providers must be vigilant for the development of polypharmacy in clients with comorbidities such as asthma, cardiovascular disease, and psychiatric conditions.

Bedell et al. (2000) reported that with polypharmacy, “one third of discrepancies involved over-the-counter drugs or herbal therapies” (para. 15). Herbal therapies and over-the-counter medications are frequently self-prescribed and not reported to primary care providers. Kaufman et al. (2002) reported that the most common over-the-counter medications contributing to polypharmacy are acetaminophen, ibuprofen, and aspirin. These findings have implications for practice because over-the-counter medications can interact with or duplicate the action of many of the medications prescribed for cardiovascular conditions, the most frequently mentioned predictor for the development of polypharmacy. Bedell et al. recommended a “compulsive, specific, and systematic review” of client’s medication bottles, including nonprescription medications, to decrease potential drug interactions (para. 23).

Another possible indicator for polypharmacy reported by Jørgensen et al. (2001) was that visiting a primary care physician five or more times per year increased the risk of using five or more medications by 15 times. Veehof et al. (2000) reported an increase in the average number of medications utilized among the older population over a 4-year span of time, from 1.3 to 1.8, and almost 20% of the study participants developed polypharmacy as they aged. Multiple authors (Bedell et al., 2000; Filiri et al., 1999; Jørgensen et al.; Kaufman et al., 2002; Linjakumpu et al., 2002; Veehof et al.) reported that advancing age was a factor in the development of polypharmacy. Additionally, Veehof et al. reported that predictors of polypharmacy were (a) numbers of medications at the start of the study, (b) age, (c) cardiovascular conditions (i.e., hypertension, coronary ischemic diseases, atrial fibrillation, and heart failure), (d) diabetes, (e) stomach disorders, and (f) medication use without a clear indication (see Table 1).

The inferences drawn from these studies indicate that diseases, gender, and the number of visits to a primary care provider per year may suggest increased risk in developing

polypharmacy. Further positive predictors for the development of polypharmacy are advancing age and the use of medications without a clear indication.

### ***What Methods are Utilized by Primary Care Providers to Assess Polypharmacy in Older Individuals?***

Few research studies reported methods that primary care providers utilized to assess polypharmacy. Many methods were recommended in nonempirical articles such as utilizing the SAIL, TIDE, and Beers' criteria; however, there are only three research studies on polypharmacy assessment methods. Medication review (i.e., brown bag approach) and assessing medication regimen adherence were reported in the research. Assessment of medication adherence was completed by reviewing the client medication profile to determine compliance with the prescribed regimen (i.e., frequency, dosage).

*Medication review and regimen compliance.* Fillit et al. (1999) (see Table 2) reported utilizing the brown bag approach for medication review. Of 37,372 potential subjects, 5737 had an identified risk for polypharmacy based upon a review of prescription medication data obtained from managed care pharmacy database and 1087 participants voluntarily brought all prescription and nonprescription medications to their primary care provider for a medication review. Sixty-one percent of the 275 physicians involved in the study reported that the medication review was "very" or "somewhat" useful (Fillit et al.). In the review, 35% of client's drugs were discontinued as unnecessary medications, and 45% of the physicians made at least one change in their prescribing practices as a result of the medication reviews. Medication review is especially useful when a patient is under the care of multiple physicians (e.g., specialists). Drug duplications, new medications, drug interactions, and drug-disease interactions can be identified by reviewing all medications. Visual medication review is a useful intervention to assess polypharmacy, manage disease processes effectively, decrease drug interactions, and evaluate the medication regimens.

Bikowski et al. (2001) sought to characterize the degree of disparity between physicians' and patients' perceptions of the medication regimen. The medication regimen was analyzed in 50 physician-patient dyads. In 74% of the sample ( $n = 50$ ), discrepancies in medication regimen compliance were found by Bikowski et al. Medication regimen congruence was defined as agreement between the physician and the patient regarding all prescription medications, dosages, and frequency (Bikowski et al.). Complete medication regimen congruence between physician and patient occurred in only 14% of the sample, with some level of disagreement present 86% of the time (Bikowski et al.). Barat, Andreasen, and Damsgaard (2001) reported discrepancy in 22% of drug regimens between a home visit review and information collected at the primary care provider's office. Also, Barat et al. (2001) noted a positive correlation between nonadherence to the prescribed medication regimen and the use of three or more prescription medications as well as 71% of the medication discrepancies concerned dosage (see Table 2). Bedell et al. (2000) reported similar results. In 60-and-older age group, 82% ( $n = 312$ ) had a discrepancy between the

medication regimen and medications actually taken, and patients cared for by cardiologists were more likely to have discrepancies in the medication regimen.

Bikowski et al. (2001) recommended the brown bag approach, computerized medication regimens, and online communications to decrease medication regimen discrepancies. Continual medication reviews at every visit with the older patient are necessary to determine regimen compliance. Barat et al. (2000) recommended improved patient education (i.e., regarding dosage, indication, benefits, risks), the use of "compliance aids" such as pill boxes, medication calendars, and careful evaluation of each drug by primary care providers to reduce the number of medications prescribed and to increase drug regimen compliance (see Table 2).

Based upon client feedback, Bedell et al. (2000) also reported that medication regimen compliance could be improved by providing clients with information regarding medication indication, symptom improvement, adverse effects, cost, and the importance of providing a complete medication list to all providers involved in the clients' care. Visual identification of medications, continuous meticulous medication review, and thorough patient education by primary care providers are methods to increase medication regimen compliance and decrease polypharmacy.

### ***What Interventions do Primary Care Providers Utilize to Decrease Medications That Are Not Clinically Indicated in the Older Population?***

The third question related to how primary care providers decrease medications not clinically indicated was not addressed in any studies. This is an important issue because of the high incidence of polypharmacy in older individuals. Indicative of a significant gap in the literature, this area warrants more research. No research was identified that addressed the most effective interventions to utilize when decreasing medications; however, there were several studies that addressed inappropriate prescribing. These research articles are included here.

*Inappropriate prescribing in the older population.* Beers' criteria were utilized in several research studies addressing inappropriate prescribing (Aparasu & Sitzman, 1999; Gallagher, 2001; Golden et al., 1999; Hanlon et al., 2002). Beers' criteria help the clinician identify adverse reactions and medications that should be avoided or used with caution in the older population. The original criteria were developed by 13 experts in geriatrics and pharmacology for use in frail elderly (Beers et al., 1991). Beers et al. also defined appropriate and inappropriate medication use, including doses and frequencies of medications (see Table 3). Beers' criteria were modified in 1997 to include information on clinical diagnosis, new pharmacological information, and generalize the criteria to individuals aged 65 and older. The criteria are useful guides for primary care providers to utilize when prescribing medications in older populations.

Aparasu and Sitzman (1999) utilized Beers' criteria to determine the appropriateness of prescriptions prescribed in outpatient visits. A reported incidence of inappropriate prescribing occurred in 4.45% of outpatient visits, with 1 in 20 prescriptions reported as inappropriate (Aparasu & Sitzman). Platelet

inhibitors and antispasmodics were the most frequent medications prescribed inappropriately. Another recommendation involved caution in referring patients to other healthcare providers because the rate of inappropriate prescribing in referred patients was 73%. In addition, Tamblyn et al. (1996) reported a positive association between the number of prescribing physicians and the increased incidence of inappropriate prescribing. Utilizing a single prescribing physician reduced the risk of potentially inappropriate cardiovascular and psychotropic drug combinations by 30%. Thus, the number of prescribing physicians is an important risk factor when assessing inappropriate prescribing practices.

The best predictor of potential medication interactions was the number of medications used (Gallagher, 2001). Inappropriate medication combinations as defined by Beers' criteria were prescribed in 44.5% of the sample ( $n = 146$ ), with the most common inappropriate combination being beta blockers and antiarrhythmics. The most common diagnoses of patients prescribed inappropriate medications were congestive heart failure, hypertension, arteriosclerotic heart disease, chronic obstructive pulmonary disease, non-insulin dependent diabetes mellitus, and pleural effusion. Golden et al. (1999) reported similar results of inappropriate prescribing utilizing Beers' criteria. In 39.7% of clients ( $n = 2193$ ) at least one medication was inappropriate. Golden et al. also reported a positive association between the number of medications prescribed and the likelihood of receiving an inappropriate medication. These studies demonstrate the importance of primary care providers attempting to simplify medication regimens and decreasing the number of medications prescribed.

One study addressed the implications of inappropriate prescribing. Hanlon et al. (2002) reported a significant association ( $p < 0.05$ ) between inappropriate medication use and a decline in basic self-care such as independent bathing and dressing. Individuals with drug-to-drug or drug-to-disease interactions exhibited a higher rate of decline in activities of daily living (Hanlon et al.). Twenty-eight percent of the sample used one or more medications that should be avoided as recommended by Beers' criteria.

Further research is needed regarding the interventions primary care providers utilize to decrease medications that are not clinically indicated. Based upon this review of literature, primary care providers are in the best position to assist in preventing a decline in functional status by utilizing appropriate prescribing practices.

## DISCUSSION

Generalizing these results is difficult because of the multiple countries represented in the studies; however, based upon this review, it is evident that more research in this area is needed. European countries appear to conduct more research regarding polypharmacy in the older population, while the focus in the United States appears to be inappropriate prescribing. For example, 12 studies were conducted in the United States, 2

addressed polypharmacy and 8 addressed inappropriate prescribing. In European studies, information regarding prescription drug use and utilization of health care is recorded in a computerized research register. The advantage of utilizing computerized databases for medication review is evident: increased accuracy of medication recording as it is not dependent upon patient recall.

Also, there is a lack of consensus on the definition of polypharmacy. Clients may have several diagnoses and comorbidities (e.g., diabetes, hypertension), necessitating the use of multiple medications; therefore, a definition of polypharmacy dependent upon the number of medications may be inappropriate. A definition focusing on whether the medication is clinically indicated may be more appropriate.

Limitations of the studies reviewed were noted. Nonprescription medications were included in only three of the studies reviewed. Potential medication interactions and duplications can occur between prescription and nonprescription medications. In future studies, detailing the use of nonprescription medication is necessary when examining polypharmacy.

Another consideration is that nonprescription medications are more common in European countries. Medications that are available by prescription only in the United States are available without a prescription in European countries; therefore, including nonprescription medications in polypharmacy research is important.

Several gaps in the literature are noted. There is a lack of research related to the methods utilized by primary care providers when assessing polypharmacy; this indicates additional research and education are necessary to provide care for the older population. Based upon the nonempirical articles reviewed, multiple methods exist to assess polypharmacy in older individuals (e.g., utilizing the SAIL, TIDE, brown bag approach, or Beers' criteria for reviewing medications). The research articles found addressed the brown bag approach, chart review, home visits, and the utilization of computerized medication databases to assess polypharmacy. Using Beers' criteria to determine inappropriate medication prescribing is useful. The SAIL and TIDE criteria for reviewing medications may be useful, but limited research is available reporting the efficiency of each technique. Research related to the interventions primary care providers utilize to decrease the incidence of medications that are not indicated was not addressed.

## CONCLUSION

Further research is indicated to address the gaps in the literature related to determining a consensus in the definition of polypharmacy, the best methods primary care providers can utilize to assess polypharmacy, and the best interventions primary care providers utilize to decrease medications that are not clinically indicated. The authors advocate the use of the following definition of polypharmacy: "the use of medications that are not clinically indicated." This definition was chosen because in individuals with multiple comorbidities, utilizing a definition

based upon the number of medications may be inappropriate as these individuals can require multiple medications to control their disease processes. Discussion regarding the definition of, assessment of, and interventions to decrease polypharmacy should be included in primary care providers' curriculum and continuing education programs. To gain consensus among healthcare providers regarding the definition of polypharmacy would entail dissemination of more research on the topic and adoption of the definition by government agencies and third-party payers. Further study regarding nonprescription medication use in conjunction with prescription medications also is indicated. This review supports the review of literature by Lee (1998) that reported polypharmacy as a significant clinical issue, with no relevant research data available addressing prevalence, complications, and treatment. In the past 5 years, there have been no significant additions to the body of knowledge relating to polypharmacy.

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### 10.5.5 Appendice E5 : Article n° 5 – Polypharmacy in Elderly

#### Patients

|                               |  |
|-------------------------------|--|
| Article n° 5                  | <b>Polypharmacy in Elderly Patients</b>  |
| Auteurs                       | Hajjar, E. R., Cafiero, A. C., & Hanlon, J. T. (2007).   |
| Titre                         | Polymédication chez les personnes âgées<br>Le thème est général.   |
| Résumé                        | <p>Le <b>résumé</b> est précis, les aspects de l'histoire du problème de polymédication et une définition sont proposés.</p> <p>L'<b>objectif</b> est d'analyser les essais contrôlés randomisés qui regroupent des études des deux dernières décennies.</p> <p>Les <b>méthodes</b> de recherche en utilisant des banques de données et une recherche manuelle ont ciblé la polymédication.</p> <p>Les <b>résultats</b> ont démontré les risques liés à la polymédication chez les personnes âgées et ont incité plusieurs études d'intervention afin de réduire ce phénomène.</p> <p>La <b>conclusion</b> souligne le fait que plus de recherche sera nécessaire dans ce domaine.</p> |
| <b>INTRODUCTION</b>           |  |
| Problème de la recherche      | Les personnes âgées avec des pathologies qui requièrent plusieurs médicaments sont à risque des interactions et effets adverses de ces traitements. Existe-t-il des études qui réduisent ce phénomène.   |
| Recension des écrits          | Des sources scientifiques des bases de données MEDLINE (1986-2007) et International Pharmaceutical Abstracts (1986-2007) ont été utilisés.   |
| Cadre de recherche            | Le concept clé des causes et effets et interventions pour le contrer sont énoncés.   |
| Buts et question de recherche | Une définition de la polymédication est proposée même si les chiffres concernant le nombre de médicaments différencient selon l'étude. (entre 2 et 9) Plusieurs études décrivent les facteurs de risque et conséquences de ce phénomène y compris sa prévalence chez les personnes âgées.  |

| METHODE                       |   |
|-------------------------------|---|
| Population et échantillon     | Les auteurs ont utilisé les mots clés « <i>polypharmacy, multiple medications, polymédicine, elderly, geriatric et aged</i> » dans les banques de donnés. Ils ont sélectionné les textes en anglais qui ciblent des adultes de plus de 65 ans et qui quantifient l'usage de plusieurs médicaments. Ils ont préféré des articles de type essai contrôlé randomisé et non les articles de type revue. |
| Considérations éthiques       | La question éthique dans cet article est que la polymédication augmente les risques des syndromes gériatriques (risque de chute, morbidité, problèmes cognitifs).   |
| Devis de recherche            | Pour cette problématique les auteurs se sont basés sur les données quantitatives. Les auteurs restent objectifs et semblent de ne pas être liés directement au sujet. Leur méthodologie leur a permis des réponses à la problématique malgré le peu d'études rigoureuses sur le sujet.  |
| Modes de collectes de données | Les étapes sont décrites brièvement.  |
| Conduite de la recherche      | Le processus de collecte n'est pas clairement décrit.   |
| Analyse des donnés            | Le résumé des résultats est compréhensible. Les auteurs ont pu identifier et catégoriser des facteurs de risques, basés sur les déterminants de la santé, et des interventions pour réduire la polymédication.  |
| RESULTATS                     |   |
| Présentation des résultats    | En forme de texte narratif. Un tableau qui résume les études sur la réduction de la polymédication est inclu dans le texte. 5 interventions y sont résumées.  |
| DISCUSSION                    |   |
| Interprétations des résultats | Les auteurs stipulent que plusieurs facteurs doivent être pris en considération dans la définition de la polymédication, quel type de médication et l'usage de médicaments non prescrits.   |

|  |   |
|--|---|
| <b>Conséquences et recommandations</b> | <p>Les auteurs confirment qu'il existe plusieurs conséquences associées à la polymédication chez la personne âgée. Le risque de recevoir des prescriptions inappropriées, le problème d'adhérence au régime médicamenteux et le danger lié aux effets secondaires ou interactions des traitements.</p> <p>Plus de recherches sont nécessaires et les professionnels de la santé doivent être conscients dans leurs évaluations médicamenteuses.</p> |
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# Polypharmacy in Elderly Patients

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## ABSTRACT

**Background:** Polypharmacy (ie, the use of multiple medications and/or the administration of more medications than are clinically indicated, representing unnecessary drug use) is common among the elderly.

**Objective:** The goal of this research was to provide a description of observational studies examining the epidemiology of polypharmacy and to review randomized controlled studies that have been published in the past 2 decades designed to reduce polypharmacy in older adults.

**Methods:** Materials for this review were gathered from a search of the MEDLINE database (1986–June 2007) and International Pharmaceutical Abstracts (1986–June 2007) to identify articles in people aged >65 years. We used a combination of the following search terms: *polypharmacy*, *multiple medications*, *polymedicine*, *elderly*, *geriatric*, and *aged*. A manual search of the reference lists from identified articles and the authors' article files, book chapters, and recent reviews was conducted to identify additional articles. From these, the authors identified those studies that measured polypharmacy.

**Results:** The literature review found that polypharmacy continues to increase and is a known risk factor for important morbidity and mortality. There are few rigorously designed intervention studies that have been shown to reduce unnecessary polypharmacy in older adults. The literature review identified 5 articles, which are included here. All studies showed an improvement in polypharmacy.

**Conclusions:** Many studies have found that various numbers of medications are associated with negative health outcomes, but more research is needed to further delineate the consequences associated with unnecessary drug use in elderly patients. Health care professionals should be aware of the risks and fully evaluate all medications at each patient visit to prevent polypharmacy from occurring. (*Am J Geriatr Pharmacother.* 2007;5:345–351) Copyright © 2007 Excerpta Medica, Inc.

**Key words:** polypharmacy, older adults, morbidity, mortality.

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## INTRODUCTION

People aged  $\geq 65$  years are one of the most rapidly growing age groups in the United States. In 2005, there were ~27 million adults in this age group, with the number of women outweighing men.<sup>1</sup> Many older adults have multiple medical conditions, such as hypertension, arthritis, heart disease, cancer, and diabetes mellitus, which require multiple medications for proper treatment.<sup>1,2</sup> The use of multiple medications is often referred to as polypharmacy, but a standard definition is not used.<sup>3</sup> A second and perhaps more important definition is the administration of more medications than are clinically indicated, representing unnecessary drug use.<sup>4</sup> Unfortunately, using multiple medications may cause problems such as the increased risk of inappropriate use of medications (including drug–drug interactions and duplication of therapy), nonadherence, and adverse effects.

The objective of this review was to provide a description of observational studies examining the epidemiology of polypharmacy and to review randomized controlled studies that have been published in the past 2 decades designed to reduce polypharmacy in older adults.

## MATERIALS AND METHODS

The MEDLINE database (1986–June 2007) and International Pharmaceutical Abstracts (1986–June 2007) were searched to identify articles on polypharmacy in the elderly. We used a combination of the following search terms: *polypharmacy*, *multiple medications*, *polymedicine*, *elderly*, *geriatric*, and *aged*. We also conducted a manual search of the reference lists from identified articles and the authors' article files, book chapters, and recent reviews to identify additional articles.<sup>2–13</sup> Articles were included only if they were: (1) in English; (2) involved those aged  $>65$  years; (3) not a review; or (4) observational or randomized trials that either quantified the multiple use of medicines and their consequences or described interventions to reduce polypharmacy.

## RESULTS

### Drug Utilization Studies

Twenty-one studies were examined. There is not a consistent cut point that defines polypharmacy. Previous studies have used 2, 4, 5, and 9 medications to identify polypharmacy.<sup>5,14–20</sup> Surveys of community-based elderly patients show that 2 to 9 prescription medications on average are taken per day.<sup>5,7,21,22</sup> A national survey by Kaufman et al<sup>23</sup> found that 57% of US women aged  $\geq 65$  years took  $\geq 5$  prescription medications and 12%

took  $\geq 10$  medications. This is consistent with results from a large study in Europe (N = 2707; mean age, 82.2 years), which found that 51% of patients took  $\geq 6$  medications per day.<sup>16</sup>

It is also important to evaluate the use of nonprescription medications in older adults. A study of 1059 rural community-dwelling elderly patients (mean age, 74.5 years) found that almost 90% took  $\geq 1$  and almost 50% took 2 to 4 over-the-counter medications.<sup>24</sup> Another study of 2590 noninstitutionalized patients reported that 47% to 59% of older patients took a vitamin or mineral and 11% to 14% took herbal supplements.<sup>23</sup> Data also suggest that polypharmacy may be increasing in the elderly, especially in those aged  $>85$  years.<sup>17</sup>

An important consideration in evaluating polypharmacy is the types of medications that are being consumed. A large national survey in the United States found that the most common prescription medications used in noninstitutionalized patients were estrogen products, levothyroxine, hydrochlorothiazide, atorvastatin, and lisinopril.<sup>23</sup> Cardiovascular agents, antibiotics, diuretics, opioids, and antihyperlipidemics were the most frequently used classes of prescription medications in a large study of Medicare patients.<sup>25</sup> Pain medications (eg, acetaminophen, ibuprofen, acetylsalicylic acid), cold and cough medications (eg, pseudoephedrine, diphenhydramine), and vitamin or nutrient products (eg, multivitamins, vitamins E and C, ginseng, *Ginkgo biloba* extract) were the most common nonprescription medications consumed.<sup>23</sup> Analgesics, vitamins, minerals, antacids, and laxatives were also found to be commonly used nonprescription agents among the elderly.<sup>24</sup>

### Prevalence, Predictors, and Risks of Unnecessary Polypharmacy

Five studies have evaluated the unnecessary drug use definition of polypharmacy.<sup>26–30</sup> A study of 236 ambulatory patients aged  $\geq 65$  years by Lipton et al<sup>26</sup> found that almost 60% of patients were taking medications that were suboptimal or lacking an indication. Schmadler et al<sup>27</sup> had similar findings: they reported that 55% of 208 elderly patients were taking drugs without an indication. They also found that one third of patients were taking ineffective drugs, and 16% had a therapeutic duplication in their medication regimens. In a study of 834 outpatients aged  $\geq 65$  years, Schmadler et al<sup>28</sup> evaluated unnecessary drug use, defined by the Medication Appropriateness Index (MAI) criteria as a medication with no indication, lack of effectiveness, or therapeutic

duplication. The daily mean number of unnecessary drugs was 0.65 per person. A study in frail elderly veterans (N = 384), which also used the MAI to define unnecessary drug use, found that 44% of patients had  $\geq 1$  unnecessary medication at hospital discharge, with 25% of the patients having the medication started during the hospitalization.<sup>29</sup> The reasons for the unnecessary drug use included no indication (32%), lack of effectiveness (18%), and therapeutic duplication (7%). Gastrointestinal, central nervous system, and therapeutic nutrient/mineral agents were found to be the most commonly used unnecessary drugs. Another recent study<sup>30</sup> of veteran outpatients (N = 196) aged  $\geq 65$  years found a 64% prevalence of medication underuse. This study also showed that underuse and unnecessary use of medications simultaneously occurred in 42% of patients.

No studies were found in the literature search linking unnecessary drug use with health outcomes. However, it is likely that unnecessary drug use would be related to increased drug expenditures.

### Risk Factors for Polypharmacy

Nine studies were assessed to determine the risk factors for polypharmacy. Many risk factors for polypharmacy have been identified and can be classified into 1 of 3 groups: demographic, health status, and access to health care characteristics. Increased age, white race, and education are demographic characteristics associated with polypharmacy.<sup>17,21,31,32</sup> Poorer health, depression, hypertension, anemia, asthma, angina, diverticulosis, osteoarthritis, gout, diabetes mellitus, and use of  $\geq 9$  medications are the health status characteristics associated with polypharmacy.<sup>5,14,29,31-33</sup> Predictors of polypharmacy related to access to health care characteristics include number of health care visits, supplemental insurance, and multiple providers.<sup>32-34</sup>

### Consequences of Polypharmacy

Eighteen studies examined the consequences associated with polypharmacy. There may be many consequences associated with polypharmacy. Patients are at an increased risk of receiving an inappropriate medication and having an adverse drug reaction (ADR), which may impact a patient's adherence to his or her medication regimen. Polypharmacy has also been reported to increase the risk of geriatric syndromes and morbidity/mortality.

### Adherence

Polypharmacy creates complex medication regimens that make nonadherence a common problem in the

elderly, with prevalence rates averaging 50%.<sup>35-37</sup> However, elderly patients are adherent with  $\sim 3$  out of every 4 of their individual medications.<sup>35,36</sup> The elderly also have adherence rates similar to younger patients when number of drugs is taken into account.<sup>38</sup>

### Inappropriate Prescribing

Studies have shown that the use of multiple medications increases the risk of inappropriate prescribing. Hanlon et al<sup>39</sup> found that both the number of prescription (odds ratio [OR], 1.28; 95% CI, 1.21-1.36) and nonprescription (OR, 1.17; 95% CI, 1.12-2.35) medications increased the risk of inappropriate prescribing as defined by the MAI in frail elderly veterans. A cross-sectional study in 786 patients (mean age, 78 years) receiving home health care reported that polypharmacy increased the risk of potentially inappropriate medications, as defined by the Beers criteria, and the risk of potentially dangerous drug interactions.<sup>18</sup>

### Adverse Drug Reactions

The risk of ADRs may increase with increased number of drugs taken. An ADR, as defined by the World Health Organization, is a reaction that is noxious and unintended, and which occurs at dosages normally used in humans for prophylaxis, diagnosis, or therapy.<sup>40</sup> ADRs have been reported to occur in 5% to 35% of outpatients and account for as many as 12% of hospital admissions in older patients.<sup>6,25,41-43</sup> The risk of ADRs is strongly associated with multiple comorbidities, use of specific types of drugs such as warfarin, and increasing number of drugs taken.<sup>3,6,18,41-45</sup>

### Geriatric Syndromes

A study by Larson et al<sup>46</sup> showed an increased risk of cognitive impairment with multiple medications. A study by Ruby et al<sup>47</sup> found that the use of multiple medications with urologic activity increased the risk of urinary incontinence.

A few studies have examined the impact of multiple medication use on falls. Those patients taking  $\geq 2$  psychotropic agents had a 2.4- to 4.5-fold increased risk of falling than those taking 1 central nervous system drug.<sup>48</sup> A study by Agostini et al<sup>49</sup> examined the risk of polypharmacy and balance in 885 community-dwelling residents aged  $\geq 72$  years. For impaired balance, adjusted ORs were 1.44 (95% CI, 0.94-2.19) for those taking 1 to 2 medications, 1.72 (95% CI, 1.09-2.71) for those taking 3 to 4 medications, and 1.80 (95% CI, 1.02-3.19) for those taking  $\geq 5$  medications. The authors concluded that a greater number of medications were

associated with an increased risk of adverse drug outcomes.<sup>49</sup> Weiner et al<sup>50</sup> found that elderly male outpatients (N = 305; age range, 70–104 years) taking  $\geq 2$  central nervous system medications (ie, benzodiazepines, other sedative/hypnotics, antidepressants, antipsychotics, opioid analgesics) had a 2.37-fold increased risk of falls.

### Morbidity/Mortality

There are data which suggest that, even after controlling for multiple comorbidities, polypharmacy is associated with a decline in physical and instrumental activities of daily living.<sup>51</sup> Polypharmacy is also associated with negative consequences, such as increased risk of mortality.<sup>52</sup> In addition, polypharmacy increases medical costs. Older patients with heart failure taking 11 doses per day were found to have annual drug costs  $> \$3800$  in 2001.<sup>53</sup>

### Interventions to Reduce Polypharmacy

Five studies were found that met our inclusion criteria (Table).<sup>20,28,54–56</sup> Overall, 3 studies were conducted in managed care populations that used prescriber education as the intervention to reduce polypharmacy.<sup>20,54,55</sup> Another study utilized a medication grid to alert providers as to how many drugs were being administered.<sup>56</sup> Finally, the last study was a randomized controlled trial that evaluated the use of geriatric evaluation and management (GEM) on inpatient and outpatient care.<sup>28</sup>

Although there are a number of studies that have targeted older patients taking multiple medications, polypharmacy may not be reduced if one improves both unnecessary use and underuse simultaneously, as no difference in overall medications will be found.<sup>11</sup> Several studies have proposed possible methods of reducing the number of medications for elderly patients. Muir et al<sup>56</sup> supplied a medication grid to medical resi-

Table. Summary of studies on reducing polypharmacy in older adults (ie, those aged  $> 65$  years).

| Author/Year                        | Setting  | Intervention  | Results   |
|------------------------------------|--|---|---|
| Muir et al, 2004 <sup>56</sup>     | General medicine inpatient service                       | Medication grid provided to admitting residents that listed all medications and administration times for 1 week.  | Medication grid reduced number of medications per patient in the intervention group (0.92) compared with the control group (1.65) ( $P < 0.001$ ).                                |
| Fillit et al, 1999 <sup>54</sup>   | Medicare managed care organization                       | Mailing to elderly Medicare managed care members at risk for polypharmacy urging them to meet with their physicians and bring medications with them for review. | Of the 42% of the population at risk who had a medication review with their physician, 20% reported having a medication discontinued.   |
| Fick et al, 2004 <sup>55</sup>     | Medicare + Choice southeastern managed care organization | Physicians were mailed a list of patients taking potentially inappropriate medications.   | Overall, 12.5% of potentially inappropriate medications were discontinued.  |
| Zarowitz et al, 2005 <sup>20</sup> | Outpatient, managed care                                 | Clinical pharmacy medication review with physician education.   | Overall, polypharmacy event rate decreased from 29.01 to 9.43 events/1000 patients after the first mailing and from 27.99 to 17.07 events/1000 patients after the second mailing. |
| Schmader et al, 2004 <sup>28</sup> | Inpatient and outpatient care for veterans               | Inpatient or outpatient GEM.  | Unnecessary and inappropriate drug use was reduced in inpatients receiving GEM care ( $P < 0.05$ ).   |

GEM = geriatric evaluation and management.

dents caring for hospitalized elderly patients ready to be discharged to home that consisted of a listing of all medications and times of administration over the previous week. They found that the number of medications was reduced in the intervention group by 0.92 per patient compared with an increase of 1.65 medications in the control group ( $P < 0.001$ ). Number of doses per day also decreased in the intervention group. A survey study in a Medicare managed care population evaluated whether a medication review by primary care physicians resulted in a change in medications.<sup>54</sup> Patients were sent letters urging them to bring their medications in for a review, and primary care physicians were given clinical practice guidelines on polypharmacy. Of the 42% of patients at risk who had a medication review with their physician, 20% had a medication discontinued by their physician and almost 30% had a change in medication dose. Another study among Medicare managed care patients found that mailing physicians a list of patients who were taking a potentially inappropriate medication resulted in a discontinuation of a medication in 12.5% of cases.<sup>55</sup> Zarowitz et al<sup>20</sup> used clinical pharmacists to educate and aid physicians in reducing polypharmacy among outpatient managed care patients (N = 195,971). They found that the rate of patients receiving  $\geq 5$  medications decreased from 7.99 to 4.1 events/1000 patients after the intervention. It was also reported that the rate of overall polypharmacy events—defined as use of  $\geq 5$  medications,  $\geq 2$  narcotics,  $\geq 2$  benzodiazepines,  $\geq 3$  oral antidiabetic medications, or the use of sildenafil with a nitrate—was reduced from 27.99 to 17.07 events/1000 patients after a second mailing.<sup>20</sup>

Only one study was found in our literature search that attempted to reduce unnecessary drug use. A multisite, randomized controlled study was reported that examined the impact of inpatient and outpatient GEM on drug-related problems in 834 patients at 11 US Veterans Affairs hospitals and clinics.<sup>28</sup> They found that inpatient GEM care significantly reduced ( $P < 0.05$ ) unnecessary drug use, as measured by the MAI, compared with usual care.

### Clinical Considerations for Polypharmacy

Obtaining a thorough medication history is very important before any new medication is prescribed. Both prescription and nonprescription medications need to be taken into account and should be brought with the patient to all health care provider visits. Once the prescriber has a complete medication history, he or she can then decide whether the addition of another

medication is clinically indicated and if the benefits outweigh the risk of use. Nonpharmacologic therapy, such as diet modification or exercise, may be appropriate instead of medication in some cases. If a medication is determined to be clinically necessary, the drug's pharmacokinetic, pharmacodynamic, and adverse-event profile, along with the patient's renal and hepatic function, must be taken into account for proper dosing. Starting doses are often lower in the elderly and may be administered differently than in younger patients to prevent toxicity from occurring. Other concomitant disease states and medications should be evaluated to prevent any drug–disease or drug–drug interactions from occurring. Educating both patients and their families verbally and in writing about their medications can improve adherence. Considering generic options, utilizing compliance aids (eg, pillboxes, medication calendars), limiting the prescribing of as-needed drugs, simplifying medication regimens to medications that can be dosed QD or BID, and encouraging family support may help enhance medication adherence.<sup>57–59</sup> Setting sensible therapeutic goals and assessing medication regimens periodically are also very important to ensure that polypharmacy does not lead to unnecessary medical problems.

### CONCLUSIONS

Polypharmacy is common among the elderly. Many studies have found that various numbers of medications are associated with negative health outcomes, but more research is needed to further delineate the consequences associated with unnecessary drug use. Health care professionals should be aware of the risks and fully evaluate all medications at each patient visit to prevent polypharmacy from occurring.

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**10.5.6 Appendice E6 : Article n° 6 – Interventions to improve the appropriate use of polypharmacy for older people (Review)**

|                               |  |
|-------------------------------|--|
| Article n° 6                  | <b>Interventions to improve the appropriate use of polypharmacy for older people (Review)</b>  |
| Auteurs                       | Patterson, S. M., Hughes, C., Kerse, N., Cardwell, C. R., & Bradley, M. C. (2012).   |
| Titre                         | Quelles interventions améliorent la polymédication chez les personnes âgées.   |
| Résumé                        | Le problème de polymédication est énoncé. Une recherche de la littérature des banques de données fait partie de la méthode. Certains facteurs ne sont pas clairs s'ils réduisent la polymédication, toutefois ils sont bénéfiques en réduisant des prescriptions inappropriées et les problèmes liés.  |
| <b>INTRODUCTION</b>           |  |
| Problème de la recherche      | Trouver quelles interventions sont efficaces pour améliorer l'usage approprié de la polymédication et diminuer ses effets négatifs chez les personnes âgées. Cette recherche est congruente pour la discipline infirmière.   |
| Recension des écrits          | L'article fait référence à plusieurs études scientifiques sur le même thème y compris les contrôles randomisés.  |
| Cadre de recherche            | Le concept clé de comment identifier et prévenir cette problématique est affirmé.  |
| Buts et question de recherche | But est clairement énoncé. Polymédication est définie et l'article souligne le fait que ce phénomène a des aspects négatifs en particulier chez les personnes âgées.   |
| <b>METHODE</b>                |  |
| Population et échantillon     | La population de personnes âgées est définie comme ceux de 65 ans ou plus. 21'911 participants d'âge moyen de 74 ans. Plusieurs banques de données ont été utilisées comme MEDLINE, OVID, CINHALL et EMBASE et une recherche manuelle des listes de références. Ils ont choisi les études qui décrivent les interventions qui améliorent la polymédication chez les personnes âgées. |
| Considérations éthiques       | Cette revue de littérature cherche à maximiser les bénéfices et diminuer les effets néfastes associés avec la polymédication chez les personnes âgées.   |

|                                 |  |
|---------------------------------|--|
| Devis de recherche              | La méthode utilisée a permis une réponse au problème initial.  |
| Modes de collectes de données   | Les étapes sont énoncées. A travers des banques de données les auteurs ont sélectionné les articles pertinents à cette recherche en excluant des articles où des opinions biaisées sur l'utilisation d'un médicament.  |
| Conduite de la recherche        | Le processus est décrit clairement.  |
| Analyse des données             | Le plan analytique est approprié par rapport aux données collectionnées. Les auteurs ont pris en compte le risque de biais et ont utilisé un outil (Cochrane) afin de réduire les divergences.   |
| <b>RESULTATS</b>                |  |
| Présentation des résultats      | Sous forme de texte et de tableaux. Les auteurs soulignent le fait que les interventions dans leur étude étaient limitées et souvent complexes.  |
| <b>DISCUSSION</b>               |  |
| Interprétations des résultats   | Les auteurs ont choisi de ne pas inclure certaines études dans leur recherche soit à cause de leur taille d'échantillon soit car il y avait un biais. Ils parlent d'une limite dans cette recherche car à travers les études il y avait des incohérences avec certaines interventions. De plus, la majorité d'interventions étaient effectués par des pharmaciens. Une approche multidisciplinaire semble avoir plus de réussite dans la diminution des prescriptions inappropriées. |
| Conséquences et recommandations | Malgré le doute que ces interventions améliorent une polymédication appropriée, elles semblent bénéfiques en réduisant des prescriptions inappropriées.<br><br>La polymédication est améliorée lorsque la notion d'une multidisciplinarité est impliquée. Plus de recherche est nécessaire car le terme polymédication peut être soit positif soit négatif.  |



# Interventions to improve the appropriate use of polypharmacy for older people (Review)

Patterson SM, Hughes C, Kerse N, Cardwell CR, Bradley MC



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[Intervention Review]

# Interventions to improve the appropriate use of polypharmacy for older people

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## ABSTRACT

### Background

Inappropriate polypharmacy is a particular concern in older people and is associated with negative health outcomes. Choosing the best interventions to improve appropriate polypharmacy is a priority, hence there is growing interest in appropriate polypharmacy, where many medicines may be used to achieve better clinical outcomes for patients.

### Objectives

This review sought to determine which interventions alone, or in combination, are effective in improving the appropriate use of polypharmacy and reducing medication-related problems in older people.

### Search methods

A range of literature databases including MEDLINE and EMBASE were searched in addition to handsearching reference lists. Search terms included polypharmacy, Beers criteria, medication appropriateness and inappropriate prescribing.

### Selection criteria

A range of study designs were eligible. Eligible studies described interventions affecting prescribing aimed at improving appropriate polypharmacy in people aged 65 years and older where a validated measure of appropriateness was used (e.g. Beers criteria or Medication Appropriateness Index - MAI).

### Data collection and analysis

Three authors independently reviewed abstracts of eligible studies, extracted data and assessed risk of bias of included studies. Study specific estimates were pooled, using a random-effects model to yield summary estimates of effect and 95% confidence intervals.

## **Main results**

Electronic searches identified 2200 potentially relevant citations, of which 139 were examined in detail. Following assessment, 10 studies were included. One intervention was computerised decision support and nine were complex, multifaceted pharmaceutical care provided in a variety of settings. Appropriateness of prescribing was measured using the MAI score postintervention (seven studies) and/or Beers criteria (four studies). The interventions included in this review demonstrated a reduction in inappropriate medication use. A mean difference of -6.78 (95% CI -12.34 to -1.22) in the change in MAI score in favour of the intervention group (four studies). Postintervention pooled data (five studies) showed a mean reduction of -3.88 (95% CI -5.40 to -2.35) in the summated MAI score and a mean reduction of -0.06 (95% CI -0.16 to 0.04) in the number of Beers drugs per patient (three studies). Evidence of the effect of the interventions on hospital admissions (four studies) was conflicting. Medication-related problems, reported as the number of adverse drug events (three studies), reduced significantly (35%) postintervention.

## **Authors' conclusions**

It is unclear if interventions to improve appropriate polypharmacy, such as pharmaceutical care, resulted in a clinically significant improvement; however, they appear beneficial in terms of reducing inappropriate prescribing and medication-related problems.

## **PLAIN LANGUAGE SUMMARY**

### **A review of the ways that healthcare professionals can improve the use of suitable medicines for older people**

Taking medicines for chronic illnesses both to treat symptoms and to prevent diseases getting worse is common in older people. However, taking too many medicines can cause harm. This review examines studies in which healthcare professionals have taken action to make sure that older people are receiving the most effective and safe medication for their illness. The actions taken included pharmaceutical care, a service provided by pharmacists, which involves identifying, preventing and resolving medication-related problems, as well as promoting the correct use of medications and encouraging health promotion and education. Another strategy was computerised decision support, a programme on the doctor's computer that helps him/her to decide on the right treatment.

This review provides limited evidence that interventions, such as pharmaceutical care, may be successful in ensuring that older people are receiving the right medicines and reducing medication-related problems in this group, but it is not clear if this always results in clinical improvements.

## SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

| Patient or population: older people<br>Settings: all<br>Intervention: pharmaceutical care<br>Comparison: usual care |   |   |                          |                                  |  |          |
|---|---|---|--------------------------|----------------------------------|--|----------|
| Outcomes  | Illustrative comparative risks* (95% CI)                                  |   | Relative effect (95% CI) | Number of Participants (studies) | Quality of the evidence (GRADE)          | Comments |
|   | Assumed risk  | Corresponding risk (95% CI)   |                          |                                  |  |          |
|   | Usual care  | Pharmaceutical care   |                          |                                  |  |          |
| <b>Summated MAI score</b><br>MAI<br>Follow-up: 0 to 12 months   | The mean summated MAI score in the control groups was 1.44                | The mean summated MAI score in the intervention groups was <b>3.88 lower</b> (5.4 to 2.35 lower)                        |                          | 965 (5 studies)                  | ⊕○○○<br><b>very low</b> <sup>1,2,3</sup> |          |
| <b>Change in MAI score</b><br>The change in the MAI<br>Follow-up: 0 to 3 months                                     | The mean change in MAI score in the control groups was 1.43               | The mean change in MAI score in the intervention groups was <b>3.81 higher</b> (1.17 lower to 8.78 higher)              |                          | 424 (4 studies)                  | ⊕○○○<br><b>very low</b> <sup>1,2,3</sup> |          |
| <b>Number of Beers drugs per patient</b><br>The Beers criteria<br>Follow-up: 0 to 12 months                         | The mean number of beers drugs per patient in the control groups was 0.23 | The mean number of Beers drugs per patient in the intervention groups was <b>0.06 lower</b> (0.16 lower to 0.04 higher) |                          | 1440 (3 studies)                 | ⊕○○○<br><b>very low</b> <sup>1,2,3</sup> |          |

\*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

**CI:** Confidence interval

GRADE Working Group grades of evidence

**High quality:** further research is very unlikely to change our confidence in the estimate of effect.

**Moderate quality:** further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

**Low quality:** further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

**Very low quality:** we are very uncertain about the estimate.

- <sup>1</sup> Limitations in the design of studies included in the analysis such as lack of protection against contamination, lack of allocation concealment and the absence of a power calculation resulted in the evidence being downgraded
- <sup>2</sup> Statistically significant heterogeneity, variation in effect sizes and overlap in CIs reported in some studies resulted in downgrading the quality of evidence
- <sup>3</sup> Relating to precision studies tended to have wide CIs as a result of large standard deviations and this was independent of sample size

## BACKGROUND

Prescribing for older people is complex due to factors such as age-related changes in body composition and multiple pathologies. Finding the balance between aggressively treating diseases and avoiding medication-related harm is a critical objective often set by healthcare professionals, yet rarely achieved (Steinman 2007).

Polypharmacy has a range of definitions that refer to the use of multiple medication regimens, but no standard definition is used consistently (Stewart 1990). A simple definition: “the administration of more medicines than are clinically indicated, representing unnecessary drug use” (Montamat 2004) has been used, but for the purpose of this review we have used the common definition of the concomitant ingestion of four or more medications (DoH 2001; Rollason 2003).

Polypharmacy is common in older people, conventionally defined as aged 65 years or over, as this age group often suffers from multiple comorbidities such as heart disease and diabetes that require multiple medications for treatment and prophylaxis. In the USA, the prevalence of polypharmacy, defined by Kaufman as five or more medicines, in older people was approximately 7% (Kaufman 2002) and individuals over 65 years of age, who constituted less than 15% of the American population, purchased 33% of prescription medicines and 40% of over-the-counter (OTC) medicines (Werder 2003). In 2007, people of 65 years and over constituted 16% of the UK population, yet consumed 43% of all National Health Service (NHS) resources in 2003 to 2004 (Philp 2007). The average number of medicines prescribed for people aged 60 years and over in England has almost doubled from 21.2 to 40.8 items per person per year over the past decade (Information Centre 2007).

Inappropriate medications can be defined, in terms of older people, as “medications or medication classes that should generally be avoided in persons 65 years or older because they are either ineffective or they pose unnecessarily high risk for older persons and a safer alternative is available” (Beers 1991). The term ‘inappropriate prescribing’ also encompasses the use of medicines that lead to a significant risk of adverse drug events (ADEs) arising from prescribing practices, for example continuing therapy for longer than necessary in addition to unnecessary polypharmacy.

Reasons for the occurrence of polypharmacy in older patients have been described in the literature and can be broadly classified into three groups: demographic factors such as white race and education (Fillenbaum 1996), health status factors such as poorer health including depression, hypertension, anaemia, asthma, angina, diverticulosis, osteoarthritis, gout, diabetes mellitus, poor self-perceived health and poor life satisfaction, and factors related to access to health care such as number of healthcare visits, supplemental insurance and multiple providers of health care (Espino 1998; Hajar 2007).

Recent promotion of the use of clinical guidelines has influenced prescribing patterns and these often advocate the use of more than one drug to manage common diseases. Many guidelines for prevention and management of diseases common in older people frequently recommend adding medications for secondary prevention. For example, within the UK, current guidelines such as the Joint British Societies’ guidelines on prevention of cardiovascular disease in clinical practice (JBS 2005) advocate this approach. Diseases such as tuberculosis and congestive heart failure, with well-understood causes and pathophysiologies, are often treated with multiple therapeutic drug combinations. However, it has been reported that some clinical guidelines do not modify or discuss the applicability of their recommendations, for older patients, with multiple comorbidities, take account of patient preferences or comment on the quality of the evidence underpinning the guideline (Boyd 2005). Use of clinical guidelines may therefore promote polypharmacy and increase the risk of adverse events such as drug-drug and drug-disease interactions.

Polypharmacy is, however, associated with negative health outcomes including adverse drug reactions, poor adherence and geriatric syndromes, for example, urinary incontinence, cognitive impairment and impaired balance leading to falls (Hajar 2007). The chance of medication-related problems occurring is increased in older age because the ageing process reduces the efficiency of the body’s organs to eliminate drugs (Mangoni 2003). The risk of an ADE is 13% with the use of two medications, but with five medications, it increases to 58% (Fulton 2005). If seven or more medications are used, the incidence increases to 82% (Prybys 2002). In addition, the number of medicines prescribed predicts the number of drug interactions likely to occur (Gallagher 2001). The poor understanding of causes of certain disorders makes prescribing drug combinations more difficult. Treating poorly understood diseases may be a risk factor for inappropriate polypharmacy (Werder 2003).

Appropriate or therapeutic polypharmacy also occurs when the results of clinical trials recommend using multiple medications to treat specific diseases (Gurwitz 2004). There is increasing acceptance that such appropriate polypharmacy may be beneficial and there are many conditions in which the combined use of three or more drugs is beneficial and appropriate especially in older people with multiple comorbidities. Diabetes mellitus is often treated with several drugs at once (Standl 2003). However, it is important to consider whether each drug has been prescribed appropriately or inappropriately, both individually and in the context of the whole prescription (Aronson 2006). Improving appropriate polypharmacy involves encouraging the use of the correct drugs, under appropriate conditions to treat the right diseases. In certain circumstances this may include the removal of unnecessary drugs or those with no valid clinical indication and also the addition of useful ones.

Under-prescribing is defined as a lack of drug treatment for a

present disease for which drug therapy is indicated according to clinical practice guidelines (Lipton 1992). Under-prescribing can be equally as challenging as polypharmacy, in older people, and it has only recently gained recognition as a concern. Under-prescribing has also been shown to be associated with polypharmacy (Kuijpers 2007); the probability of under-prescription increases with the number of medicines used. In one study, the treatment of current medical problems, in geriatric patients, was compared with general practitioners (GPs) and national guidelines (Kuijpers 2007). Polypharmacy was present in 61% of 150 patients and under-prescription in 31%. Of patients with polypharmacy, 42.9% were under-treated, in contrast to 13.5% of patients using four medicines or less (odds ratio (OR) 4.8, 95% confidence interval (CI) 2.0 to 11.2) showing that the estimated probability of under-prescription increased significantly with the number of drugs. These findings may be explained by the unwillingness of GPs to prescribe additional drugs to patients with polypharmacy (e.g. complexity of drug regimens, fear of ADEs, drug-drug interactions and poor adherence) (Kuijpers 2007). This so-called treatment-risk paradox or risk-treatment mismatch exists and may be observed in patients who are at highest risk for complications, having the lowest probability of receiving the recommended medications (Ko 2004; Lee 2005).

Thus, polypharmacy can refer to the prescribing of many drugs (appropriately) or too many drugs (inappropriately) (Aronson 2004). What constitutes 'many' or 'too many' drugs is a physician's dilemma, and choosing the best interventions aimed at ensuring appropriate polypharmacy is a challenge for healthcare practitioners and organisations.

### Description of the condition

Inappropriate polypharmacy, as described above, occurs when older people are prescribed more medicines than are clinically indicated. As under-prescribing is also inappropriate therapy in older people, we included interventions addressing this problem, that is the promotion of appropriate polypharmacy.

Inappropriate polypharmacy has been measured by validated instruments or screening tools such as a validated list of medicines considered inappropriate for older people (Beers 1991; Fick 2003), a list of clinically significant criteria for potentially inappropriate prescribing in older people (Gallagher 2008) or the MAI (Knight 2001). Other methods of assessment of inappropriate polypharmacy include examining patients' adherence to prescribed medication to identify target areas for intervention (Barat 2001; Bedell 2000).

### Description of the intervention

An improvement in appropriate polypharmacy can be achieved through a wide range of interventions. These can be classified as

professional, for example education programmes for prescribers or consumers; organisational, for example medication review clinics, specific audits on benzodiazepine use; or financial, for example prescribing incentive schemes and regulatory interventions. Interventions that reduce the risk of medication-related problems are important to consider (Fick 2008). These may be undertaken by healthcare professionals, educators, policy makers and healthcare service planners. The traditional approach to intervention in polypharmacy, based on the assumption that polypharmacy is harmful, has been to reduce inappropriate medication. By identifying the risk factors for polypharmacy, it is possible to decrease its associated morbidity, mortality and cost (Werder 2003).

Methods recommended in many intervention studies include adopting computer data entry and feedback procedures, which have been shown to decrease polypharmacy and drug-drug interactions (Werder 2003); visual identification of medicines; continuous medication review and thorough patient education to optimise polypharmacy (Fulton 2005).

This review seeks to identify evidence about which types of interventions can improve appropriate polypharmacy.

### How the intervention might work

Interventions to improve polypharmacy are likely to achieve the following outcomes.

1. Improvement of appropriate polypharmacy through the removal of inappropriately prescribed medication.
2. Increase in appropriate medications by promoting adherence to evidence-based therapy.

Computerised decision support (CDS), aimed at prescribers, where electronic alerts are produced to guide the prescriber to the right treatment, has been successful in reducing inappropriate prescribing in older people. Pharmacist-led interventions such as medication review, coordinated transition from hospital to long-term care facilities and pharmacist consultation to patients and physician have been shown to effectively reduce inappropriate prescribing and ADEs (Hanlon 1996; Kaur 2009). Multidisciplinary case conferences involving GPs, geriatricians, pharmacists and residential care staff where individual patients cases are discussed reduced the use of inappropriate medications in residential care (Crotty 2004a)

### Why it is important to do this review

A systematic review may help to identify how we can improve appropriate polypharmacy in older people. Inappropriate prescribing is frequently associated with polypharmacy (Cowan 2002). The prevalence of inappropriate prescribing (and hence polypharmacy) is high (Simon 2005). Therefore, it is important that the gap in current evidence be addressed so that interventions that are



effective in managing disease with appropriate polypharmacy may be identified and put into practice.

## OBJECTIVES

The aim of this review was to determine the effectiveness of interventions designed to improve the appropriate use of polypharmacy (assessed by validated measures) in older people and reduce the risk of medication-related problems. The specific objectives were:

- to determine what interventions that alone, or in combination, are effective in improving the appropriate use of polypharmacy for older people and
- to determine whether these interventions are effective in reducing medication-related problems in older people

## METHODS

### Criteria for considering studies for this review

#### Types of studies

We included all randomised controlled trials (RCTs), including cluster randomised controlled trials (cRCTs), non-randomised controlled clinical trials (CCTs), controlled before-and-after studies (CBAs) and interrupted time series (ITS) studies meeting the Effective Practice and Organisation of Care (EPOC) specification (EPOC 2009) in the review.

We classified trials eligible for inclusion according to the reader's degree of certainty that random allocation was used to form the comparison groups in the trial. If the author(s) stated explicitly that the groups compared in the trial were established by random allocation, then we classified the trial as an RCT. If the author(s) did not state explicitly that the trial was randomised, but randomisation could not be ruled out, we classified the report as a CCT.

#### Types of participants

The review included studies of older people aged 65 years or more, who had more than one long-term medical condition, including those where polypharmacy (classified as four or more medicines) was common practice, for example, Parkinson's disease or diabetes. We considered trials for inclusion if they included a majority (80% or more) of subjects aged 65 years or more or if the mean age was over 65 years. If studies included both older and younger people, we included them if we were able to extract relevant data. We contacted the authors to check the availability of the relevant data.

We excluded studies where the intervention focussed on people with a single long-term medical condition or who were receiving short-term polypharmacy, for example those who were terminally ill or receiving cancer chemotherapy.

#### Types of interventions

We examined all types of interventions aimed at improving appropriate polypharmacy in any setting compared with usual care as defined by the study. We included all unifacected interventions, for example those solely targeted at drug prescription, and multi-facected interventions, for example specialist clinics involving comprehensive geriatric assessment, where the majority of the outcomes related to polypharmacy. We included studies of interventions where the target was polypharmacy across all ages, provided the results for those aged 65 years and over were available separately. We examined all types of interventions that directly or indirectly affected prescribing and were aimed at improving appropriate polypharmacy. These included the following:

- professional interventions such as educational programmes aimed at prescribers
- organisational interventions such as skill-mix changes, pharmacist-led medication review services or specialist clinics, information and communication technology (ICT) interventions such as clinical decision support systems or use of risk screening tools
- financial interventions such as incentive schemes for changes in prescribing practice
- regulatory interventions such as government policy or legislative changes affecting prescribing

#### Types of outcome measures

Validated measures of inappropriate prescribing were the main outcome measure considered in the review. Increasing appropriate polypharmacy could improve indicators of morbidity such as a reduction in ADEs or hospital admissions, but clinical outcomes were not clearly reported because of confounding factors such as multiple comorbidity in older people. We excluded studies where expert opinion was used to determine medication appropriateness.

#### Primary outcomes

The primary outcome was the change in the prevalence of appropriate use of polypharmacy, measured by a validated instrument. This was defined as meeting one or more of the following criteria.

1. Appropriateness of medications prescribed, measured by a validated instrument, for example Beers criteria (Fick 2003) or MAI (Knight 2001).
2. Prevalence of appropriate medication, for example an increase in the number of appropriate drugs as defined by a validated tool, for example Screening Tool to Alert doctors to the Right Tool “(START)” criteria (Barry 2007).

3. Hospital admissions.

### Secondary outcomes

Secondary outcomes included the following.

1. Medication-related problems in older people, for example adverse drug reactions, drug-drug interactions, medication errors.
2. Adherence to medication.
3. Quality of life (assessed by a validated method).

### Search methods for identification of studies

Related systematic reviews were identified by searching the Database of Abstracts of Reviews of Effectiveness (DARE), MEDLINE and EMBASE. Primary studies were identified using the databases, sources, and approaches detailed below. All sources were searched from database start date to April 2009; an update search was run in MEDLINE, EMBASE and *The Cochrane Library* in May 2010.

#### Databases

MEDLINE, OVID <1948-, In-Process, Daily Update>

EMBASE, OVID <1947->

PsycINFO, OVID <1806->

AARP AgeLine, OVID <1978 ->

OVID Evidence Based Medicine (EBM) Collection, including: Cochrane Central Register of Controlled Trials (CENTRAL), ACP Journal Club, DARE, NHS-EED <all dates>

Cochrane Central Register of Controlled Trials (CENTRAL), Wiley [OVID search translated and rerun in Wiley interface for 2010 update search]

CINAHL (Cumulative Index to Nursing and Allied Health Literature), EbscoHost <1980 ->

The EPOC Specialised Register, Reference Manager

Science Citation Index, Social Sciences Citation Index [1975 -] (ISI Web of Science)

Clinical Trials Registry: [www.clinicaltrials.gov](http://www.clinicaltrials.gov)

#### Strategy development process

The search strategy published in the protocol ([Appendix 2](#)) was assessed by M. Fiander, EPOC Trials Search Co-ordinator (TSC) and was broadened to improve retrieval of relevant material. Strategies for MEDLINE, EMBASE, CINAHL, AgeLine, PsycINFO, *The Cochrane Library* and DARE were written by the TSC in consultation with the authors. Strategies for all databases reflect an iterative development process whereby the TSC sought feedback from the authors on the relevance of citations identified by various search terms and edited search strategies accordingly. The Medical Subject Heading (MeSH) polypharmacy was searched as were synonyms and phrases related to polypharmacy such as: Beer's Criteria, over-prescribing, under-prescribing, optimal/suboptimal prescribing, and ACOVE (Assessing Care of Vulnerable Elders). The broader concept of medication errors was also searched. These

concepts were combined using the Boolean operator 'AND' with terms describing the population of interest, for example e.g. aged, geriatrics, etc. Future search strategies for this topic should, however, search the term polypharmacy alone (e.g. not ANDed with "age" terms since the majority of literature on polypharmacy focusses on elderly populations.

The first search of MEDLINE and EMBASE in April 2009 used a single search strategy combining both MEDLINE and EMBASE controlled vocabulary, MeSH and Emtree, respectively, under the assumption that MeSH would identify only MEDLINE citations and that Emtree terms would identify only EMBASE citations but this was not the case. Thus, strategies in 2010 were run in each database independently. The 2009 MEDLINE/EMBASE strategy is in [Appendix 3](#), AARP [Appendix 4](#), CENTRAL [Appendix 5](#), PsycINFO [Appendix 6](#), and CINAHL [Appendix 7](#). The 2010 update search was run in MEDLINE, EMBASE ([Appendix 8](#)), and CENTRAL ([Appendix 9](#)). Changes between the 2009 and 2010 strategies were made based on an analysis of keywords and controlled vocabulary of relevant studies and a validated Cochrane RCT filter (cf. the *Cochrane Handbook for Systematic Reviews of Interventions*, Section 6.4d) and revised EPOC filter were applied.

### Searching other resources

- a) Screened selected issues of the *Journal of the American Geriatrics Society* (e.g. handsearching).
- b) Reviewed reference lists of relevant systematic reviews.
- c) Contacted authors of relevant studies or reviews to clarify reported published information or seek unpublished results/data.
- d) Contacted researchers with expertise relevant to the review topic or EPOC interventions.
- e) Conducted cited reference searches on studies selected for inclusion in this review, related reviews and other relevant citations in ISI Web of Science/Web of Knowledge.

### Data collection and analysis

#### Selection of studies

Two review authors (SP and CH) screened titles and abstracts identified in searches independently to assess which studies met the inclusion criteria. We excluded any papers that did not meet the inclusion criteria at this stage. If there was uncertainty or disagreement, we reached consensus by discussion with the co-review authors (MB, CC and NK). Two review authors (SP and CH) obtained full-text articles and assessed them independently to ensure they met the previously defined inclusion criteria.

### **Data extraction and management**

Three review authors independently extracted details of articles included in the review including the study design, study population, intervention, usual care, outcome measures used and length of follow-up data using a specially designed data extraction form based on the EPOC template (EPOC 2009). We contacted authors for missing information or clarification. We used information from data extraction forms to guide the extraction of numerical data for meta-analysis in Review Manager 5 (RevMan 2008).

We have presented data from RCT and CBA studies using the format suggested in the EPOC Working Paper on presentation of data (EPOC 2009).

### **Assessment of risk of bias in included studies**

At least two review authors independently assessed the internal validity of each included study, and resolved discrepancies by discussion or with the involvement of another review author.

We used The Cochrane Collaboration's tool for assessing risk of bias (Higgins 2008) on six standard criteria: adequate sequence generation, concealment of allocation, blinded or objective assessment of primary outcome(s), adequately addressed incomplete outcome data, freedom from selective reporting and freedom from other risk of bias. We used three additional criteria specified by EPOC (EPOC 2009): similar baseline characteristics, reliable primary outcome measures and adequate protection against contamination. We have reported all included studies in the Cochrane 'Risk of bias' tables.

### **Measures of treatment effect**

We measured the effect of the intervention by reference to published tools for measuring inappropriate prescribing and tools to assess appropriateness of prescribing as outlined above, for example MAI, Beers criteria. We have reported outcomes for each study in natural units. Where baseline results were available from studies, pre- and postintervention means and proportions for both study and control groups have been reported. We analysed data using RevMan 5. Wherever possible, results have been presented with 95% CIs and estimates for dichotomous outcomes (e.g. number of patients receiving appropriate polypharmacy) as risk ratios.

### **Unit of analysis issues**

We examined the methods of analysis of all study types critically. Where studies with a unit of analysis error were identified, the data were re-analysed excluding such studies (sensitivity analysis).

### **Dealing with missing data**

No studies were excluded from a meta-analysis due to a differential loss to follow-up between groups greater than 20%.

### **Assessment of reporting biases**

We assessed reporting bias by scrutinising the study results using the 'Risk of bias' tables in RevMan 5. We examined funnel plots corresponding to meta-analysis of the primary outcome in order to assess the potential for small study effects such as publication bias.

### **Data synthesis and investigation of heterogeneity**

Methods utilised to synthesise the studies depended on their quality, design and heterogeneity. We pooled the results of studies if at least two studies were homogeneous regarding the participants, interventions and outcomes. We grouped studies and described them according to type of intervention, setting and study design, together with an assessment of the evidence of the theoretical basis for each of the approaches described.

In the presence of statistical heterogeneity (greater than 50% as estimated by the  $I^2$  statistic), we applied a random-effects model for meta-analysis. We considered only groups of studies of the same design for pooling (RCTs and CCTs).

Where it was not possible to combine outcome data due to differences in the reporting or substantive heterogeneity, we have reported a narrative summary.

### **Sensitivity analysis**

We performed a sensitivity analysis for pooled results based on methodological quality to assess the overall effect. We excluded one study, which had a unit of analysis error, and another study which was an outlier and had a much larger effect size than other studies in the review as well as high risk of bias in respect of contamination, selective outcome reporting and allocation concealment.

### **Ongoing studies**

We have described ongoing studies identified during the review and provided details of the primary author, research question(s), methods and outcome measures, together with an estimate of the reporting date in the 'Characteristics of studies' tables appended to this review.

### **Summary of findings**

We used 'Summary of findings' tables for the main comparisons in the review to interpret the results and draw conclusions about the effects of different interventions, including the size of the effects and the quality of the evidence.

## **RESULTS**

## Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#); [Characteristics of ongoing studies](#).

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#); [Characteristics of ongoing studies](#).

## Results of the search

The electronic searches identified 2657 potentially relevant citations, of which 139 appeared to meet the inclusion criteria following review of the titles and abstracts. We retrieved the full publications for a more detailed assessment.

Fifty five studies were excluded primarily because of an unsuitable design, for example observational study, no control group. In five studies, the participants were too young as the mean age was less than 65 years and no data were available separately for those aged 65 years and over. There were 18 studies on a single long-term medical condition that were not polypharmacy-focussed.

We excluded a further 51 studies primarily because of the outcome measure used (the primary outcome being the change in the prevalence of appropriate use of polypharmacy, measured by a validated instrument).

Validated measures of appropriateness were used in 22 studies. These measures were: ACOVE (two studies; [Spinewine 2007](#); [Wenger 2007](#)), Beers criteria (12 studies; [Bergkvist 2009](#); [Burnett 2009](#); [Christensen 2004](#); [Crotty 2004b](#); [Fick 2004](#); [Laroche 2006](#); [Monane 1998](#); [Roughead 2007](#); [Schmader 2004](#); [Spinewine 2007](#); [Trygstad 2005](#); [Trygstad 2009](#); [Willcox 1994](#); [Zuckerman 2005](#)), McLeod criteria (1 study; [Tamblyn 2003](#)) and the MAI (nine studies; [Bucci 2003](#); [Crotty 2004a](#); [Davis 2007](#); [Hanlon 1996](#); [Kassam 2003](#); [Spinewine 2007](#); [Taylor 2003](#)). Of these, 10 studies met all other inclusion criteria (including study design, study population, types of intervention examined) and remained in the review.

## Included studies

Ten studies were included in the review: [Bucci 2003](#); [Crotty 2004a](#); [Crotty 2004b](#); [Hanlon 1996](#); [Schmader 2004](#); [Spinewine 2007](#); [Tamblyn 2003](#); [Taylor 2003](#); [Trygstad 2005](#) and [Trygstad 2009](#). The North Carolina Long-Term Care Polypharmacy Initiative was published as three studies ([Christensen 2004](#); [Trygstad 2005](#); [Trygstad 2009](#)) but only two of these studies ([Trygstad 2005](#); [Trygstad 2009](#)) met the inclusion criteria. Details are provided in the [Characteristics of included studies](#) table and are briefly summarised below.

### Study design

The included studies consisted of six RCTs ([Bucci 2003](#); [Crotty 2004b](#); [Hanlon 1996](#); [Schmader 2004](#); [Spinewine 2007](#); [Taylor 2003](#)) and two cluster RCTs ([Crotty 2004a](#); [Tamblyn 2003](#)). Two studies were controlled before and after studies ([Trygstad 2005](#); [Trygstad 2009](#)).

### Settings

Of the five studies (962 participants) conducted in hospital settings, three were conducted in hospital outpatient clinics (general medicine, [Hanlon 1996](#); heart function, [Bucci 2003](#); geriatric evaluation and management (GEM), [Schmader 2004](#)), one was at the hospital/care home interface ([Crotty 2004b](#)) and one was performed in an inpatient setting ([Spinewine 2007](#)). Two studies (12,629 participants) were conducted in the primary care setting in community-based family-medicine clinics ([Taylor 2003](#)) and in GPs' practices ([Tamblyn 2003](#)). Three studies (8320 participants) took place in nursing homes ([Crotty 2004a](#); [Trygstad 2005](#); [Trygstad 2009](#)).

The included studies were carried out in four countries: Australia (two studies), Belgium (one study), Canada (two studies) and the USA (five studies).

### Participants

A total of 21,911 participants were included in this review. The mean age of intervention group participants was 74.2 years and of the control group participants was 74.9 years. Just fewer than 50% (48.8%) of the intervention group participants were female while 50.2% of the control group were female. Ethnicity was not reported in the majority of studies; of the four studies (8685 participants) that did report this, 68.7% of participants were white. All of the participants had more than one long-term medical condition and were receiving four or more medicines at baseline. In nine of the 10 studies where data were available (9351 participants), the participants were prescribed a mean of 7.72 (intervention) and 7.71 (control) medicines.

Common long-term care conditions among participants in the studies included in this review were asthma, diabetes, dyslipidaemia, hypertension, cardiovascular disease (including congestive heart failure) and dementia.

### Interventions

In all cases, the interventions were classified as organisational according to EPOC definitions; none of the included studies was classified as professional, financial or regulatory.

Nine studies examined complex, multifaceted interventions of pharmaceutical care in a variety of settings. Pharmaceutical care is the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life ([Hepler 1990](#)). Pharmaceutical care reflects a systematic approach that ensures patients receive the correct medicines, at an appropriate dose, for appropriate indications. It involves pharmacists moderating drug management in collaboration with the physician, patient and carer ([Hepler 1990](#)). One unifacted study ([Tamblyn 2003](#)) examined CDS provided to GPs in their own practices.

Pharmaceutical care was provided by pharmacists working closely with other healthcare professionals in a variety of settings. In hospital settings, pharmacists worked as part of a multidisciplinary team in outpatient clinics ([Bucci 2003](#); [Hanlon 1996](#); [Schmader 2004](#)) and inpatient services on hospital wards as a clinical pharmacy service ([Spinewine 2007](#)) or took part in the hospital discharge process ([Crotty 2004b](#)). In community settings, pharma-

ceutical care services, including medication reviews, patient interviews and counselling, were undertaken by pharmacists in community-based family medicine clinics (Taylor 2003). In nursing homes, multidisciplinary case conferences combined with staff education were provided by pharmacists (Crotty 2004a) and a drug therapy management service was also provided (Trygstad 2005; Trygstad 2009).

Physicians delivered the intervention via a computerised support programme in one study (Tamblyn 2003), whereas in all other studies, pharmacists used criteria-based processes to give recommendations on improving the appropriateness of prescribing to prescribers.

The models of pharmaceutical care provided in the included studies were complex and variable. In seven studies the pharmacist(s) conducted an independent medication review either using patient notes (Crotty 2004a; Crotty 2004b) or in conjunction with patients during a face-to-face encounter (Bucci 2003; Hanlon 1996; Schmadler 2004; Spinewine 2007; Tamblyn 2003; Taylor 2003). Following medication review, the recommendations were discussed with a multidisciplinary team during case conferences (Crotty 2004a; Crotty 2004b) or discussed with prescribers and followed up with written recommendations (Hanlon 1996) with multidisciplinary team members of the same outpatient clinic (Bucci 2003) or on inpatient ward rounds (Spinewine 2007). In one study, the pharmacist was an integral member of the multidisciplinary team (Schmadler 2004) and contributed to the pharmaceutical aspect of the patients' care plan at the point of decision making. In two studies, consultant pharmacists performed a comprehensive profile review of selected patients' computerised drug profiles using a range of tools including the Beers criteria and made recommendations to prescribers in nursing homes by fax, telephone or written communication (Trygstad 2005; Trygstad 2009).

Patient education was provided as part of the pharmaceutical care intervention in four of six studies where the intervention was conducted face-to-face and these patients were given 'directive guidance' and specialised medication scheduling tools (e.g. monitored dosage systems) to assist with adherence to their prescribed medication regimens (Bucci 2003; Hanlon 1996; Spinewine 2007; Taylor 2003). Directive guidance describes pharmaceutical care activities, such as the provision of information about medications, their administration and their adverse effects (Bucci 2003).

Education was also provided to prescribers and multidisciplinary team healthcare professionals specifically as part of the intervention in five studies (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Spinewine 2007) at case conferences and during ward rounds or by providing evidence-based information and answering specific medication-related queries. In two studies where the pharmacist was part of a multidisciplinary team, no educational intervention was specified in the methodology (Schmadler 2004; Taylor 2003).

The timing of intervention provision was variable. Interventions

were delivered over a period of time, for example during the length of hospital inpatient stay and at discharge (Schmadler 2004; Spinewine 2007) or over several clinic visits and several months on an ongoing basis (Tamblyn 2003). Interventions were also delivered at the time of an event, for example during attendance at outpatient clinics (Bucci 2003; Hanlon 1996; Schmadler 2004; Taylor 2003), at nursing home visits (Crotty 2004a; Trygstad 2005; Trygstad 2009) or at hospital discharge to a nursing home (Crotty 2004b). All study interventions except three (Crotty 2004b; Schmadler 2004; Spinewine 2007) were administered during a single episode of care. The interventions were provided over varying durations, ranging from 5 to 6 months (Bucci 2003; Trygstad 2005) to 3 years and 3 months (Schmadler 2004). Further details of the interventions are detailed in the [Characteristics of included studies](#) tables.

### Outcomes

The primary outcome of interest, in this review, was the change in the prevalence of appropriate use of polypharmacy, measured by a validated instrument. Validated measures of appropriateness reported in all of the included studies were measured independently by pharmacists or the research team who had access to patients' charts and medication records except in Trygstad 2005 and Trygstad 2009 where the Medicaid dispensed prescription claims database was used. The length of time between delivery of the intervention and the follow-up outcome measurement varied from immediately postintervention (e.g. posthospital discharge or clinic visit (Schmadler 2004; Spinewine 2007; Tamblyn 2003) to at least 1 month (Bucci 2003), 8 weeks (Crotty 2004b), 0 to 3 months (Crotty 2004a; Trygstad 2005; Trygstad 2009) and up to 1 year (Hanlon 1996; Taylor 2003).

Seven studies measured appropriateness using the summated MAI score postintervention (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Schmadler 2004; Spinewine 2007; Taylor 2003). If it was not possible to calculate the change in MAI from the results presented, the study authors were contacted to obtain the change in the summated MAI score. One study reported the MAI score in terms of number of prescriptions with inappropriate medications; this was unsuitable for inclusion in the meta-analysis (Taylor 2003). The Beers list of criteria was used to assess the appropriateness of medications post intervention in four studies (Schmadler 2004; Spinewine 2007; Trygstad 2005; Trygstad 2009) and one reported the number of patients with one or more Beers criteria drugs postintervention (Spinewine 2007). Data for the change in the number of Beers drugs were not reported by the Spinewine 2007 study authors.

One study measured appropriateness using the McLeod criteria and reported the rate of inappropriate medications prescribed per physician visit postintervention (Tamblyn 2003). No other validated criteria (e.g. Zhan, Screening Tool of Older Person's Prescriptions (STOPP) or START) were reported.

Under-use of medication was reported in two studies (Schmadler 2004; Spinewine 2007). Under-use defined as "the omission of

drug therapy indicated for the treatment or prevention of established diseases“ (Lipton 1992) was measured using the Assessment of Underutilisation of Medication (AUM) instrument (Jeffery 1999) by Schmader 2004 whereas Spinewine 2007 used seven process measures, from the full range of ACOVE criteria (Wenger 2001), which relate to the inappropriate under-use of medication. Hospital admissions were measured by examination of hospital records at 8 weeks postintervention (Crotty 2004b; Spinewine 2007), after 3 months (Trygstad 2005) and after 1 year (Taylor 2003). Six studies did not measure this outcome.

Medication-related problems, a secondary outcome measure, was measured in six studies and reported as medication misadventure (defined as an iatrogenic incident that occurs as a result of error, immunological response or idiosyncratic response and is always unexpected or undesirable to the patient) (Taylor 2003), potential drug therapy problems (Trygstad 2005; Trygstad 2009) or postintervention ADEs (Crotty 2004b; Hanlon 1996; Schmader 2004). One study assessed adherence to medication via patient self report (Taylor 2003).

Health-related quality of life (HRQoL) was assessed using the Medical Outcomes Study 36-item Short Form health survey (SF-36) in two studies (Hanlon 1996; Taylor 2003).

### Excluded studies

The excluded studies that were read in full (129 studies) are summarised with the reasons for exclusions in the [Characteristics of excluded studies](#) table.

Studies of unsuitable design (55 studies) were excluded from the review. The most common reason for exclusion of other studies was they did not measure appropriateness (91 studies; e.g. they only considered the number of drugs prescribed (12 studies) or used a non-validated measure of appropriateness; e.g. algorithms or guideline adherence (26 studies). Where non-validated measures of appropriateness were reported, the use of expert opinion to decide the appropriateness of prescribing was most common (10 studies; Allard 2001; Avorn 1992; Claesson 1998; Coleman 1999; Ledwidge 2004; Lipton 1992; Meredith 2002; Raebel 2007; Sellors 2003; Simon 2006). Non-validated variations of the MAI score was used in two studies (Mador 2004 (psychoactive drugs only), RESPECT 2010 (UK-version of MAI)). Other reasons for exclusion were that the participants were too young (five studies) or the study was not polypharmacy-focussed (18 studies).

### Risk of bias in included studies

Details of the risk of bias are presented in [Figure 1](#) and in the [Characteristics of included studies](#) tables

Figure 1. 'Risk of bias' summary: review authors' judgements about each 'Risk of bias' item for each included study.

|                | Random sequence generation (selection bias) | Allocation concealment (selection bias) | Blinding (performance bias and detection bias) | Incomplete outcome data (attrition bias) | Selective reporting (reporting bias) | Baseline data? | Reliable Primary outcome measure | Protection against contamination | Power calculation |
|----------------|---|---|--|--|--------------------------------------|----------------|----------------------------------|----------------------------------|-------------------|
| Bucci 2003     | +   | ?                                       | +  | +  | +                                    | +              | +                                | -                                | +                 |
| Crotty 2004a   | +   | +                                       | ?  | +  | +                                    | +              | +                                | +                                | +                 |
| Crotty 2004b   | +   | +                                       | +  | +  | ?                                    | +              | +                                | -                                | +                 |
| Hanlon 1996    | +   | ?                                       | +  | +  | ?                                    | +              | +                                | -                                | +                 |
| Schmader 2004  | +   | -                                       | +  | ?  | +                                    | +              | ?                                | ?                                | +                 |
| Spinewine 2007 | ?   | -                                       | +  | +  | -                                    | +              | +                                | -                                | +                 |
| Tamblyn 2003   | ?   | ?                                       | ?  | +  | +                                    | +              | ?                                | ?                                | -                 |
| Taylor 2003    | ?   | ?                                       | ?  | +  | +                                    | +              | -                                | -                                | -                 |
| Trygstad 2005  | -   | ?                                       | ?  | +  | ?                                    | +              | +                                | ?                                | -                 |
| Trygstad 2009  | -   | ?                                       | ?  | ?  | ?                                    | -              | +                                | ?                                | -                 |



There were no major differences in the risk of bias of studies included in the review.

### **Allocation**

Five trials reported adequate sequence generation (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Schmader 2004) and two reported concealment of allocation (Crotty 2004a; Crotty 2004b).

### **Blinding**

In six studies, blinded measurement of outcomes had taken place to ensure that primary outcome assessors had no knowledge of the intervention received by participants (Bucci 2003; Crotty 2004b; Hanlon 1996; Schmader 2004; Spinewine 2007; Trygstad 2009)

### **Incomplete outcome data**

Incomplete outcome data was adequately addressed in eight of the studies. In one study (Schmader 2004) 864 participants were randomised but only 834 were included in the analysis and no intention-to-treat analysis was reported. Therefore it was unclear if all outcome data were included.

### **Selective reporting**

One study (Trygstad 2009) did not report baseline data and all but one study (Spinewine 2007) reported on the primary and secondary outcomes that have been described in the methods.

In this study the authors failed to report one of the secondary outcomes 'medications taken'.

### **Other potential sources of bias**

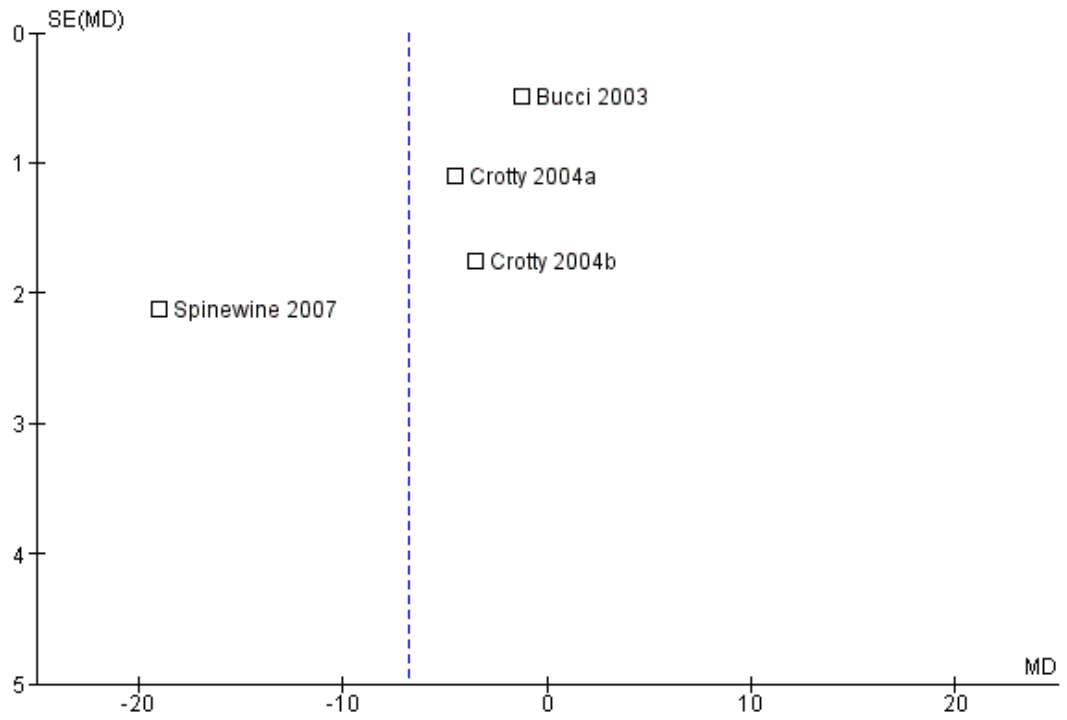
The primary outcome measures used were reliable instruments in all studies, for example MAI kappa value = 0.84.

Participants in one study were protected from contamination (Crotty 2004a). In four studies it was unclear if there had been protection against contamination (Schmader 2004; Tamblyn 2003; Trygstad 2005; Trygstad 2009) and the remaining studies had a high risk of contamination (Bucci 2003; Crotty 2004b; Hanlon 1996; Spinewine 2007; Taylor 2003). Contamination bias occurs when members of the control group are inadvertently exposed to the intervention, thus potentially minimising the difference in outcomes between the two groups (Higgins 2008). This is an important limitation for this review where, in some studies, for example, a pharmacist involved in the provision of pharmaceutical care to members of the intervention group may have inadvertently modified the treatment of those in the control group as a result of knowledge of the intervention. The possible influence of contamination bias should be considered when interpreting the results of this review.

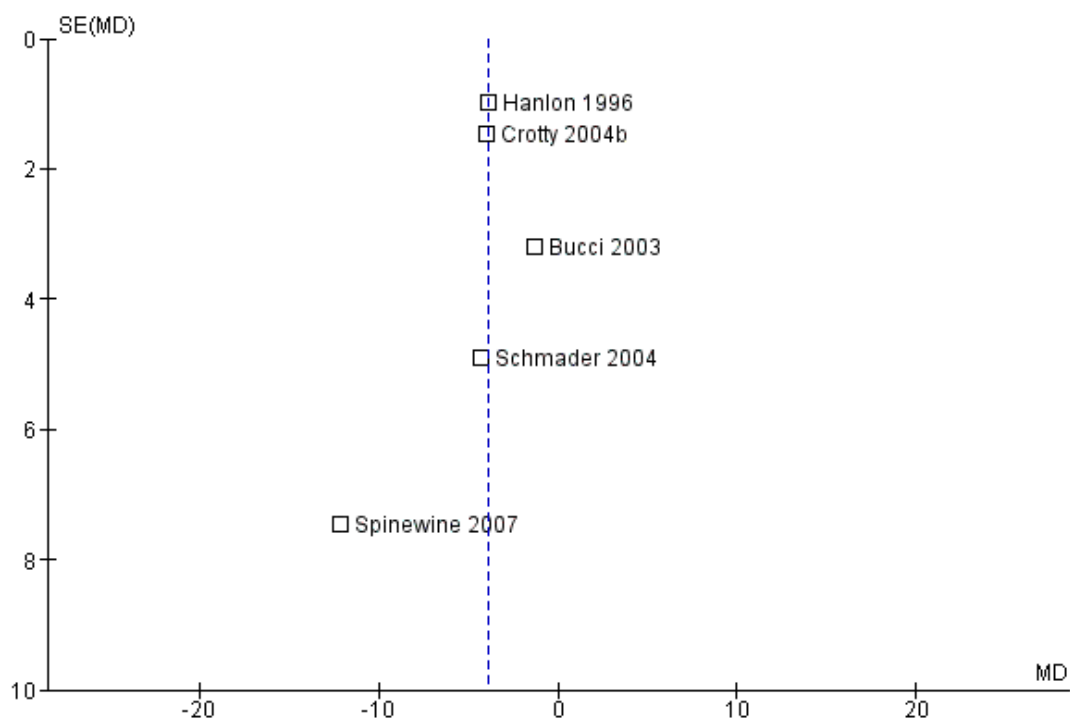
Five studies (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Schmader 2004) had sufficient power to detect a meaningful effect size. Funnel plots of postintervention estimates of the change in MAI and summated MAI indicated little evidence of publication bias (Figure 2; Figure 3).



Figure 2. Funnel plot of comparison: I Postintervention analysis, outcome: I.I Change in MAI score.



**Figure 3. Funnel plot of comparison: I Postintervention analysis, outcome: I.4 Summated MAI score.**



### Effects of interventions

See: [Summary of findings for the main comparison](#)

#### Pharmaceutical care compared to usual care for older people

The pharmaceutical care and CDS interventions included in this review demonstrated a reduction in inappropriate polypharmacy. Hospitalisations, reported in four studies, were significantly reduced in three studies (Crotty 2004b; Taylor 2003; Trygstad 2009 (one cohort, but not in the remaining nine cohorts)) and one study (Spinewine 2007) found no difference.

Medication-related problems, reported in six studies as ADEs (Crotty 2004b; Hanlon 1996; Schmader 2004), medication misadventures (Taylor 2003) or potential drug therapy problems (Trygstad 2005; Trygstad 2009), reduced as a result of the interventions, although not all the results were statistically significant. An improvement in adherence to medication was demonstrated (Taylor 2003) but no changes in HRQoL (Hanlon 1996; Taylor 2003) were detected.

#### Primary outcome results

As there was only one unifacted study included (Tamblyn 2003), a subgroup analysis was not possible. Tamblyn 2003 was also not included in the meta-analysis as a different outcome measure was

used (McLeod criteria, McLeod 1997) and this was not considered similar enough to the other outcomes to combine.

#### Change in the prevalence of appropriate use of polypharmacy, measured by a validated instrument

#### Change in summated MAI score postintervention

Two studies reported the appropriateness of polypharmacy as the change in the summated MAI scores (Bucci 2003; Crotty 2004a) and further unpublished data were received from the authors of two studies (Crotty 2004b; Spinewine 2007). The combined number of participants was 210 intervention and 214 controls. The comparison of the change in MAI score over time in the intervention group compared with the control group is shown in Analysis 1.1. Overall there was a larger reduction in mean MAI in the intervention compared with the control group by on average -6.78 (95% CI -12.34 to -1.22). There was marked and significant heterogeneity between the studies ( $I^2 = 96\%$ ,  $P < 0.0001$ ). Crotty 2004a had a unit of analysis error; nursing homes were the unit of randomisation but the analysis was conducted at the patient level. Sensitivity analysis, excluding Crotty 2004a from the above

model, included 178 intervention participants and 175 controls with a mean difference in the change of MAI score of -7.75 (95% CI -17.06 to 1.56,  $I^2 = 97%$ ) in favour of the intervention group (Analysis 1.2). Sensitivity analyses removing both Crotty 2004a and Spinewine 2007 (an outlying study with a large effect size that had a high risk of bias in respect of contamination, allocation concealment and selective outcome reporting) resulted in a mean difference of -1.79 (95% CI -3.73 to 0.16;  $I^2 = 39%$ ) (Analysis 1.3).

## Prevalence of appropriate use of polypharmacy postintervention

### a. Summated MAI score postintervention

Postintervention pooled data from five studies (Bucci 2003; Crotty 2004b; Hanlon 1996; Schmader 2004; Spinewine 2007) with 488 (intervention) and 477 (control) participants showed a mean improvement of -3.88 (95% CI -5.40 to -2.35) in the summated MAI score postintervention in favour of the intervention group (see Data and analyses section, Postintervention Analysis 1.4). There was little evidence of heterogeneity between these estimates ( $I^2 = 0%$ )

### b. MAI score - other

One study (Taylor 2003) expressed the MAI score as the number of inappropriate prescriptions and thus could not be included in the meta-analysis. The percentage of inappropriate prescriptions decreased in all 10 MAI domains in the intervention group and increased in five domains in the control group.

### c. Beers criteria

#### a. Number of Beers drugs postintervention

Pooled data from two studies (Schmader 2004; Spinewine 2007) with 298 intervention and 288 controls showed a mean reduction of -0.10 (95% CI -0.28 to 0.09) in the number of Beers list drugs per patient postintervention ( $I^2 = 89%$ ) (post-intervention Analysis 1.5). The Trygstad 2009 study, which also reported the number of Beers list drugs, comprised 10 cohorts. It was not included in the meta-analysis as the study design, analysis and reporting (e.g. using propensity matching, results reported as difference in difference) differed from others resulting in estimates that were not sufficiently similar to include. We were unable to ascertain the standard deviation of the results for Trygstad 2005 and it was also not included in the meta-analysis.

#### b. Number of patients with one or more Beers drugs

As well as the total number of Beers list drugs postintervention, Spinewine 2007 also reported the proportion of patients taking one or more Beers list drugs pre- and postintervention. The OR of receiving one or more Beers list drugs postintervention (at hospital discharge) was 0.6 (95% CI 0.3 to 1.1). As this was the only study to report this measure of appropriate polypharmacy, meta-analysis was not possible.

### d. McLeod criteria

The McLeod criteria were used in one study (Tamblyn 2003) to identify the initiation and discontinuation rates of 159 prescription-related problems. During the 13-month study period the number of inappropriate medications started by the study physicians per 1000 visits was 43.8 (intervention) and 53.2 (control). The relative rate of initiation of an inappropriate prescription for the intervention group was 0.82 (95% CI 0.69 to 0.98). Meta-analysis was not possible as these criteria were not used in other studies.

### e. Under-use of medication

The intervention group ACOVE scores (Spinewine 2007) were significantly reduced from 50.0 at baseline to 14.6 postintervention ( $P < 0.001$ ) compared to the control group (58.9 at baseline to 44.4 postintervention,  $P = 0.02$ ) indicating that intervention patients were six times as likely as control patients to have at least one improvement in appropriate prescribing (OR 6.1, 95% CI 2.2 to 17.0) postintervention. In the Schmader 2004 study, a significant reduction in the number of conditions with omitted drugs was observed postintervention; the difference in change AUM score was -0.3 ( $P < 0.0001$ ). No meta-analysis was possible as these measures were measured differently and under-use was not reported in other studies.

## Hospital Admissions

There were four studies measuring hospital admissions postintervention (Crotty 2004b; Spinewine 2007; Taylor 2003; Trygstad 2009). Spinewine 2007 reported no significant reduction in hospitalisations and the remaining studies reported some overall reductions in hospital admissions using a variety of measurements as detailed below.

Taylor 2003 reported a significant reduction in hospital admissions ( $P = 0.003$ ) but not the number of emergency department visits ( $P = 0.44$ ) during the intervention year compared to preintervention. Crotty 2004b reported a reduction in hospital usage among patients still alive at 8 weeks postintervention (OR 0.38; 95% CI 0.15 to 0.99). However, analysis of all patients including deaths and loss to follow-up showed similar hospital usage in both the intervention and control groups (-9 (16.7%) with intervention

versus -15 (26.8%) with control; risk reduction (RR) 0.58; 95% CI 0.28 to 1.21). [Trygstad 2009](#) showed a reduction in the RR of hospitalisation in one cohort of nursing home residents receiving retrospective-only type medication reviews (RR 0.84; 95% CI 0.71 to 1.00,  $P = 0.04$ ) but the remaining eight cohorts had an RR below 1.0, which was not statistically significant at the  $P < 0.05$  level.

Because of the differences in methodology in the measurement of hospital admissions and the expression of results, a meta-analysis was not possible for studies reporting hospital admissions.

Inappropriate medication was also reported by these studies. In the study by [Trygstad 2009](#), the Beers list was used to measure inappropriate medication but no statistically significant reductions were observed in the cohorts receiving retrospective medication review. In the remaining three studies appropriateness of prescribing improved as shown by reductions in the MAI scores but the association with hospitalisations was inconsistent.

## Secondary outcome results

### Medication-related problems in older people (e.g. adverse drug reactions, drug-drug interactions, medication errors)

Medication-related problems were reported as ADEs in three studies ([Crotty 2004b](#); [Hanlon 1996](#); [Schmader 2004](#)). A significant reduction was found in the number of ADEs postintervention. For example, the risk of a serious ADE was significantly reduced ( $P = 0.05$ ) by 35% in a GEM clinic compared with usual outpatient care ([Schmader 2004](#)).

No significant reductions in medication misadventures postintervention ([Taylor 2003](#)) were reported. In the intervention group 2.8% of patients and 3.0% of control group patients had at least one medication misadventure at 12 months ( $P = 0.73$ ).

Potential medication problems categorised as "consider duration" (of therapy), "clinical initiatives" and "therapeutic duplication" were reported in the two North Carolina initiative studies (see [Characteristics of included studies](#) tables; [Trygstad 2005](#); [Trygstad 2009](#)). No statistical significance was reported in either paper. At 3 months, duration alert rates reduced by 6.3% in the intervention group ( $n = 5160$ ) and 16.7% in the control group ( $n = 2202$ ); clinical initiatives reduced by 10.8% in the intervention group and 0.7% in the control group and therapeutic duplication reduced in the intervention group by 9.4% and in the control group by 8.8% ([Trygstad 2005](#)). Control group results were not reported separately in [Trygstad 2009](#). At 3 months, duration of therapy alerts reduced by 27.8% (difference in the difference (DID) = -0.023); there was a mean DID in clinical initiative alerts of -0.24 ( $P < 0.05$ ), a reduction of 13.9% and therapeutic duplication alerts reduced by 5.6% (DID = -0.87) ([Trygstad 2009](#)).

### Adherence to medication

One study ([Taylor 2003](#)) reported adherence to medication in terms of compliance scores, calculated from assessment of patients' reports of missed doses. Patients with medication compliance scores of 80% to 100% increased by 15% at 12 months from a mean ( $\pm$  standard deviation (SD)) of  $84.9 \pm 6.7\%$  to 100% in the intervention group ( $n = 33$ ) while the control group ( $n = 36$ ) did not change; from  $88.9\% \pm 5.8\%$  at baseline to  $88.9\% \pm 6.3\%$  at 12 months ( $P = 0.115$ ).

### Quality of life (assessed by a validated method)

Two studies ([Hanlon 1996](#); [Taylor 2003](#)) assessed HRQoL. No differences in HRQoL scores (SF-36) were observed between groups at baseline or at the endpoint.

### Quality assessment - the GRADE APPROACH

Using the GRADE Pro assessment tool the studies included in this review were deemed to be of very low quality.

Factors that were considered in the GRADE assessment include:

1. Limitations in the design and implementation: major limitations that are likely to result in a biased assessment of the intervention effect include lack of allocation concealment, lack of blinding (particularly with subjective outcomes highly susceptible to biased assessment), a large loss to follow-up, randomised trials stopped early for benefit or selective reporting of outcomes. The 'Risk of bias' assessment carried out for a Cochrane review should feed directly into this GRADE factor. In particular, 'low risk of bias' would indicate 'no limitation'; 'unclear risk of bias' would indicate either 'no limitation' or 'serious limitation'; and 'high risk of bias' would indicate either 'serious limitation' or 'very serious limitation'. We found serious limitations in the design and implementation in a number of studies included in this review: for example, allocation concealment was not conducted in the studies by [Schmader 2004](#) and [Spinewine 2007](#) and the presence of allocation concealment was unclear in all other studies included in the review except [Crotty 2004a](#) and [Crotty 2004b](#). The method of randomisation was not reported in the studies by [Trygstad 2005](#) and [Trygstad 2009](#) and was unclear in the studies by [Spinewine 2007](#), [Taylor 2003](#) and [Tamblyn 2003](#). Protection against contamination was absent in the studies by [Bucci 2003](#), [Crotty 2004b](#), [Hanlon 1996](#), [Spinewine 2007](#) and [Taylor 2003](#). Only one study in the review provided firm evidence of protection against contamination ([Crotty 2004a](#)).

2. Indirectness of evidence. Two types of indirectness are relevant. First, a review comparing the effectiveness of alternative interventions (say A and B) may find that randomised trials are available, but they have compared A with placebo and B with placebo. Thus, the evidence is restricted to indirect comparisons between A and B. Second, a review may find randomised trials

that meet eligibility criteria but that address a restricted version of the main review question in terms of population, intervention, comparator or outcomes. We found no serious problems relating to indirectness of evidence among the studies included in this review.

3. Unexplained heterogeneity or inconsistency of results: when studies yield widely differing estimates of effect (heterogeneity or variability in results), investigators should look for robust explanations for that heterogeneity. For instance, the study by [Spinewine 2007](#) had a much larger effect size than the others in [Analysis 1.1](#).

4. Imprecision of results: when studies include few participants and few events and thus have wide CIs, authors can lower their rating of the quality of the evidence. The studies by [Crotty 2004b](#) and [Spinewine 2007](#) had larger CIs than the other studies included in the review [Analysis 1.1](#), which were deemed to represent a degree of imprecision in the results.

5. High probability of publication bias: the quality of evidence level may be downgraded if investigators fail to report studies (typically those that show no effect: publication bias) or outcomes (typically those that may be harmful or for which no effect was observed: selective outcome reporting bias) on the basis of results. There was no evidence of publication bias detected among studies included in this review.

## DISCUSSION

### Summary of main results

Of 138 studies originally identified, many were excluded due to poor design, the choice of outcome measures used, or both. The studies included in this review were limited by their small sample sizes and poor quality.

The summated MAI was one of the measures of appropriate medication used in the studies to indicate the appropriateness of polypharmacy in older people. Four of the 10 included studies were pooled in a meta-analysis of the change in the summated MAI, which showed a small effect on the appropriateness of polypharmacy ([Analysis 1.1](#)). The postintervention summated MAI results of five studies were pooled in a meta-analysis ([Analysis 1.4](#)), which appeared to indicate that pharmaceutical care interventions had a positive impact on the improvement of appropriate polypharmacy. There was little evidence of heterogeneity in the effect of the interventions on the summated MAI score ( $I^2 = 0$ ).

The change in summated MAI score results were normally distributed and more suitable for meta-analysis, but there was greater heterogeneity among the included studies ( $I^2 = 96\%$ ), largely due to the influence of the results of one study ([Spinewine 2007](#)). Overall a significant reduction in the summated MAI score post intervention was observed. A sensitivity analysis removing [Crotty](#)

[2004a](#), which had a unit of analysis error, from the meta-analysis further improved the effect estimate. Furthermore the removal of an outlying study with a large effect size ([Spinewine 2007](#)) reduced the heterogeneity but also reduced the effect estimate. This may have been related to the small sample size for this meta-analysis (82 intervention patients and 85 control patients). Combination of the two studies using the number of Beers list drugs per patient as a measure of appropriateness ([Schmader 2004](#); [Spinewine 2007](#)) showed a non-significant reduction in the number of Beers list drugs per patient. This reduction is unlikely to have any clinical significance. Only one study reported in terms of the ACOVE criteria, which measure the under-use of medication ([Spinewine 2007](#)).

The various endpoints of inappropriate medication score considered in this review are surrogate markers and future studies should focus on clinical outcomes such as hospital admissions. Only four studies reported hospitalisations and we were unable to combine these results as the reporting styles were different.

### Overall completeness and applicability of evidence

The types of interventions included in the review were limited. Few trials aimed to improve the skills of the prescriber. The majority of interventions were pharmaceutical care interventions including outreach by pharmacists, screening of automated drug alerts by consultant pharmacists visiting nursing homes and clinical pharmacist interventions in various settings. Only one trial was identified that involved CDS. The interventions were complex and mostly multifaceted. The variation in heterogeneity observed in the pooled estimates should be treated cautiously as the interventions did not seem to work consistently across all studies. This is perhaps because of differences in how the interventions were provided, background practice and culture and variable processes in delivery of care. In addition, there may be study-specific factors such as the variation in the quality of studies. The method sections of the studies provided little detail about how complex interventions were developed, the design of the trials and how staff were trained in the delivery of the intervention. Other information pertinent to the success of pharmaceutical care interventions including documentation, communication and sharing of information and the extent of access of intervention pharmacists to clinical records was not clear in the papers.

Although a promising result was obtained suggesting that the interventions described in this review were successful in improving appropriateness of polypharmacy, the clinical impact of this is not known. The summated MAI score is a weighted average of the individual process scores of 10 criteria for each prescribed drug. For each criterion, the index has operational definitions, explicit instructions, and examples and the evaluator rates whether the particular medication is 'appropriate', 'marginally appropriate' or 'inappropriate'. Each patient can score between 0 and 18, repre-

senting the range of medication appropriateness from completely appropriate to completely inappropriate. Although the removal of any inappropriate medication (with a resultant improvement in appropriate polypharmacy) is beneficial, it is unclear to what extent a reduction of the magnitude -3.88 represents in the clinical significance of reduction of risk of harm. However, improvement in these scores is important as quality of prescribing is assuming increasing importance as a means of preventing avoidable medication-related harm.

There was evidence of potential bias in some studies, for example only two studies reported adequate concealment of allocation and only two reported appropriate protection from contamination both, of which may have influenced the effect estimate in these studies and therefore the overall pooled estimate.

There have been few rigorously conducted studies testing interventions that examined clinically relevant outcomes such as hospital admissions or ADEs. Four studies in this review reported hospital admissions postintervention (Crotty 2004b; Spinewine 2007; Taylor 2003; Trygstad 2009) and in three studies (Crotty 2004b; Spinewine 2007; Taylor 2003) the appropriateness of prescribing improved as shown by reductions in the MAI but the association with hospital admissions was inconsistent. In the fourth study (Trygstad 2009), no difference was found in the number of Beers list alerts postintervention but there was a reduction in the relative risk of hospitalisation. The differences between studies in the use of different appropriateness scales make it difficult to assess the extent of the improvement in medication appropriateness on hospital admissions. Similarly, associations between measures of appropriateness and ADEs appeared to exist but were difficult to assess due to the variations in scales used to measure the outcomes and reporting methods.

The aim of the intervention studies included in this review was to reduce harm subsequent to the prescription of too many medicines and ensure that older people are prescribed appropriate medication that enhances their quality of life. However, the focus of a number of studies identified was a reduction of the number of medications, rather than improving overall appropriateness of prescribing including under-prescribing, that is recommending medications that are clinically indicated yet currently missing. Such undertreatment is a relevant outcome with clinical relevance (Aronson 2004; Gurwitz 2004) that is not often studied.

## Limitations of the data

### Quality of the evidence and potential biases in the review process

The variation in heterogeneity between studies included in this review, should be treated cautiously as the interventions did not seem to work consistently across all studies. Factors contributing to this heterogeneity included variation in types, intensity and

duration of interventions, or differences in timing of follow-up measurements. This is perhaps because of differences in how the interventions were provided, background practice and culture and variable processes in delivery of care. In addition, there may be study-specific factors such as the variation in the quality of studies. The method sections of the studies provided little detail about how complex interventions were developed, the design of the trials and how staff were trained in the delivery of the intervention. Other information pertinent to the success of pharmaceutical care interventions including documentation, communication and sharing of information and the extent of access of intervention pharmacists to clinical records was not clear in the papers. It was often unclear exactly what processes constituted successful interventions and this may have contributed to the heterogeneity of the results. A limited number of studies were included in this review as there was a paucity of studies in this area that used validated instruments to measure appropriateness of prescribing. The number of studies that could be combined in the meta-analyses was small, for example the meta-analysis based on the number of Beers drugs per patient included just two studies. The quality of evidence presented in this review was described by the GRADE assessment system as very low. The main limitations of studies that contributed to the assignment of this grade were issues with the design of studies (e.g. It was unclear if allocation was concealed in six studies, protection from contamination was confirmed in only one study), imprecision and heterogeneity. Only six studies reported power calculations (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Schmader 2004; Taylor 2003) and so in the remaining four it is unknown if they had adequate power (80%) to detect changes in the summated MAI score of 0.9 or more (See [Characteristics of included studies](#) tables).

No language restrictions were placed on the search strategy but the trials included were all in English and were conducted in developed countries. We were able to pool data on a limited number of studies. Despite the limited number of studies included, funnel plots of studies reporting the MAI detected no apparent publication bias (Figure 2; Figure 3).

### Agreements and disagreements with other studies or reviews

Other systematic reviews have reported that the most influential factor affecting the results of pharmaceutical care interventions is the way that interventions were conducted, for example face-to-face consultations with physicians achieved a greater reduction in the number of medications taken than written recommendations (Rollason 2003). In addition, another narrative review reported that the timely provision of the intervention, that is prospective advice at the time of prescription rather than dispensing of medication is also more effective (Spinewine 2007a). In general, other studies were unable to detect the effects of pharmaceutical care on reduction of hospital admissions (Holland 2007) or ADEs

(Holland 2007; Spinewine 2007a). One systematic review (Kaur 2009) identified that the most successful types of intervention to reduce inappropriate prescribing in older people were those that had multidisciplinary involvement including a geriatrician, utilised CDS, and those that had mandatory pharmaceutical services or drug restriction policies in place. The results from this current review largely support the above findings as the majority of the pharmaceutical care interventions involved a multidisciplinary component and the CDS intervention study (Tamblyn 2003) had a positive result.

## AUTHORS' CONCLUSIONS

### Implications for practice

The evidence obtained from the combination of the studies is rather weak, and is unclear if interventions to improve appropriate polypharmacy, such as pharmaceutical care, resulted in a clinically significant improvement. There is uncertainty about the effect of such interventions on hospital admissions and ADEs, and it could be argued that these are the critical outcomes for patients. However, the interventions appear beneficial in terms of reducing inappropriate prescribing and reducing some medication-related problems, as well as encouraging proper use of medications and general health promotion and education.

From the results of this review we can recommend that pharmaceutical care appears to improve appropriate polypharmacy especially when there is a multidisciplinary element to the provision of care (Bucci 2003; Crotty 2004a; Crotty 2004b; Hanlon 1996; Schmader 2004; Spinewine 2007; Taylor 2003). In addition, although only one study was included in this review, CDS appears to be a helpful intervention to improve appropriate polypharmacy (Tamblyn 2003).

Given the difficulties in applying results of clinical studies to older people, physicians need to consider their sources of evidence and recommendations carefully and to find the right balance between avoiding the "risk-treatment paradox" (high-risk older patients being denied safe medications capable of materially improving survival or quality of life) while avoiding inappropriate use of medications in which risks are likely to outweigh benefit (Scott 2010).

We are uncertain about which elements of the intervention processes constitute success in improving appropriate polypharmacy and a number of unanswered questions remain. For example, is it sufficient to provide the intervention during a single episode of care or should patients be exposed to the intervention on a daily/weekly or monthly basis? What is the optimal duration of an intervention and should interventions ideally be multi- or unifacted? It is clear that control of processes to support fidelity and control

of the chosen interventions is critical. Staff training is important to ensure consistency; the receptiveness of the prescribers, the patients and the staff in various settings will impact on the uptake and effectiveness of interventions in older people.

### Implications for research

Overall, the quality of the studies in this review was poor and further research should attend to rigour in study design. The term "polypharmacy" can be both negative and positive and this duality of meaning makes objective research difficult (Bushardt 2008). Future studies should utilise clearer definitions of appropriate polypharmacy, for example, hyperpharmacotherapy (too many drugs) (Bushardt 2005) and there should be an acceptance that appropriate polypharmacy is not just about the reduction in the numbers of drugs but rather the prescription of medication appropriate to the needs of patients. Older patients frequently have complex needs therefore it is also important to focus on undertreatment to guide best practice. Older patients are frequently under-represented in clinical trials, are more vulnerable to treatment-induced harm and often are unable to participate in treatment decisions fully (Scott 2010).

More research is needed to test whether existing tools for comprehensive medication review (e.g. the hyperpharmacotherapy assessment tool (HAT tool) (Bushardt 2008) and other similar interventions) can improve appropriate polypharmacy. Careful documentation of the development of the intervention and the training and background of the providers that may be critical to the effectiveness of the intervention is essential to facilitate replication of successful interventions in practice. Relevant risk factors for polypharmacy should also be included in intervention development. Demographic factors, such as white race and education (Fillenbaum 1996), health status, poorer health and access to health care (Hajar 2007), multiple providers of health care (Espino 1998), and number of healthcare visits (Jørgensen 2001), could be considered more pragmatically in designing future interventions. Documentation and analysis of intervention processes utilised would enable identification of the critical elements for successful interventions. Detailed information of how these processes were conducted were absent from the studies included in this review; this information may be gleaned by conducting qualitative research, for example interviewing recipients of the interventions.

A two-stage process of simple screening at drug level only (this could be automatically generated by computer, e.g. Christensen 2004) then application of a more comprehensive tool such as the MAI by clinically trained personnel, for example consultant allowing detection of clinical problems through clinical knowledge and access to patients, medical records or both, may be beneficial.

It is likely that increasingly, policy makers will also be interested in the costs of these types of interventions.

Perhaps most critically, the selection of clinical and humanis-

tic outcomes appropriate for older people (e.g. hospitalisations, ADEs) will be important to consider in future studies. Quality of life is difficult to measure in the older comorbid population especially given longitudinal changes in this outcome and the SF-36 may not be the most appropriate tool (McHorney 1996). Strategies for improving the evidence base for older patient care have been reviewed by Scott 2010.

The judgement as to whether there are many (appropriate polypharmacy) or too many (inappropriate polypharmacy) medications is difficult. The complexity of the clinical situation, the patients' attributes and wishes, and the individuality of prescribing for older complex patients will remain a challenge in this regard. Development of a new, universal, easily applied valid and reliable outcome measure to evaluate effectiveness of interventions should be a priority for future research. Ideally the measure should be globally applicable across various healthcare and cultural settings; for example "STOPP" and "START" are new, recently validated, instruments that may go some way to fulfilling this need (Gallagher 2008). In addition, regional drug availability, economic considerations and clinical practice patterns can impact on criteria selection. Research to validate the several newer criteria in various practice settings and to explore the effect of adhering to the guidelines on patient outcomes is warranted. Data from such research will aid practitioners in identifying preferred criteria (Levy 2010).

Heterogeneity among the fitness levels of older people (Spinewine 2007a) means that translational research and retesting of success-

ful interventions may be necessary in dissemination to new populations, for example a population of quite healthy 70-year-old people may respond differently to an intervention compared to very frail 92 year olds.

Establishing the reasons why not all interventions are accepted may be enlightening and support research into the development of universally successful interventions. There appears to be a ceiling (75% approximately) effect where inappropriate prescribing continues despite the evidence-base of interventions (Furniss 2000; Zermansky 2006). Use of qualitative methodology by interviewing prescribers may uncover reasons why they did not accept interventions (e.g. timing or appropriateness of the intervention provision or expertise of providers). There is additionally a need to explore and understand poor prescribing practice in order to know how to improve it and enhance patient safety through reducing the need for intervention.

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- \* Indicates the major publication for the study

## CHARACTERISTICS OF STUDIES

### Characteristics of included studies [ordered by study ID]

#### Bucci 2003

|               |  |
|---------------|--|
| Methods       | Study design: RCT (block design, using a computerised randomisation scheme)<br>Unit of allocation/analysis: patient<br>Follow-up: 1 month after intervention<br>Duration: unclear<br>Providers: pharmacists  |
| Participants  | Setting/patients: 80 participants (39 intervention and 41 control) patients enrolled at a hospital clinic at the University Health Network Toronto General Hospital, Canada<br>Focus on polypharmacy: mean number of medications at baseline 7.6 (intervention), 6.0 (control)<br>Age (mean) 56.4 years (intervention), 60.2 (control)<br>Male sex: 78.9% (intervention), 78% (control)<br>Ethnicity: no information given   |
| Interventions | The intervention involved receipt of pharmacist services, that is functioning as part of a healthcare team, meeting patient's drug-related needs and ensuring continuity of care. Specifically, this involved the pharmacist reviewing the appropriateness of drug therapy and making recommendations for change, providing information about medications, their administration and their adverse effects<br>Those randomised to the non-intervention group received usual care from other clinic staff                    |
| Outcomes      | Patient outcomes were assessed by the research assistant pharmacist at baseline and follow-up using the MAI and the directive guidance scale<br>Appropriateness of prescribing determined by pre- and postintervention mean MAI scores<br>The Purdue Pharmacist Directive Guidance score rated the guidance provided by the pharmacist. Directive guidance is described as pharmaceutical care activities such as providing information about medicines, their administration and their potential to cause adverse effects |
| Notes         | The patient chart was reviewed by a research assistant pharmacist blinded to the intervention and information required to assess the appropriateness of medications was abstracted. A summated MAI score was determined for each patient at least 1 month after the intervention. Follow-up took place at a scheduled clinic visit or by telephone   |

#### *Risk of bias*

| Bias  | Authors' judgement | Support for judgement                     |
|---|--------------------|---|
| Random sequence generation (selection bias) | Low risk           | Using a computerised randomisation scheme |
| Allocation concealment (selection bias)     | Unclear risk       | Insufficient information to judge yes/no  |

**Bucci 2003** (Continued)

|  |           |  |
|--|-----------|--|
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk  | The research assistant was blinded to the intervention   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk  | One patient in intervention group had died at follow-up  |
| Selective reporting (reporting bias)                           | Low risk  | All outcomes reported  |
| Baseline data?   | Low risk  | Baseline patient characteristics were reported   |
| Reliable Primary outcome measure                               | Low risk  | The MAI has good (kappa value = 0.59) to excellent (kappa value = 0.83) reproducibility  |
| Protection against contamination                               | High risk | The presence of the pharmacist in the clinic may have contaminated the medication appropriateness results of the non-intervention group                |
| Power calculation  | Low risk  | Assuming a change of 25% between groups using the MAI with an alpha of 0.05, a power of 80% and 10% dropout rate requires a sample size of 76 subjects |

**Crotty 2004a**

|               |   |
|---------------|---|
| Methods       | Study design: RCT (cluster)<br>Unit of allocation: 10 residential facilities<br>Unit of analysis: patient<br>Follow-up: 3 months<br>Duration: 2 case conferences 6 to 12 weeks apart<br>Providers: resident's GP, geriatrician, pharmacist, care home staff and Alzheimer's Society representative  |
| Participants  | Setting/patients: 154 residents (100 intervention and internal control and 54 external control) from 10 high-level residential aged care facilities (nursing homes) in Southern Adelaide<br>Focus on polypharmacy: residents were prescribed more than 5 medications<br>Age (mean): 85.3 years (95% CI 84.0 to 86.6) (intervention), 83.6 (95% CI 81.3 to 85.9) (external control)<br>Male sex: 44% (intervention), 43% (external control)<br>Ethnicity: no information given |
| Interventions | A medication review was conducted prior to a multidisciplinary case conference. The resident's GP, a geriatrician, a pharmacist, carers and a representative from the Alzheimer's   |



**Crotty 2004a** (Continued)

|          |  |
|----------|--|
|          | <p>Association of South Australia attended the case conferences, which were held at the nursing home. At the case conference care staff expanded on any issues in the case notes that required discussion and the Alzheimer's representative discussed non-pharmacological management of dementia-related behaviour. A problem list was developed by the GP in conjunction with the care staff</p> <p>A half day training workshop examining the use of a toolkit in the management of challenging behaviours was provided to all facilities in the study including the control facilities</p> |
| Outcomes | <p>Medication appropriateness was assessed using the MAI. The change in MAI was reported. All residents had their medication charts reviewed pre- and postintervention by an independent pharmacist</p> <p>The Nursing Home Behaviour Problem Scale (NHBPS) was used to assess the effect of the intervention on residents' behaviour</p> <p>Monthly drug costs for all regular medications on the government's pharmaceutical benefits scheme were calculated for each resident in the intervention and control groups</p>  |
| Notes    | <p>Mean MAI score at baseline and at follow-up (3 months).</p> <p>Unit of analysis error.</p>  |

***Risk of bias***

| Bias   | Authors' judgement | Support for judgement  |
|--|--------------------|--|
| Random sequence generation (selection bias)                    | Low risk           | Computer generated random numbers were used by a researcher independent of the investigators                           |
| Allocation concealment (selection bias)                        | Low risk           | Randomly allocated by the pharmacy department using sequential sealed opaque envelopes to receive the case conferences |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk       | Insufficient information to judge yes/no   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk           | Those lost to follow-up were stated and an ITT analysis was used   |
| Selective reporting (reporting bias)                           | Low risk           | The impact of case conferences on appropriateness of medication and patient behaviours were stated as the objectives   |
| Baseline data?   | Low risk           | Characteristics of residents at baseline were reported   |
| Reliable Primary outcome measure                               | Low risk           | The MAI has good to excellent reproducibility (kappa value = 0.59 to 0.83)   |

**Crotty 2004a** (Continued)

|                                  |          |  |
|----------------------------------|----------|--|
| Protection against contamination | Low risk | No evidence of a carryover effect to other residents within the facilities   |
| Power calculation                | Low risk | An effect size of 0.9 in the MAI between the intervention and control groups would be detected with 28 residents in each group |

**Crotty 2004b**

|                     |   |
|---------------------|---|
| Methods             | <p>Study design: single-blind RCT</p> <p>Unit of allocation/analysis: patients</p> <p>Follow-up: at 8 weeks</p> <p>Duration: unclear</p> <p>Providers: transition coordinator pharmacist, nurses</p>  |
| Participants        | <p>Setting/patients: 110 (56 intervention and 54 control) eligible patients making first-time transition from a hospital to 1 of 85 long-term residential care facility in Southern Adelaide South Australia. Patients were eligible if they or their career gave consent and they had a life expectancy of &gt; 1 month</p> <p>Focus on polypharmacy: the number of pre-admission medicines was 6.6 (intervention group) and 7.7 (control group)</p> <p>Age (mean): 82 years (95% CI 80.2 to 83.7) (intervention), 83.4 years (95% CI 81.7 to 85.1) (control)</p> <p>Female sex: 58.9% (intervention), 63% (control)</p> <p>Ethnicity: non-English speaking background: 8.9% (intervention), 5.6% (control)</p>  |
| Interventions       | <p>The intervention focussed on transferring information on medications to care providers in long-term care facilities (first-time transition). When discharged from hospital to long-term care facilities both the patients' family physicians and community pharmacists were faxed a medication transfer summary compiled by the transition pharmacist. After transfer, the transition pharmacist coordinated an evidence-based medication review that was conducted by community pharmacists within 10 to 14 days of transfer</p> <p>A case-conference that involved the transition co-coordinator, the family physician, community pharmacist and nurse was held within 14 to 28 days of transfer</p> <p>Usual hospital discharge process was received by controls and included a standard hospital discharge summary</p> |
| Outcomes            | <p>The appropriateness of prescribing was measured using the MAI. A single score was determined for each medication received. A total MAI score for each resident was calculated as a sum of MAI scores</p> <p>Secondary outcome measures included unplanned visits to the emergency department or hospital readmissions (grouped together as hospital usage), ADEs, falls, worsening of mobility, behaviours, pain and increasing confusion</p>  |
| Notes               |   |
| <b>Risk of bias</b> |   |

| Bias   | Authors' judgement | Support for judgement  |
|--|--------------------|--|
| Random sequence generation (selection bias)                    | Low risk           | A computer generated allocation sequence that used block randomisation   |
| Allocation concealment (selection bias)                        | Low risk           | Centralised hospital pharmacy service used for randomisation   |
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk           | Independent pharmacists who were blinded to the study group allocation assessed patient medication charts and case notes   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk           | 12 patients in the intervention group and 10 in the control group died or did not complete the study for other reasons   |
| Selective reporting (reporting bias)                           | Unclear risk       | Insufficient information to permit judgement of yes/no   |
| Baseline data?   | Low risk           | At baseline there was no significant difference in the mean MAI  |
| Reliable Primary outcome measure                               | Low risk           | The validity of the MAI has been reported previously   |
| Protection against contamination                               | High risk          | The transition pharmacist also coordinated a case-conference involving him or herself, the family physician, the community pharmacist and a registered nurse at the facility within 14 to 28 days of the transfer. At this case-conference, the transition pharmacist provided information concerning medication use and appropriateness |
| Power calculation  | Low risk           | 90% power to detect a mean ( $\pm$ SD) difference in MAI of 4.0 ( $\pm$ 4.5) between groups at 8 week follow-up  |

## Hanlon 1996

|               |  |
|---------------|--|
| Methods       | <p>Study design: RCT</p> <p>Unit of allocation/analysis: patients</p> <p>Follow-up: 3 and 12 months after randomisation</p> <p>Duration: unclear</p> <p>Providers: geriatrician, clinical pharmacist, nurse</p>  |
| Participants  | <p>Setting/patients: 208 patients who were 65 years or older and were enrolled at the Veteran Affairs Medical Center, Durham, North Carolina, USA</p> <p>Focus on polypharmacy: included patients were prescribed 5 or more regularly scheduled medications by a Veteran Affairs physician) and were enrolled at the Veteran Affairs Medical Center, Durham, North Carolina</p> <p>Age (mean <math>\pm</math> SD): 69.7 <math>\pm</math> 3.5 (intervention), 69.9 <math>\pm</math> 4.1 (control)</p> <p>Male sex: 98.1% (intervention), 100% (control)</p> <p>Ethnicity: % white 79 (intervention), 74.8 (control)</p>   |
| Interventions | <p>The clinical pharmacist: monitored drug therapy outcomes by reviewing each patient's medical record and medication list, ascertained current medication use, identified drug-related problems by meeting with patients and carers and evaluated patients' medications by applying the MAI. The pharmacist then formulated prioritised written recommendations presented orally and in writing to the primary physician. After the physician visit the clinical pharmacist educated the patient regarding drug-related problems and encouraged compliance</p> <p>In the control group the clinic nurse reviewed patients' current medications before the visit</p> |
| Outcomes      | <p>Patient MAI scores were determined by summing MAI medication scores across evaluated medications</p> <p>HRQoL</p> <p>Patient medication compliance and knowledge were assessed by patient self-report</p> <p>Potential ADEs</p> <p>Patient satisfaction</p>   |
| Notes         |  |

### *Risk of bias*

| Bias   | Authors' judgement | Support for judgement  |
|--|--------------------|--|
| Random sequence generation (selection bias)                    | Low risk           | Patients were randomised to either the control or intervention group using a computer generated scheme                             |
| Allocation concealment (selection bias)                        | Unclear risk       | Insufficient information to permit judgement of yes/no   |
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk           | Prescribing appropriateness was assessed by a blinded research clinical pharmacist. The HRQoL was assessed by blinded interviewers |

**Hanlon 1996** (Continued)

|  |              |   |
|--|--------------|---|
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk     | 36 patients were not interviewed. 5 in both control and intervention groups were institutionalised. 5 from the intervention group and 1 from the control group were lost to follow-up. 7 from the intervention and 10 from the control group died |
| Selective reporting (reporting bias)                     | Unclear risk | Insufficient information to permit judgement of yes/no  |
| Baseline data?   | Low risk     | Characteristics at baseline reported  |
| Reliable Primary outcome measure                         | Low risk     | Previously MAI assessments made by a clinical pharmacist and a physician demonstrated excellent inter-rater (kappa value = 0.83) and intra-rater reliability (kappa value = 0.92)   |
| Protection against contamination                         | High risk    | There was potential for contamination since physicians had patients in both intervention and control groups   |
| Power calculation  | Low risk     | 100 subjects per group were required to obtain 80% power to detect an effect size of 0.4. 84 patients per group to obtain 80% power to detect an effect size of 0.5   |

**Schmader 2004**

|               |   |
|---------------|---|
| Methods       | Study design: RCT (2 x 2 factorial design)<br>Unit of allocation/analysis: patient<br>Follow-up: closeout telephone interviews 12 months after randomisation<br>Duration: patients were followed for 12 months<br>Provider: pharmacists/nurses/geriatrician/social worker   |
| Participants  | 834 (430 intervention (inpatient), 404 control (inpatient)) patients who were 65 years old or more, hospitalised on a medical ward or surgical ward had an expected stay of 3 or more days and met criteria for frailty, in 11 Veterans Affairs hospitals, in the USA<br>Focus on polypharmacy: at baseline the mean number of prescription drugs per patient in the geriatric inpatient unit was 7.7 and 7.6 in the usual inpatient care group<br>Age: ranges: 65 to 73 years (196 people in intervention group, 191 people in control group), 74 years or more (234 people in intervention group, 213 people in control group)<br>% Male: 97% intervention, 98% control<br>Ethnicity: % white 71% intervention, 75% control |
| Interventions | All 11 inpatient and outpatient geriatric evaluation management programmes had a core team that included a geriatrician, a social worker and a nurse. Pharmacists performed regular assessments and recommendations regarding medications in 7 inpatient and  |



|  |  |  |
|--|--|--|
|  | 6 outpatient teams. For patients assigned to the GEM unit or clinic, team members implemented evaluation and management protocols<br>Usual inpatient care was the customary medical or surgical treatment by attending physicians<br>Usual outpatient care was the customary care delivered by ambulatory care attending physicians or house staff under their direction |  |
| Outcomes   | Adverse drug reactions and serious adverse drug reactions.<br>Inappropriate prescribing was assessed using the MAI and Beers list at baseline and discharge<br>Polypharmacy and under-use were also measured.  |  |
| Notes  |  |  |
| <b>Risk of bias</b>  |  |  |
| <b>Bias</b>  | <b>Authors' judgement</b>  | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                    | Low risk   | Computer generated random allocation   |
| Allocation concealment (selection bias)                        | High risk  | The centre notified site research assistants of each patient's inpatient assignment by telephone. Outpatient assignment was revealed at hospital discharge   |
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk   | A trained research assistant blinded to group assignment conducted close-out telephone interviews 12 months after randomisation  |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Unclear risk   | Insufficient information to permit judgement of yes/no   |
| Selective reporting (reporting bias)                           | Low risk   | All outcomes were reported   |
| Baseline data?   | Low risk   | Patient characteristics at baseline were reported  |
| Reliable Primary outcome measure                               | Unclear risk   | The primary outcomes were related to adverse drug reactions which were assumed when the relation between an event and a drug was determined to be causally related. Disagreements on the item level were resolved by clinical consensus conference |
| Protection against contamination                               | Unclear risk   | Insufficient information to permit judgement of yes/no   |

**Schmader 2004** (Continued)

|                   |          |  |
|-------------------|----------|--|
| Power calculation | Low risk | 376 subjects per group (total of 752 subjects) were required to obtain 80% power and a 95% confidence interval |
|-------------------|----------|--|

**Spinewine 2007**

|               |  |  |
|---------------|--|--|
| Methods       | <p>Study design: RCT<br/>         Unit of allocation/analysis: patient<br/>         Follow-up: 1 month, 3 months and 1 year<br/>         Duration: from admission to discharge<br/>         Provider: pharmacists</p>  |  |
| Participants  | <p>Setting/patients: 186 hospital inpatients (96 intervention, 90 controls) aged 70 years and older with acute geriatric problems in a GEM unit of a university teaching hospital, Mount-Godinne, Yvoir, Belgium<br/>         Focus on polypharmacy: at baseline the mean (<math>\pm</math> SD) number of prescribed drugs was 7.9 (<math>\pm</math> 3.5) for patients in the intervention group and 7.3 (<math>\pm</math> 3.3) for those in the control group<br/>         Age (MEAN <math>\pm</math> SD): 82.4 <math>\pm</math> 6.9 intervention, 81.9 <math>\pm</math> 6.2 control<br/>         Female sex: 71.9% intervention, 66.7% control<br/>         Ethnicity: no information given</p>  |  |
| Interventions | <p>The intervention consisted of the provision of pharmaceutical care from admission to discharge by a clinical pharmacist. A pharmacist was present 4 days per week and participated in medical and multidisciplinary rounds, had direct contact with patients and carers and had access to patient medical records. For every patient the pharmacist performed a medication history on admission and prepared a patient record with clinical and pharmaceutical data. Appropriateness of treatment was analysed and a pharmaceutical care plan was prepared. Whenever an opportunity to optimise prescribing arose the pharmacist discussed this with the prescriber who could accept or reject the advice. The pharmacist answered all questions from healthcare professionals about medications. At discharge the pharmacist provided written and oral information on treatment changes to the patient or carer as well as written information to the GP</p> |  |
| Outcomes      | <p>Prescribing appropriateness measured using MAI, Beers list, ACOVE<br/>         Mortality, readmission (hospitalisation) or visit to an emergency department, medications taken, unnecessary drug use and satisfaction with information provided at admission and discharge</p>  |  |
| Notes         |  |  |

***Risk of bias***

| Bias  | Authors' judgement | Support for judgement  |
|---|--------------------|--|
| Random sequence generation (selection bias) | Unclear risk       | Randomisation was alternate and stratified for age, number of prescribed medicines and identity of the resident in charge of the |

**Spinewine 2007** (Continued)

|  |           |  |
|--|-----------|--|
|  |           | patient. A pharmacist external to the main study checked the inclusion criteria and assigned participants to their groups  |
| Allocation concealment (selection bias)                        | High risk | A pharmacist external to the main study checked inclusion criteria and assigned participants to their groups   |
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk  | Due to the nature of the project physicians were not blinded to group assignment however MAI, Beers, ACOVE and hospital admissions all carried out in a blinded manner   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk  | 7 patients were transferred to another unit in both the control and intervention groups<br>5 patients died in each of the groups (10 people in total)  |
| Selective reporting (reporting bias)                           | High risk | A secondary outcome "medications taken" was not reported   |
| Baseline data?   | Low risk  | Baseline patient characteristics reported  |
| Reliable Primary outcome measure                               | Low risk  | MAI, Beers criteria and ACOVE are validated measures   |
| Protection against contamination                               | High risk | Some physicians cared for control and intervention patients  |
| Power calculation  | Low risk  | 90 patients per group were required to have 80% power to detect a 20% absolute improvement in ACOVE and Beers criteria. 28 patients per group would provide 90% power to detect an effect size of 0.9 on the MAI |

**Tamblyn 2003**

|         |  |
|---------|--|
| Methods | <p>Study design: RCT<br/> Unit of allocation: physicians<br/> Unit of analysis: patients<br/> Follow-up: Follow-up was terminated after an inappropriate prescription had been initiated or discontinued<br/> Duration: 13 months<br/> Provider: physician</p> |
|---------|--|

|  |  |   |
|--|--|---|
| Participants   | <p>Setting/patients: 107 primary care physicians with at least 100 patients, who were 30 years of age or older, had practices in Montreal and spent at least 70% of the week in fee-for-service practice were randomised. Patients were 66 years of age or older and had been seen on 2 or more occasions by the study physician in the past year and were living in the community at the start of the study</p> <p>Focus on polypharmacy: implied 35.6 (intervention)/33.8 (control) prescriptions per elderly patient in the 18 months before the study date</p> <p>Age (mean <math>\pm</math> SD): 75.4 <math>\pm</math> 6.3 (intervention), 75.3 <math>\pm</math> 6.2 (control)</p> <p>Female sex: 61.2% (intervention), 64.2% (control)</p> <p>Ethnicity: no information given</p>  |   |
| Interventions  | <p>Each physician was given a computer, printer, health record software and dial-up access to the internet. The software documented health problems and medication supplied. For each patient, trained personnel developed a health problem list, documented 26 health problems related to the targeted drug-disease contraindications and other health problems</p> <p>CDS group physicians downloaded updates of dispensed prescriptions from the Quebec beneficiary, medical-service and prescription claims database (Regie de l'assurance maladie du Quebec (RAMQ)). The data were integrated into the patient's health record and categorised as having been prescribed by the study physician or by another physician. Alerts were instituted to identify the 159 clinically relevant prescribing problems in the elderly (McLeod 1997). Alerts appeared when the physician accessed the record, when prescription record updates were downloaded from RAMQ, and when current health problems and prescriptions were recorded by the physician in the chart. They identified the nature of the problem, possible consequences and suggested alternative therapy in accordance with expert consensus</p> |   |
| Outcomes   | <p>Initiation and discontinuation rates of 159 prescription-related problems (McLeod criteria)</p>   |   |
| Notes  |  |   |
| <b>Risk of bias</b>  |  |   |
| <b>Bias</b>  | <b>Authors' judgement</b>  | <b>Support for judgement</b>  |
| Random sequence generation (selection bias)                    | Unclear risk   | Physicians were stratified by age, sex, language, location of medical school and number of elderly patients. Half of the physicians within each stratum were randomly assigned to the CDS group |
| Allocation concealment (selection bias)                        | Unclear risk   | Insufficient information to permit judgement of yes/no  |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk   | Insufficient information to permit judgement of yes/no  |

**Tamblyn 2003** (Continued)

|  |              |  |
|--|--------------|--|
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk     | The number of inappropriate scripts started per 1000 visits and the number of inappropriate scripts discontinued per 1000 visits were reported |
| Selective reporting (reporting bias)                     | Low risk     | Results of outcomes specified in the methodology were all reported   |
| Baseline data?   | Low risk     | The prevalence of potentially inappropriate prescribing in the 2-month period before the study was reported                                    |
| Reliable Primary outcome measure                         | Unclear risk | McLeod criteria used   |
| Protection against contamination                         | Unclear risk | To minimise the possibility of contamination, only 1 physician per group practice was included   |
| Power calculation  | High risk    | No power calculation given   |

**Taylor 2003**

|               |  |
|---------------|--|
| Methods       | Study design: RCT<br>Unit of allocation/analysis: patient<br>Follow-up: 12 months<br>Duration: baseline until 12 months<br>Provider: pharmacists   |
| Participants  | Setting/patients: adult patients (33 intervention, 36 control) who received care at 3 community-based family medicine clinics affiliated with the University of Alabama School of Medicine in Tuscaloosa and other towns in Pickens County Alabama<br>Focus on polypharmacy: patients eligible for inclusion were taking 5 or more medications, 12 or more doses per day, or both<br>Age (mean ± SD): 64.4 ± 13.37 years (intervention), 66.7 ± 12.3 years (control)<br>Male sex: 36.4% (intervention), 27.8% (control)<br>Ethnicity: % white = 60.6% (intervention), 61.1% (control)  |
| Interventions | Patients received usual medical care along with pharmacotherapeutic interventions by a pharmacist during regularly scheduled clinic visits, based on the principles of pharmaceutical care. A patient typically met with a pharmacist for 20 minutes before seeing a physician. Published therapeutic algorithms and guidelines were used as the basis of the pharmacists' recommendations. The pharmacists were specifically trained to evaluate a therapy's indication, effectiveness and dosage as well as the correctness and practicality of directions, drug-drug interactions, drug-disease interactions, therapeutic duplication, and the duration of treatment, untreated indications and expense<br>The pharmacist reviewed the medical record for medication-related problems, conducted a chart review to ensure that information on drug therapy and allergies was accurately |



|  |   |  |
|--|---|--|
|  | <p>documented, examined the medication history to determine compliance with and complications of medications and provided comprehensive individualised patient education that included a brief review of the disease, important lifestyle modifications and basic drug information. Pharmacists monitored patients' responses to drugs and attempted to improve compliance by consolidating medication regimens, reducing dosage frequency, devising medication reminders and teaching patients techniques for using devices such as inhalers. In addition to this, a system was developed in which the patient, physician or nurse reported suspected problems with drug therapy. Patients, nurses and physicians were educated about the signs and symptoms of medication misadventures<br/>The control group received standard medical care.</p> |  |
| Outcomes   | <p>The number of inappropriate prescriptions at baseline and at 12 months using the MAI<br/>The change in the number of hospitalisations and Emergency Department visits at 12 months. Medication misadventures, medication compliance and quality of life were also assessed</p>   |  |
| Notes  |   |  |
| <b>Risk of bias</b>  |   |  |
| <b>Bias</b>  | <b>Authors' judgement</b>   | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                    | Unclear risk  | "Patients were randomly assigned to a control group or an intervention group" insufficient information to permit judgement of yes/no |
| Allocation concealment (selection bias)                        | Unclear risk  | Insufficient information to permit judgement of yes/no   |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk  | Insufficient information to permit judgement of yes/no   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk  | 12 patients were not included because they were lost to follow-up  |
| Selective reporting (reporting bias)                           | Low risk  | All outcomes described were reported   |
| Baseline data?   | Low risk  | Baseline data were reported  |
| Reliable Primary outcome measure                               | High risk   | Insufficient information to permit judgement of yes/no   |
| Protection against contamination                               | High risk   | Although patients were randomised, physicians were not because of the small number of physicians practising in the rural community   |

**Taylor 2003** (Continued)

|                   |           |                            |
|-------------------|-----------|----------------------------|
| Power calculation | High risk | No power calculation given |
|-------------------|-----------|----------------------------|

**Trygstad 2005**

|               |  |
|---------------|--|
| Methods       | Study design: controlled before and after study<br>Unit of allocation/analysis: patient<br>Follow-up: 3 months March to June 2003<br>Duration: 6 months<br>Providers: pharmacists  |
| Participants  | Setting/patients: medicaid-dependent nursing home residents from 253 nursing homes in North Carolina<br>Focus on polypharmacy: participants had 18 or more prescription fills in the 90-day period prior to the start of the study<br>Age (mean ± SD): 77.57 ± 12.72 years<br>Male sex: 24.98%   |
| Interventions | An on-site drug profile review by pharmacists was completed. A toolkit with instructions for documenting and screening criteria, used to flag drugs, was given to pharmacists. Pharmacists were also provided with computer-generated drug profiles from Medicaid pharmacy claims that displayed flags for patients and suggestions for modification of drugs and classes of drugs. Drug profiles were a compilation of all the drugs for which a claim was paid in the 90 days prior to the generation regardless of the presence of an alert. The first alert criterion was receipt of a drug widely considered to be inappropriate for use in the elderly (Beers list drug). The second criterion was receipt of a drug on the community care of North Carolina prescription advantage list (PAL), which encourages substitution of a less-expensive drug within a therapeutic class. The third criterion was appearance of a drug in the clinical initiatives list, which includes 16 drugs that had potential for quality improvement and cost savings. Pharmacists were asked to record the result of the review and the result of the consultation with the prescribing physician. If an intervention resulted in a drug therapy change of any type, the new drug, dose and quantity were noted. Drug dose and quantity were also reported for each new drug added for previously untreated indications |
| Outcomes      | Number of Beers list drugs per patients, number of PAL list alerts, potential medication problems categorised as "consider duration" (of therapy), "clinical initiatives" and "therapeutic duplication"  |
| Notes         |  |

**Risk of bias**

| Bias  | Authors' judgement | Support for judgement   |
|---|--------------------|---|
| Random sequence generation (selection bias) | High risk          | The comparison group consisted of patients in nursing homes not responding to the invitation for inclusion in phase 1 of the intervention |

**Trygstad 2005** (Continued)

|  |              |  |
|--|--------------|--|
| Allocation concealment (selection bias)                        | Unclear risk | Pharmacist and physician prescriber knew the allocation  |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk | Prescription profiles were generated and sent to consultant pharmacists. However, it does not state if the patient knew the status of the nursing home (intervention or control) |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Low risk     | Dropout rates were similar between groups  |
| Selective reporting (reporting bias)                           | Unclear risk | Not stated, not registered so insufficient information to permit judgement of yes/no   |
| Baseline data?   | Low risk     | Beers list drugs and the number of prescription fills measured in 3 months before intervention   |
| Reliable Primary outcome measure                               | Low risk     | The Beers drug list which is a validated instrument was used   |
| Protection against contamination                               | Unclear risk | This is unclear as the authors stated that comparison group homes participated after 6 months  |
| Power calculation  | High risk    | No power calculation given   |

**Trygstad 2009**

|               |  |
|---------------|--|
| Methods       | Study design: controlled before and after<br>Unit of allocation/analysis: patient<br>Follow-up: 3 months<br>Duration: 3 months<br>Providers: pharmacists   |
| Participants  | Setting/patients: Medicaid-dependent nursing home residents in North Carolina<br>Focus on polypharmacy: patients were included if they had 18 or more drug fills in the 90 days immediately preceding the intervention<br>Age(mean): 77.6 years<br>Male sex: 24.9%   |
| Interventions | Prescription drug records of all North Carolina nursing facilities were retrieved from Medicaid claims databases for the period of August 2002 to April 2003. This period encompassed the 90-day baseline, the 90-day intervention and the 90-day postintervention periods to allow for a difference-in-difference (DID) with a comparison-group study method. Targeted ("value added") Drug Regimen Reviews (DRRs) were performed during the routine monthly DRRs required by Omnibus Budget Reconciliation Act |



|  |   |  |
|--|---|--|
|  | (OBRA) nursing facility guidelines. Drug claims data were used to create drug profiles that contained cost- and quality-focussed alerts for patients with 18 or more drug fills in the 90 days immediately preceding the intervention. Computer algorithms were used to screen profiles for 5 types of drug alerts. These were Beers drug alerts, Prescription Advantage List (PAL) alerts, Clinical Initiatives alerts, duration alerts for specific drugs and therapeutic duplication alerts. The alerts were generated retrospectively from claims data and provided to the consultant pharmacist for their retrospective reviews together with the residents' most recent drug claims profile. These profiles were comprehensive in nature and considered all drugs on a residents profile regardless of the presence or absence of an alert. The prospective component of the study allowed a pharmacist to intervene and request a drug change for new medication orders that came into the dispensing facility using the same alerting-targeting criteria developed for the retrospective, computer-generated drug profiles. Some residents received only retrospective reviews and interventions, some received only prospective interventions and some received both |  |
| Outcomes   | Number of Beers list drugs per patients, number of PAL list alerts, potential medication problems categorised as "consider duration" (of therapy), "clinical initiatives" and "therapeutic duplication"   |  |
| Notes  |   |  |
| <b>Risk of bias</b>  |   |  |
| <b>Bias</b>  | <b>Authors' judgement</b>   | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                    | High risk   | Comparison-group residents were drawn from non-participating long term care facilities   |
| Allocation concealment (selection bias)                        | Unclear risk  | Consultant pharmacists performed targeted, value-added drug regimen reviews for selected Medicaid-dependent residents. It is not clear if the consultant pharmacists worked in both the intervention and control homes |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk  | Insufficient information to permit judgement of yes/no   |
| Incomplete outcome data (attrition bias)<br>All outcomes       | Unclear risk  | 63 residents had a prospective review  |
| Selective reporting (reporting bias)                           | Unclear risk  | Insufficient information to permit judgement of yes/no   |
| Baseline data?   | High risk   | Baseline measures not reported for the comparison group.   |

**Trygstad 2009** (Continued)

|                                  |              |   |
|----------------------------------|--------------|---|
| Reliable Primary outcome measure | Low risk     | Beers criteria  |
| Protection against contamination | Unclear risk | It is not clear if the consultant pharmacists worked in both the intervention and control homes |
| Power calculation                | High risk    | No power calculation given  |

**Characteristics of excluded studies** [ordered by study ID]

| Study            | Reason for exclusion   |
|------------------|--|
| Alexopoulos 2008 | Not polypharmacy focus. No measure of appropriateness                                  |
| Alkema 2006      | Unsuitable study design. No measure of appropriateness                                 |
| Allard 2001      | Outcome measure. Appropriateness criteria not validated (expert opinion)               |
| Allen 1986       | Outcome measure. No measure of appropriateness   |
| Atkin 1996       | Outcome measure. No measure of appropriateness   |
| Avorn 1992       | Outcome measure. Appropriateness criteria not validated (expert opinion)               |
| Bartlett 2008    | Unsuitable study design. No measure of appropriateness                                 |
| Bergkvist 2009   | Unsuitable study design  |
| Bloomfield 2005  | Not polypharmacy focus. No measure of appropriateness                                  |
| Bosma 2008       | Unsuitable study design. Appropriateness criteria not validated (WinAP HighRisk Drugs) |
| Buckmaster 2006  | Not polypharmacy focus. Participants too young. No measure of appropriateness          |
| Burnett 2009     | Participants too young   |
| Burns 1995       | Outcome measure. No measure of appropriateness   |
| Carey 2008       | Unsuitable study design. No measure of appropriateness                                 |
| Christensen 2004 | Unsuitable study design  |
| Claesson 1998    | Outcome measure. Appropriateness criteria not validated (expert opinion)               |

(Continued)

|                     |  |
|---------------------|--|
| Coleman 1999        | Outcome measure. Appropriateness criteria not validated (expert opinion)   |
| Colpaert 2006       | Unsuitable study design. No measure of appropriateness   |
| Courtenay 2007      | Not polypharmacy focus. No measure of appropriateness  |
| Davis 2007          | Unsuitable study design  |
| Delate 2008         | Unsuitable study design. No measure of appropriateness   |
| Denneboom 2007      | Outcome measure. No measure of appropriateness   |
| Der 1997            | Outcome measure. Appropriateness criteria not validated (unnecessary drugs)  |
| Diaz 2003           | Unsuitable study design. No measure of appropriateness   |
| Feder 1999          | Not polypharmacy focus. Outcome measure. No measure of appropriateness   |
| Feldstein 2006      | Unsuitable study design. No measure of appropriateness   |
| Fick 2004           | Unsuitable study design  |
| Flanagan 2002       | Unsuitable study design. No measure of appropriateness   |
| Fontaine 2006       | Not polypharmacy focus. No measure of appropriateness  |
| Gaede 2008          | Not polypharmacy focus. No measure of appropriateness  |
| Garfinkel 2007      | Unsuitable study design. No measure of appropriateness   |
| Gerber 2008         | Unsuitable study design. No measure of appropriateness   |
| Gill 2001           | Unsuitable study design. Appropriateness criteria not validated (Improved Prescribing in the Elderly Tool (IPET)-improved prescriptions in the elderly tool) |
| Gillespie 2009      | Outcome measure. No measure of appropriateness   |
| Gislason 2007       | Unsuitable study design. No measure of appropriateness   |
| Gradman 2002        | Unsuitable study design. No measure of appropriateness   |
| Graffen 2004        | Outcome measure. No measure of appropriateness   |
| Guptha 2003         | Unsuitable study design. Appropriateness criteria not validated (algorithms to assess appropriateness)   |
| Gwadry-Sridhar 2005 | Outcome measure. No measure of appropriateness   |

(Continued)

|                  |  |
|------------------|--|
| Hamilton 2007    | Not polypharmacy focus. Participants too young. No measure of appropriateness    |
| Hobbs 2006       | Unsuitable study design. No measure of appropriateness                           |
| Humphries 2007   | Unsuitable study design. No measure of appropriateness                           |
| Izquierdo 2007   | Not polypharmacy focus. No measure of appropriateness                            |
| Jabalquinto 2007 | Unsuitable study design. No measure of appropriateness                           |
| Jensen 2003      | Unsuitable study design. No measure of appropriateness                           |
| Kairuz 2008      | Unsuitable study design. No measure of appropriateness                           |
| Kassam 2001      | Unsuitable study design. No measure of appropriateness                           |
| Kassam 2003      | Unsuitable study design  |
| Kastrissios 1998 | Outcome measure. No measure of appropriateness                                   |
| Kjekshus 2005    | Unsuitable study design. No measure of appropriateness                           |
| Kroenke 1990     | Outcome measure. No measure of appropriateness                                   |
| Kwan 2007        | Outcome measure. No measure of appropriateness                                   |
| Lalonde 2008     | Outcome measure. No measure of appropriateness                                   |
| Lapane 2007      | Unsuitable study design. No measure of appropriateness                           |
| Laroche 2006     | Unsuitable study design  |
| Ledwidge 2004    | Unsuitable study design. Appropriateness criteria not validated (expert opinion) |
| Lee 2006         | Outcome measure. No measure of appropriateness                                   |
| Lenaghan 2007    | Outcome measure. No measure of appropriateness                                   |
| Lim 2004         | Outcome measure. No measure of appropriateness                                   |
| Lipton 1992      | Outcome measure. Appropriateness criteria not validated (expert opinion)         |
| Lipton 1994      | Outcome measure. No measure of appropriateness                                   |
| Lourens 1994     | Outcome measure. No measure of appropriateness                                   |

(Continued)

|                 |  |
|-----------------|--|
| Mador 2004      | Not polypharmacy focus. Appropriateness of psychoactive drugs only measured                                      |
| Majumdar 2007   | Outcome measure. Appropriateness criteria not validated (efficacious medicine)                                   |
| Mannheimer 2006 | Not polypharmacy focus. Appropriateness criteria not validated (Drug Related Problems - PharmCareNetwork Europe) |
| Mansur 2008     | Unsuitable study design. No measure of appropriateness   |
| Masoudi 2005    | Unsuitable study design. No measure of appropriateness   |
| Meredith 2002   | Outcome measure. Appropriateness criteria not validated (expert opinion)   |
| Meyer 1991      | Outcome measure. No measure of appropriateness   |
| Midlov 2002     | Unsuitable study design. No measure of appropriateness   |
| Miller 2008     | Outcome measure. No measure of appropriateness   |
| Mills 2008      | Unsuitable study design. No measure of appropriateness   |
| Mistler 2009    | Unsuitable study design. Appropriateness criteria not validated (medication-reduction algorithm)                 |
| Monane 1998     | Unsuitable study design  |
| Muir 2001       | Outcome measure. No measure of appropriateness   |
| Murray 2004     | Unsuitable study design. No measure of appropriateness   |
| Murray 2007     | Not polypharmacy focus. No measure of appropriateness  |
| Murray 2009     | Not polypharmacy focus. No measure of appropriateness  |
| Neutel 2007     | Unsuitable study design. No measure of appropriateness   |
| Nickerson 2005  | Participants too young. No measure of appropriateness  |
| Ogihara 2008    | Outcome measure. No measure of appropriateness   |
| Owens 1990      | Outcome measure. Appropriateness criteria not validated ("Problem pairs")  |
| Pagaiya 2005    | Participants too young. Appropriateness criteria not validated (guideline adherence)                             |
| Paluch 2007     | Unsuitable study design. No measure of appropriateness   |
| Pepine 1998     | Unsuitable study design. No measure of appropriateness   |

(Continued)

|                    |  |
|--------------------|--|
| Phelan 2008        | Unsuitable study design. No measure of appropriateness   |
| Pimlott 2003       | Not polypharmacy focus. No measure of appropriateness  |
| Pit 2007           | Appropriateness criteria not validated   |
| Pitkala 2001       | Outcome measure. No measure of appropriateness   |
| Pool 2007          | Not polypharmacy focus. No measure of appropriateness  |
| Pugh 2006          | Unsuitable study design. Appropriateness criteria not validated (Health Plan Employer Data and Information Set (HEDIS) 2006 quality measure) |
| Raebel 2007        | Outcome measure. Appropriateness criteria not validated (expert opinion)   |
| RESPECT 2010       | Outcome measure. Appropriateness criteria not validated (UK - MAI)   |
| Roughead 2007      | Unsuitable study design  |
| Roughead 2007      | Unsuitable study design. No measure of appropriateness   |
| Saltvedt 2002      | Outcome measure. No measure of appropriateness   |
| Schmidt 2008       | Not polypharmacy focus. No measure of appropriateness  |
| Schrader 1996      | Unsuitable study design. No measure of appropriateness   |
| Sellors 2001       | Outcome measure. No measure of appropriateness   |
| Sellors 2003       | Outcome measure. Appropriateness criteria not validated (expert opinion)   |
| Shrestha 2006      | Participants too young. No measure of appropriateness  |
| Sicras Mainar 2004 | Outcome measure. No measure of appropriateness   |
| Sicras Mainar 2005 | Unsuitable study design. No measure of appropriateness   |
| Sicras Mainar 2007 | Outcome measure. No measure of appropriateness   |
| Silkey 2005        | Unsuitable study design. No measure of appropriateness   |
| Simon 2005         | Not polypharmacy focus. No measure of appropriateness  |
| Simon 2006         | Outcome measure. Appropriateness criteria not validated (expert opinion)   |
| Smith 1996         | Outcome measure. No measure of appropriateness   |

(Continued)

|                   |  |
|-------------------|--|
| Sorensen 2004     | Outcome measure. No measure of appropriateness   |
| Soumerai 1998     | Not polypharmacy focus. No measure of appropriateness  |
| Straand 2006      | Unsuitable study design. No measure of appropriateness   |
| Stuck 1995        | Unsuitable study design. No measure of appropriateness   |
| Sturgess 2003     | Outcome measure. No measure of appropriateness   |
| Terceiros 2007    | Unsuitable study design. No measure of appropriateness   |
| Tse 2008          | Outcome measure. No measure of appropriateness   |
| Van der Elst 2006 | Outcome measure. Appropriateness criteria not validated (Peer Review Group consensus)  |
| van Hees 2008     | Outcome measure. No measure of appropriateness   |
| Vetter 1992       | Outcome measure. No measure of appropriateness   |
| Viktil 2006       | Unsuitable study design. No measure of appropriateness   |
| Volume 2001       | Outcome measure. No measure of appropriateness   |
| Weber 2008        | Outcome measure. No measure of appropriateness   |
| Weingart 2008     | Participants too young. No measure of appropriateness  |
| Wenger 2007       | Unsuitable study design. (ACOVE criteria development/assessment)   |
| Wessell 2008      | Unsuitable study design. Appropriateness criteria not validated (potentially inappropriate medication indicators based on Zhan criteria) |
| Willcox 1994      | Unsuitable study design  |
| Williams 2004     | Outcome measure. No measure of appropriateness   |
| Wu 2006           | Outcome measure. No measure of appropriateness   |
| Zermansky 2006    | Outcome measure. No measure of appropriateness   |
| Zuckerman 2005    | Unsuitable study design  |

## Characteristics of ongoing studies *[ordered by study ID]*

### Gladman

|                     |  |
|---------------------|--|
| Trial name or title | Acute medical unit comprehensive geriatric assessment intervention study: a multicentre randomised interventional process of care trial (AMIGOS)   |
| Methods             | Multicentre randomised interventional process of care trial  |
| Participants        | Patient participants: attending and being discharged from the Acute Medical Unit (AMU) at Queen's Medical Centre, Nottingham or Leicester Royal Infirmary, Leicester; aged 70 years or over, either sex; identified as being at high risk of adverse outcomes using the Identification of Seniors At Risk (ISAR) score<br>Carer participants: identified as carer of a patient participant; any carer present with the patient participant will be invited to be a carer participant for the study   |
| Interventions       | Comprehensive Geriatric Assessment: the participants will be allocated to the intervention or the control arm (usual care), using an internet-based randomisation procedure. Those allocated to usual care will go home as planned. Those allocated to the interface geriatrician will be reviewed by a geriatrician prior to being discharged. The geriatrician will reassess their clinical care, focussing on geriatric syndromes, such as polypharmacy (multiple medications)  |
| Outcomes            | Primary: number of days spent at home over 90 days of follow-up<br>Secondary (at 90 days): death; institutionalisation; hospital use (emergency department, AMU admissions, clinics); personal activities of daily living (Barthel ADL Index); self reported falls over previous 90 days; medication audit against STOPP/START criteria at 90 days; psychological well-being (General Health Questionnaire [GHQ12]); Quality of life (EuroQoL EQ5D) and ICECAP; resource use; carer strain: Caregiver Strain Index; carer generic quality of life: EuroQol EQ5D; carer specific quality of life: CQLIR |
| Starting date       | 15 June 2010   |
| Contact information | John Gladman<br>Division of Rehabilitation and Ageing, Medical School, Queens Medical Centre, Derby Road, Nottingham. NG7 2UH, UK<br>john.gladman@nottingham.ac.uk   |
| Notes               |  |

### Rosenthal

|                     |  |
|---------------------|--|
| Trial name or title | Randomized Controlled Trial of Enhanced Pharmacy Care in Older Veteran Outpatients   |
| Methods             | RCT. Patients were randomised to usual care or to the intervention   |
| Participants        | Older outpatients. Patients enrolled in Veterans Affairs primary care clinics who are 65 years and older and who are receiving prescriptions for 5 or more scheduled medications   |
| Interventions       | Behavioural intervention - enhanced pharmacy care<br>The intervention included a structured medication history and medical records review. For intervention patients, therapeutic recommendations were developed and presented to primary care providers |



**Rosenthal** (Continued)

|                     |   |
|---------------------|---|
| Outcomes            | Medication appropriateness<br>No. of medications<br>Cost of prescribed medicines between baseline and follow-up in both intervention and controls<br>Baseline and 3-month measures obtained |
| Starting date       | Unknown   |
| Contact information | Gary E. Rosenthal, MD, Principal Investigator,<br>VA Medical Center,<br>Iowa City,<br>Iowa,<br>52246-2208<br>USA  |
| Notes               | Clinical Trials.gov identifier: NCT00122122   |

**Wei**

|                     |   |
|---------------------|---|
| Trial name or title | Pharmaceutical Care and Clinical Outcomes for the Elderly Taking Potentially Inappropriate Medication: a Randomized-Controlled Trial  |
| Methods             | Randomised controlled trial   |
| Participants        | Elderly with chronic disease. 65 to 90 years old, hospitalised  |
| Interventions       | Behavioural: pharmacist intervention<br>Patients in the intervention group will receive pharmaceutical care delivered by clinical pharmacist, which including medication review, medication reconciliation, patient education and recommended actions   |
| Outcomes            | Primary outcome measures: number of unsolved drug-related problems (time frame: 14 days after randomisation)<br><br>Secondary outcome measures:<br>rate of ADE during hospitalisation (time frame: 14 days after randomisation)<br><br>Number of potentially inappropriate medication (time frame: 14 days after randomisation) |
| Starting date       | February 2009   |
| Contact information | Liu Jen Wei, MS, Principal Investigator,<br>Shin Kong Wo Ho-Su Memorial Hospital,<br>Department of Pharmacy,<br>Taipei,<br>111,<br>Taiwan   |
| Notes               | Clinical Trials.gov identifier: NCT00844025   |

## DATA AND ANALYSES

### Comparison 1. Postintervention analysis

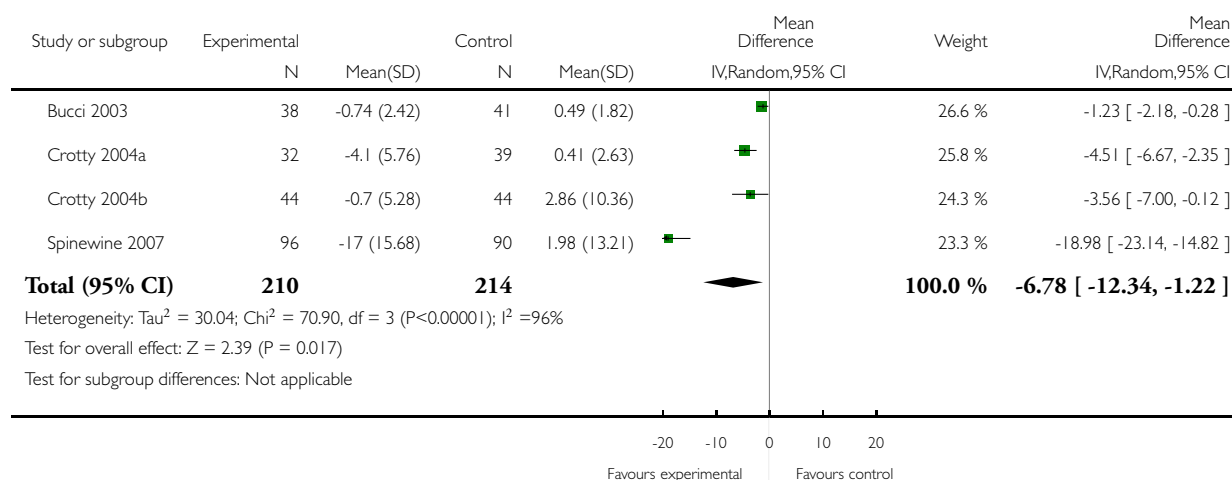
| Outcome or subgroup title                              | No. of studies | No. of participants | Statistical method                   | Effect size           |
|--|----------------|---------------------|--------------------------------------|-----------------------|
| 1 Change in MAI score                                  | 4              | 424                 | Mean Difference (IV, Random, 95% CI) | -6.78 [-12.34, -1.22] |
| 2 Change in MAI (excl Crotty 2004a)                    | 3              | 353                 | Mean Difference (IV, Random, 95% CI) | -7.75 [-17.06, 1.56]  |
| 3 Change in MAI (excl Crotty 2004a and Spinewine 2007) | 2              | 167                 | Mean Difference (IV, Random, 95% CI) | -1.79 [-3.73, 0.16]   |
| 4 Summated MAI score                                   | 5              | 965                 | Mean Difference (IV, Random, 95% CI) | -3.88 [-5.40, -2.35]  |
| 5 Number of Beers drugs per patient                    | 2              | 586                 | Mean Difference (IV, Random, 95% CI) | -0.10 [-0.28, 0.09]   |

#### Analysis 1.1. Comparison 1 Postintervention analysis, Outcome 1 Change in MAI score.

Review: Interventions to improve the appropriate use of polypharmacy for older people

Comparison: 1 Postintervention analysis

Outcome: 1 Change in MAI score

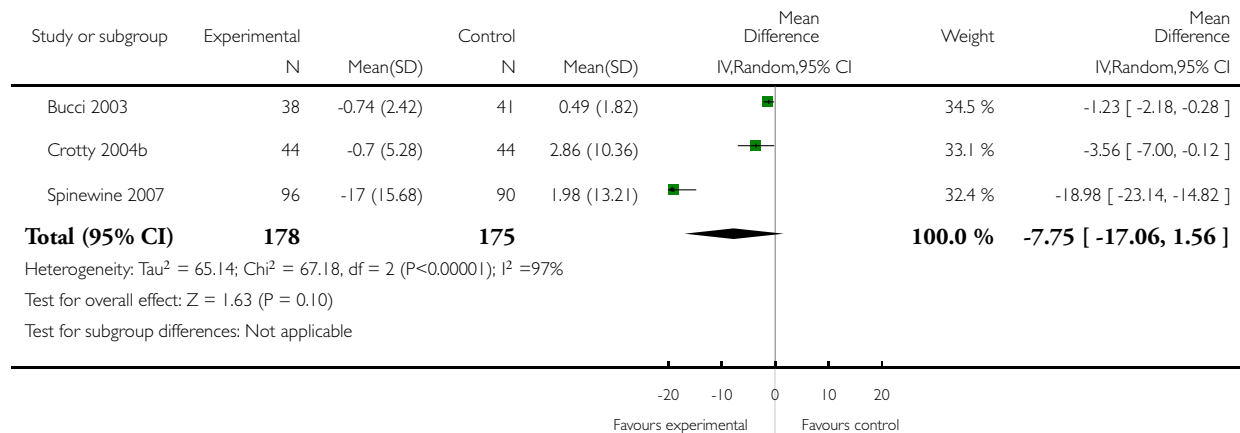


### Analysis 1.2. Comparison 1 Postintervention analysis, Outcome 2 Change in MAI (excl Crotty 2004a).

Review: Interventions to improve the appropriate use of polypharmacy for older people

Comparison: 1 Postintervention analysis

Outcome: 2 Change in MAI (excl Crotty 2004a)

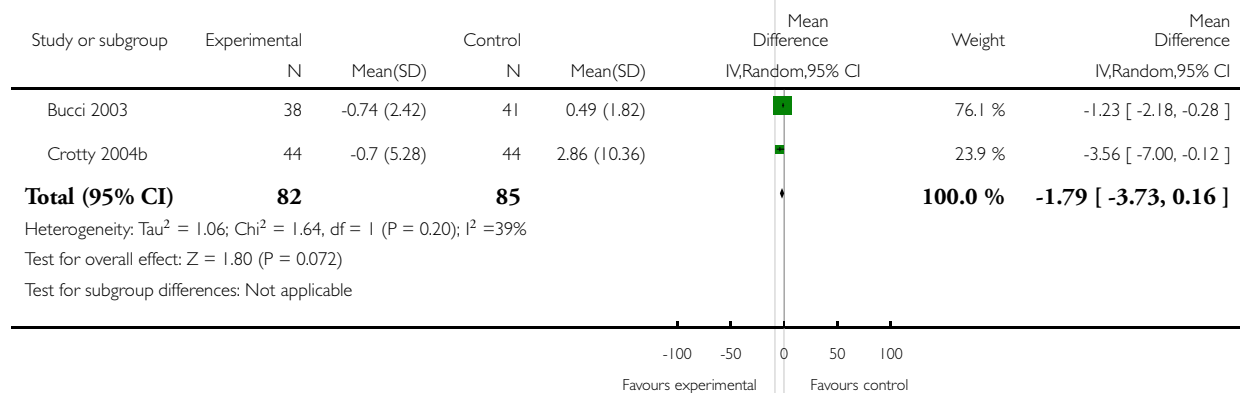


### Analysis 1.3. Comparison 1 Postintervention analysis, Outcome 3 Change in MAI (excl Crotty 2004a and Spinewine 2007).

Review: Interventions to improve the appropriate use of polypharmacy for older people

Comparison: 1 Postintervention analysis

Outcome: 3 Change in MAI (excl Crotty 2004a and Spinewine 2007)

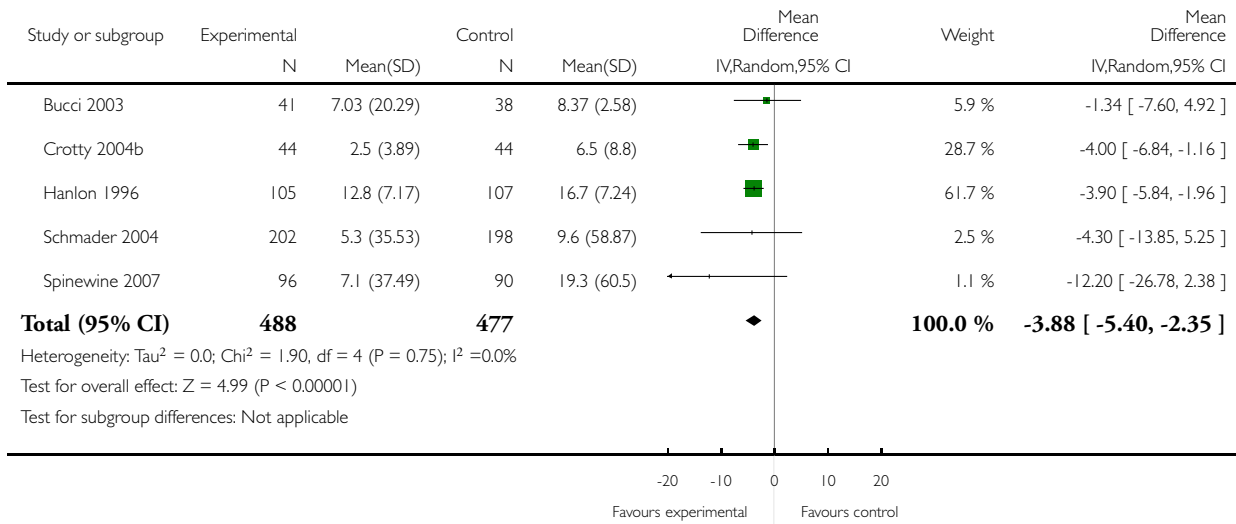


### Analysis 1.4. Comparison 1 Postintervention analysis, Outcome 4 Summated MAI score.

Review: Interventions to improve the appropriate use of polypharmacy for older people

Comparison: 1 Postintervention analysis

Outcome: 4 Summated MAI score

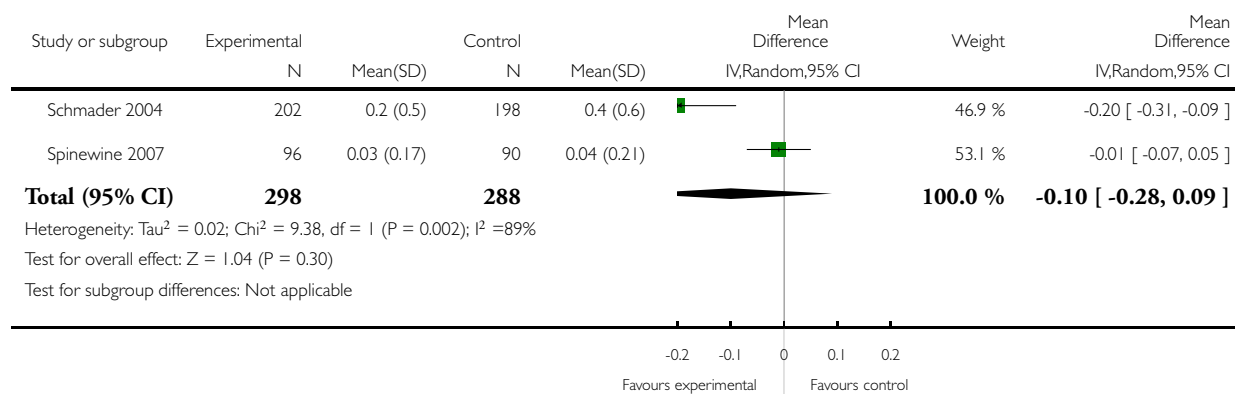


### Analysis 1.5. Comparison 1 Postintervention analysis, Outcome 5 Number of Beers drugs per patient.

Review: Interventions to improve the appropriate use of polypharmacy for older people

Comparison: 1 Postintervention analysis

Outcome: 5 Number of Beers drugs per patient



## ADDITIONAL TABLES

Table 1. Medication Appropriateness Index

| To assess the appropriateness of the drug, please answer the following questions and circle the applicable score: |                |                    |                    |         |
|---|----------------|--------------------|--------------------|---------|
| 1. Is there an indication for the drug?<br>Comments:  | 1<br>Indicated | 2<br>Not Indicated | 3<br>Not Indicated | 9<br>DK |
| 1. Is the medication effective for the condition?<br>Comments:  | 1<br>Effective | 2<br>Ineffective   | 3<br>Ineffective   | 9<br>DK |
| 3. Is the dosage correct?<br>Comments:  | 1<br>Correct   | 2<br>Incorrect     | 3<br>Incorrect     | 9<br>DK |
| 4. Are the directions correct?<br>Comments:   | 1<br>Correct   | 2<br>Incorrect     | 3<br>Incorrect     | 9<br>DK |
| 5. Are the directions practical?<br>Comments:   | 1              | 2                  | 3                  | 9<br>DK |

**Table 1. Medication Appropriateness Index** (Continued)

|  | Practical            | Impractical           |         |
|--|----------------------|-----------------------|---------|
| 6. Are there clinically significant drug-drug interactions?<br>Comments:                           | 1<br>Insignificant   | 2 3<br>Significant    | 9<br>DK |
| 7. Are there clinically significant drug-disease/condition interactions?<br>Comments:              | 1<br>Insignificant   | 2 3<br>Significant    | 9<br>DK |
| 8. Is there unnecessary duplication with other drug(s)?<br>Comments:                               | 1<br>Necessary       | 2 3<br>Unnecessary    | 9<br>DK |
| 9. Is the duration of therapy acceptable?<br>Comments:   | 1<br>Acceptable      | 2 3<br>Unacceptable   | 9<br>DK |
| 10. Is this drug the least expensive alternative compared to others of equal utility?<br>Comments: | 1<br>Least expensive | 2 3<br>Most expensive | 9<br>DK |

DK: Don't know

**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions**

| Drug  | Concern   | Severity rating (high or low) |
|---|---|-------------------------------|
| Propoxyphene (Darvon) and combination products (Darvon with ASA, Darvon-N and Darvocet-N) | Offers few analgesic advantages over paracetamol (acetaminophen), yet has the adverse effects of other narcotic drugs     | Low                           |
| Indomethacin (Indocin and Indocin SR)   | Of all available NSAIDs, this drug produces the most CNS adverse effects  | High                          |
| Pentazocine (Talwin)  | Narcotic analgesic that causes more CNS adverse effects, including confusion and hallucinations, more commonly than other | High                          |

**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions** (Continued)

|  |  |      |
|--|--|------|
|  | narcotic drugs. Additionally, it is a mixed agonist and antagonist   |      |
| Trimethobenzamide (Tigan)  | One of the least effective antiemetic drugs, yet it can cause extrapyramidal adverse effects   | High |
| Muscle relaxants and antispasmodics: methocarbamol (Robaxin), carisoprodol (Soma), chlorzoxazone (Paraflex), metaxalone (Skelaxin), cyclobenzaprine (Flexeril) and oxybutynin (Ditropan). Do not consider the extended-release Ditropan XL | Most muscle relaxants and antispasmodic drugs are poorly tolerated by elderly patients, since these cause anticholinergic adverse effects, sedation and weakness. Additionally, their effectiveness at doses tolerated by elderly patients is questionable | High |
| Flurazepam (Dalmane)   | This benzodiazepine hypnotic has an extremely long half-life in elderly patients (often days), producing prolonged sedation and increasing the incidence of falls and fracture. Medium- or short-acting benzodiazepines are preferable                     | High |
| Amitriptyline (Elavil), chlordiazepoxide-amitriptyline (Limbitrol) and perphenazine-amitriptyline (Triavil)  | Because of its strong anticholinergic and sedation properties, amitriptyline is rarely the antidepressant of choice for elderly patients   | High |
| Doxepin (Sinequan)   | Because of its strong anticholinergic and sedating properties, doxepin is rarely the antidepressant of choice for elderly patients   | High |
| Meprobamate (Miltown and Equanil)  | This is a highly addictive and sedating anxiolytic. Those using meprobamate for prolonged periods may become addicted and may need to be withdrawn slowly  | High |
| Doses of short-acting benzodiazepines: doses greater than lorazepam (Ativan), 3 mg; oxazepam (Serax), 60 mg; iprazolam (Xanax), 2 mg; temazepam (Restoril), 15 mg and triazolam (Halcion), 0.25 mg   | Because of increased sensitivity to benzodiazepines in elderly patients, smaller doses may be effective as well as safer. Total daily doses should rarely exceed the suggested maximums  | High |
| Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptyline (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Paxipam) and chlorazepate (Tranxene)             | These drugs have a long half-life in elderly patients (often several days), producing prolonged sedation and increasing the risk of falls and fractures. Short- and intermediate-acting benzodiazepines are preferred if a benzodiazepine is required      | High |

**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions** (Continued)

|  |  |      |
|--|--|------|
| Disopyramide (Norpace and Norpace CR)  | Of all antiarrhythmic drugs, this is the most potent negative inotrope and therefore may induce heart failure in elderly patients. It also has strong anticholinergic effects. Other antiarrhythmic drugs should be used | High |
| Digoxin (Lanoxin) (should not exceed 0.125 mg/day except when treating atrial arrhythmias)   | Decreased renal clearance may lead to increased risk of toxic effects  | Low  |
| Short-acting dipyridamole (Persantine). Do not consider the long-acting dipyridamole (which has better properties than the short-acting in older adults) except with patients with artificial heart valves                                     | May cause orthostatic hypotension  | Low  |
| Methyldopa (Aldomet) and methyldopa-hydrochlorothiazide (Aldoril)  | May cause bradycardia and exacerbate depression in elderly patients  | High |
| Reserpine at doses > 0.25 mg   | May induce depression, impotence, sedation and orthostatic hypotension   | Low  |
| Chlorpropamide (Diabinese)   | It has a prolonged half-life in elderly patients and could cause prolonged hypoglycaemia. Additionally, it is the only oral hypoglycaemic agent that causes SIADH  | High |
| GI antispasmodic drugs: dicyclomine (Bentyl), hyoscyamine (Levsin and Levsinex), propantheline (Pro-Banthine), belladonna alkaloids (Donnatal and others) and clidinium-chlordiazepoxide (Librax)  | GI antispasmodic drugs have potent anticholinergic effects and have uncertain effectiveness. These drugs should be avoided (especially for long-term use)  | High |
| Anticholinergics and antihistamines: chlorpheniramine (Chlor-Trimeton), diphenhydramine (Benadryl), hydroxyzine (Vistaril and Atarax), cyproheptadine (Periactin), promethazine (Phenergan), tripeleennamine, dexchlorpheniramine (Polaramine) | All non-prescription and many prescription antihistamines may have potent anticholinergic properties. Non-anticholinergic antihistamines are preferred in elderly patients when treating allergic reactions              | High |
| Diphenhydramine (Benadryl)   | May cause confusion and sedation. Should not be used as a hypnotic, and when used to treat emergency allergic reactions, it should be used in the smallest possible dose   | High |



**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions** (Continued)

|  |   |      |
|--|---|------|
| Ergot mesyloids (Hydergine) and cyclandelate (Cyclospasmol)  | Have not been shown to be effective in the doses studied  | Low  |
| Ferrous sulphate > 325 mg/day  | Doses > 325 mg/day do not dramatically increase the amount absorbed but greatly increase the incidence of constipation                          | Low  |
| All barbiturates (except phenobarbital) except when used to control seizures   | Are highly addictive and cause more adverse effects than most sedative or hypnotic drugs in elderly patients                                    | High |
| Meperidine (Demerol)   | Not an effective oral analgesic in doses commonly used. May cause confusion and has many disadvantages to other narcotic drugs                  | High |
| Ticlopidine (Ticlid)   | Has been shown to be no better than aspirin in preventing clotting and may be considerably more toxic. Safer, more effective alternatives exist | High |
| Ketorolac (Toradol)  | Immediate and long-term use should be avoided in older people, since a significant number have asymptomatic GI pathological conditions          | High |
| Amphetamines and anorexic agents   | These drugs have potential for causing dependence, hypertension, angina and myocardial infarction   | High |
| Long-term use of full-dosage, longer half-life, non-COX-selective NSAIDs: naproxen (Naprosyn, Avaprox, and Aleve), oxaprozin (Daypro), and piroxicam (Feldene) | Have the potential to produce GI bleeding, renal failure, hypertension and heart failure  | High |
| Daily fluoxetine (Prozac)  | Long half-life of drug and risk of producing excessive CNS stimulation, sleep disturbances and increasing agitation. Safer alternatives exist   | High |
| Long-term use of stimulant laxatives: bisacodyl (Dulcolax), cascara sagrada and Neoloid except in the presence of opiate analgesic use                         | May exacerbate bowel dysfunction  | High |
| Amiodarone (Cordarone)   | Associated with QT interval problems and risk of provoking torsades de pointes. Lack of efficacy in older adults                                | High |



**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions** (Continued)

|  |  |      |
|--|--|------|
| Orphenadrine (Norflex)   | Causes more sedation and anticholinergic adverse effects than safer alternatives | High |
| Guanethidine (Ismelin)   | May cause orthostatic hypotension. Safer alternatives exist                      | High |
| Guanadrel (Hylorel)  | May cause orthostatic hypotension  | High |
| Cyclandelate (Cyclospasmol)  | Lack of efficacy   | Low  |
| Isoxsuprine (Vasodilan)  | Lack of efficacy   | Low  |
| Nitrofurantoin (Macrochantin)  | Potential for renal impairment. Safer alternatives available                     | High |
| Doxazosin (Cardura)  | Potential for hypotension, dry mouth and urinary problems                        | Low  |
| Methyltestosterone (Android, Virilon and Testrad)                    | Potential for prostatic hypertrophy and cardiac problems.                        | High |
| Thioridazine (Mellaril)  | Greater potential for CNS and extrapyramidal adverse effects                     | High |
| Mesoridazine (Serentil)  | CNS and extrapyramidal adverse effects   | High |
| Short-acting nifedipine (Procardia and Adalat)                       | Potential for hypotension and constipation                                       | High |
| Clonidine (Catapres)   | Potential for orthostatic hypotension and CNS adverse effects                    | Low  |
| Mineral oil  | Potential for aspiration and adverse effects. Safer alternatives available       | High |
| Cimetidine (Tagamet)   | CNS adverse effects including confusion  | Low  |
| Ethacrynic acid (Edecrin)  | Potential for hypertension and fluid imbalances. Safer alternatives available    | Low  |
| Desiccated thyroid   | Concerns about cardiac effects. Safer alternatives available                     | High |
| Amphetamines (excluding methylphenidate hydrochloride and anorexics) | CNS stimulant adverse effects  | High |

**Table 2. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: independent of diagnosis or conditions** (Continued)

|                        |   |     |
|------------------------|---|-----|
| Oestrogens only (oral) | Evidence of the carcinogenic (breast and endometrial cancer) potential of these agents and lack of cardioprotective effect in older women | Low |
|------------------------|---|-----|

Source: Fick 2003 CNS: central nervous system; COX: cyclo-oxygenase; CR: controlled release; GI: gastrointestinal; NSAID: non-steroidal anti-inflammatory drug; SIADH: syndrome of inappropriate antidiuretic hormone hypersecretion; SR: slow release.

**Table 3. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: considering diagnoses or conditions**

| Disease or Condition  | Drug  | Concern   | Severity rating (high or low) |
|---|---|---|-------------------------------|
| Heart failure   | Disopyramide (Norpace), and high-sodium-content drugs (sodium and sodium salts [alginate bicarbonate, biphosphate, citrate, phosphate, salicylate, and sulphate]) | Negative inotropic effect. Potential to promote fluid retention and exacerbation of heart failure                                   | High                          |
| Hypertension  | Phenylpropranolamine hydrochloride (removed from the market in 2001), pseudoephedrine; diet pills, and amphetamines   | May produce elevation of blood pressure secondary to sympathomimetic activity   | High                          |
| Gastric or duodenal ulcers                                  | NSAIDs and aspirin (> 325 mg) (COXIBs excluded)   | May exacerbate existing ulcers or produce new/additional ulcers   | High                          |
| Seizures or epilepsy  | Clozapine (Clozaril), chlorpromazine (Thorazine), thioridazine (Mellaril) and thiothixene (Navane)  | May lower seizure thresholds  | High                          |
| Blood clotting disorders or receiving anticoagulant therapy | Aspirin, NSAIDs, dipyridamole (Persantin), ticlopidine (Ticlid) and clopidogrel (Plavix)  | May prolong clotting time and elevate INR values or inhibit platelet aggregation, resulting in an increased potential for bleeding. | High                          |
| Bladder outflow obstruction                                 | Anticholinergics and antihistamines, gastrointestinal antispasmodics, muscle relaxants,   | May decrease urinary flow, leading to urinary retention   | High                          |

**Table 3. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: considering diagnoses or conditions** (Continued)

|                           |   |   |      |
|---------------------------|---|---|------|
|                           | oxybutynin (Ditropan), flavoxate (Urispas), anticholinergics, antidepressants, decongestants and tolterodine (Detrol)   |   |      |
| Stress incontinence       | $\alpha$ -Blockers (doxazosin, prazosin and terazosin), anticholinergics, tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride and amitriptyline hydrochloride) and long-acting benzodiazepines | May produce polyuria and worsening of incontinence                              | High |
| Arrhythmias               | Tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride and amitriptyline hydrochloride)   | Concern due to proarrhythmic effects and ability to produce QT interval changes | High |
| Insomnia                  | Decongestants, theophylline (Theodur), methylphenidate (Ritalin), MAOIs and amphetamines  | Concern due to CNS stimulant effects  | High |
| Parkinsons disease        | Metoclopramide (Reglan), conventional antipsychotics, and tacrine (Cognex)  | Concern due to their antidopaminergic/ cholinergic effects                      | High |
| Cognitive impairment      | Barbiturates, anticholinergics, antispasmodics and muscle relaxants. CNS stimulants: dextroamphetamine (Adderall), methylphenidate (Ritalin), methamphetamine (Desoxyn) and pemolin                                   | Concern due to CNS-altering effects   | High |
| Depression                | Long-term benzodiazepine use. Sympatholytic agents: methyl-dopa (Aldomet), reserpine and guanethidine (Ismelin)   | May produce or exacerbate depression  | High |
| Anorexia and malnutrition | CNS stimulants: Dextroamphetamine (Adderall), methylphenidate (Ritalin), methamphetamine (Desoxyn), pemolin and fluoxetine (Prozac)   | Concern due to appetite-suppressing effects                                     | High |

**Table 3. Updated Beers (2002) Criteria for potentially inappropriate medication use in older adults: considering diagnoses or conditions** (Continued)

|                      |  |  |      |
|----------------------|--|--|------|
| Syncope or falls     | Short- to intermediate-acting benzodiazepine and tricyclic antidepressants (imipramine hydrochloride, doxepin hydrochloride and amitriptyline hydrochloride)   | May produce ataxia, impaired psychomotor function, syncope and additional falls                        | High |
| SIADH/hyponatraemia  | SSRIs: fluoxetine (Prozac), citalopram (Celexa), fluvoxamine (Luvox), paroxetine (Paxil) and sertraline (Zoloft)   | May exacerbate or cause SIADH  | Low  |
| Seizure disorder     | Bupropion (Wellbutrin)   | May lower seizure threshold  | High |
| Obesity              | Olanzapine (Zyprexa)   | May stimulate appetite and increase weight gain  | Low  |
| COPD                 | Long-acting benzodiazepines: chlordiazepoxide (Librium), chlordiazepoxide-amitriptyline (Limbitrol), clidinium-chlordiazepoxide (Librax), diazepam (Valium), quazepam (Doral), halazepam (Paxipam) and chlorazepate (Tranxene). $\beta$ -Blockers: propranolol | CNS adverse effects. May induce respiratory depression. May exacerbate or cause respiratory depression | High |
| Chronic constipation | Calcium channel blockers, anticholinergics and tricyclic antidepressant (imipramine hydrochloride, doxepin hydrochloride and amitriptyline hydrochloride)  | May exacerbate constipation  | Low  |

Source: Fick 2003 COPD: chronic obstructive pulmonary disease; COXIB: cyclo-oxygenase inhibitor; INR: international normalized ratio; MAOI: monoamine oxidase inhibitor; NSAID: non-steroidal anti-inflammatory drug; SIADH: syndrome of inappropriate antidiuretic hormone secretion; SSRIs: selective serotonin reuptake inhibitors.

## APPENDICES

### Appendix 1. The Medication Appropriateness Index (MAI) and the Beers criteria

The MAI was designed to assist physicians and pharmacists in assessing the appropriateness of a medication for a given patient. The MAI requires clinicians to rate 10 explicit criteria to determine whether a given medication is appropriate for an individual. For each criterion, the index has operational definitions, explicit instructions, and examples and the evaluator rates whether the particular medication is "appropriate", "marginally appropriate", or "inappropriate". (Table 1)

The 10 explicit criteria are:

1. Indication: the sign, symptom, disease or condition for which the medication is prescribed.
2. Effectiveness: producing a beneficial result.
3. Dosage: total amount of medication taken per 24-hour period.
4. Directions: instructions to the patient for the proper use of a medication.
5. Practicality: capability of being used or being put into practice.
6. Drug-drug interaction: the effect that the administration of one medication has on another drug; clinical significance connotes a harmful interaction.
7. Drug-disease interaction: the effect that the drug has on a pre-existing disease or condition; clinical significance connotes a harmful interaction.
8. Unnecessary duplication: non-beneficial or risky prescribing of two or more drugs from the same chemical or pharmacological class.
9. Duration: length of therapy.
10. Expensiveness: cost of drug in comparison to other agents of equal efficacy and safety.

These are measured on a 3-point scale (Table 1).

To assess the effect of the interventions on prescribing appropriateness, patient MAI scores may be determined by summing MAI medication scores, across all evaluated medications. Thus, this patient MAI score depends on the number of medications taken by the patient and the MAI score per medication.

Furthermore, in order to determine a single summated score for each drug in addition to an overall score for the patient, a weighting scheme was developed. A weight of three was given for indication and effectiveness. A weight of two was assigned to dosage, correct directions, drug-drug interactions and drug-disease interactions. A weight of one was assigned to practical directions, expense, duplication and duration.

The Beers criteria are consensus explicit criteria used to enhance safe medication use in older adults when precise clinical information is lacking. The Beers criteria are based on expert consensus developed through an extensive literature review with a bibliography and questionnaire evaluated by nationally recognised experts in geriatric care, clinical pharmacology and psychopharmacology using a modified Delphi technique to reach consensus. The criteria have been used to survey clinical medication use, analyse computerised administrative data sets and evaluate intervention studies to decrease medication problems in older adults.

The Beers criteria comprise two lists. The first list comprises 48 individual medications or classes of medications that should be avoided in older adults and their potential concerns (Table 2). The second list comprises 20 diseases or conditions and drugs that should be avoided in older adults with these conditions (Table 3). Sixty-six of these of these potentially inappropriate drugs were considered by the panel to have adverse outcomes of high severity.

### Appendix 2. MEDLINE Strategy per Protocol

1. polypharmacy/ or polypharm\$.ti,ab.
2. (beer\$ adj1 criter\$).ti,ab.
3. ((inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or concurrent\$) adj2 (medic\$ or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab.
4. ((over adj1 (prescrib\$ or prescript\$)) or (over-prescrib\$ or overprescrib\$)).ti,ab.
5. ((under adj1 prescrib\$) or underprescrib\$ or under-prescrib\$).ti,ab.
6. "medication appropriateness index\$.ti,ab.
7. (quality adj1 (prescribing or prescription\$ or medication\$)).ti,ab.
8. (improv\$ adj1 (prescrib\$ or pharmaco\$ or prescription\$)).ti,ab.
9. (Prescrib\$ adj1 cascade\$).ti,ab.
10. ("assessing care of vulnerable elders" or ACOVE).ti,ab.

11. (multi-drug\$ or multidrug\$).ti,ab.
  12. medication errors/
  13. or/1-12
  14. exp Aged/ or Geriatrics/
  15. (aged or elder\$ or geriatric\$).ti,ab.
  16. (old\$ adj (person\$ or adult\$ or people or patient\$ or inpatient\$ or outpatient\$)).ti,ab.
  17. Veterans/
  18. veteran\$.ti,ab.
  19. or/14-18
  20. randomized controlled trial.pt.
  21. random\$.ti,ab.
  22. control\$.ti,ab.
  23. or/20-23
- 13 and 19 and 23 = 690 citations with no language or date restrictions [searched MEDLINE 1950 to 2008]

### Appendix 3. MEDLINE & EMBASE 2009

Database: EMBASE, Ovid MEDLINE(R), Ovid MEDLINE(R) Daily Update [6 January, 2009]  
 Search Strategy: PolyPharm ML-EM v1.1

- 1 polypharmacy/ [ML] or polypharma\$.ti,ab. (6018) [ML]
- 2 (beer\$ adj1 criter\$).ti,ab. (217)
- 3 ((inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or concurrent\$ or inadvert\$) adj2 (medici\$ or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab. (20167)
- 4 ((over adj1 (prescrib\$ or prescript\$)) or (over-prescrib\$ or overprescrib\$) or ("or more" adj (medication\$ or prescrib\$ or prescript\$))).ti,ab. (1802)
- 5 ((under adj1 prescrib\$) or underprescrib\$ or under-prescrib\$).ti,ab. (492)
- 6 "medication appropriateness index\$".ti,ab. (74)
- 7 (quality adj1 (prescribing or prescription\$ or medication\$)).ti,ab. (379)
- 8 (improv\$ adj1 (prescrib\$ or pharmaco\$ or prescription\$)).ti,ab. (2435)
- 9 (Prescrib\$ adj1 cascade\$).ti,ab. (19)
- 10 ("assessing care of vulnerable elders" or ACOVE).ti,ab. (61)
- 11 ((multi-drug\$ or multidrug\$) adj2 (prescrib\$ or prescription\$ or regimen? or therap\$ or treatment?)).ti,ab. (4318)
- 12 medication errors/ [ML] or Medication Error/ [EM] (10087)
- 13 or/1-12 (43833)
- 14 exp Aged/ [ML] or Geriatrics/ [ML] or aged/ [EM] or aged hospital patient/ [EM] or frail elderly/[EM] or very elderly/[EM](2890948)
- 15 (elder\$ or geriatric\$).ti,ab. (299418)
- 16 ((old\$ or aged) adj (person\$ or adult\$ or people or patient\$ or inpatient\$ or outpatient\$)).ti,ab. (154581)
- 17 Veterans/ [ML] or Veteran/ [EM] (7691)
- 18 veteran\$.ti,ab. (27912)
- 19 or/14-18 (3045064)
- 20 randomized controlled trial.pt. [ML] or "Randomized Controlled Trial"/ [EM Heading; maps to publication type in ML](437056)
- 21 random\$.ti,ab. (898609)
- 22 controlled clinical trial.pt. [ML] or Controlled Study/ [EM heading ] or "Controlled Clinical Trial"/ [type in ML] (2900297)
- 23 or/20-22 (3633910)
- 24 humans/ (17361757)
- 25 animals/ (4440686)
- 26 24 not (24 and 25) (16257400)
- 27 13 and 19 and 23 and 26 (2042) [ML/EM RCT RESULTS]
- 28 systematic review\$.ti,ab. or "systematic review"/ (52479)
- 29 meta-analysis.pt. [ML] or meta analysis/ [EM Heading; maps to publication type in ML] (54767)

30 (meta-analys?s or metanalys?s or metaanalys?s).ti,ab. (2266)  
 31 or/28-30 (90063) [Systematic Review Filter]  
 32 13 and 19 and 26 and 31 (116) [Systematic Reviews]  
 33 "interrupted time series".ti,ab. or Cluster analysis/ [ML] or (cluster\$ adj (analys\$ or design\$ or study or studies)).ti,ab. (41448)  
 34 ("quasi-experiment\$" or "quasi-random\$").ti,ab. or quasi experimental study/ [EM heading; does not map in Medline] or pretest  
 posttest control group design/ [EM](7533)  
 35 (before adj1 after adj2 (study or studies or trial? or design?)).ti,ab. (1369)  
 36 (intervention? or evaluat\$).ti. (618897)  
 37 or/33-36 (666241) [Non-RCT Study Terms used as Filter]  
 38 13 and 19 and 37 and 26 (365) [ML/EM Non-RCT RESULTS]  
 39 Practice guideline.pt. [ML](13214)  
 40 guideline?.ti. (60199)  
 41 (consensus develop\$ or ((position or consensus) adj1 (statement? or development))).ti. (4878)  
 42 practice guideline/ or clinical pathway/ or clinical protocol/ or consensus development/ or evidence based medicine/ (234533)  
 43 or/39-42 (273384) [Guidelines etc. used as filter]  
 44 13 and 19 and 26 and 43 (516) [Guideline Results]  
 45 27 or 38 (2262) [ RCT & Non-RCT Results]  
 46 remove duplicates from 45 (1848) [Net Trial Results]  
 47 remove duplicates from 44 (470) [Net Guideline/Consensus/EBM Results]  
 48 remove duplicates from 32 (98) [Net SR Results]

#### Appendix 4. AARP AgeLine 2009

Database: AARP AgeLine, OVID <1978 to December 2008> [6 January, 2009]

1 polypharm\$.ti,ab,de,id. (275)  
 2 "beer\$ criteria".ti,ab,de,id. (20)  
 3 ((inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or concurrent\$ or inadvert\$) adj  
 (medici\$ or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab. (251)  
 4 overprescrib\$.ti,ab. (17)  
 5 underprescrib\$.ti,ab. (3)  
 6 "medication appropriateness index\$".ti,ab. (6)  
 7 (quality adj (prescribing or prescription\$ or medication\$)).ti,ab. (11)  
 8 (improv\$ adj (prescrib\$ or pharmaco\$ or prescription\$)).ti,ab. (18)  
 9 Prescrib\$ cascade\$.ti,ab. (1)  
 10 ("assessing care of vulnerable elders" or ACOVE).ti,ab. (10)  
 11 (multidrug\$ adj (prescrib\$ or prescription\$ or regimen? or therap\$ or treatment?)).ti,ab. (1)  
 12 Medication error\$.de. (206)  
 13 or/1-12 (624)  
 14 "Randomized-Controlled-Trials".de. (793)  
 15 random\$.ti,ab. (4396)  
 16 ("cluster\$ analys\$" or "cluster\$ design\$" or "cluster\$ studies" or "cluster study").ti,ab. (132)  
 17 (before adj2 after).ti,ab. (0)  
 18 (intervention? or evaluat\$).ti. (2506)  
 19 interrupted time series.ti,ab. (17)  
 20 ((pretest or posttest) adj1 control\$).ti,ab. (22)  
 21 ("quasi-experiment\$" or "quasi-random\$" or quasiexperiment\$ or quasirandom\$).ti,ab. (119)  
 22 or/14-21 (6751)  
 23 journal\$.pt. (68517)  
 24 13 and 22 and 23 (54)



## Appendix 5. Cochrane Central Register of Controlled Trials via EBM 2009 Reviews Collection, OVID 2009

Database: All EBM Reviews - Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED (January 2009)

- 15 polypharm\$.ti,ab,kf,hw,kw,sh. (135)
- 16 (overprescrib\$ or underprescrib\$).ti,ab. (9)
- 17 ((inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or concurrent\$ or inadvert\$) adj2 (medici\$ or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab. (751)
- 18 or/15-17 (884) [Polypharmacy]
- 19 aged\$.sh. (113270)
- 20 "middle aged".sh. (174665)
- 21 19 not 20 (12907)
- 22 ((old\$ or aged) adj (person\$ or adult\$ or people or patient\$ or inpatient\$ or outpatient\$)).ti,ab. (4226)
- 23 "frail elderly".sh. (339)
- 24 elderly.ti,ab. (9991)
- 25 or/21-24 (21895) [Aged]
- 26 18 and 25 (102) [Polypharmacy and Aged]

## Appendix 6. PsycINFO 2009

PsycINFO, OVID run 1 June 2009

- 1 polypharmacy/ or polypharma\$.ti,ab.
- 2 (beer\$ adj1 criter\$).ti,ab.
- 3 ((inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or concurrent\$ or inadvert\$) adj2 (medici\$ or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab.
- 4 ((over adj1 (prescrib\$ or prescript\$)) or (over-prescrib\$ or overprescrib\$) or ("or more" adj (medication\$ or prescrib\$ or prescript\$))).ti,ab.
- 5 ((under adj1 prescrib\$) or underprescrib\$ or under-prescrib\$).ti,ab.
- 6 "medication appropriateness index".ti,ab.
- 7 (quality adj1 (prescribing or prescription\$ or medication\$)).ti,ab.
- 8 (improv\$ adj1 (prescrib\$ or pharmaco\$ or prescription\$)).ti,ab.
- 9 (Prescrib\$ adj1 cascade\$).ti,ab.
- 10 ("assessing care of vulnerable elders" or ACOVE).ti,ab.
- 11 ((multi-drug\$ or multidrug\$) adj2 (prescrib\$ or prescription\$ or regimen? or therap\$ or treatment?)).ti,ab.
- 12 or/1-11
- 13 geriatric patients/
- 14 (elder\$ or geriatric\$).ti,ab.
- 15 geriatric\$.sh.
- 16 ((old\$ or aged) adj (person\$ or adult\$ or people or patient\$ or inpatient\$ or outpatient\$)).ti,ab.
- 17 Military veterans/
- 18 veteran\$.ti,ab.
- 19 or/13-14,16-18
- 20 or/13-18
- 21 random\$.ti,ab.
- 22 (control\$ adj2 (group\$ or study or studies or trial?)).ti,ab.
- 23 "interrupted time series".ti,ab.
- 24 (cluster\$ adj (analys\$ or design\$ or study or studies)).ti,ab.
- 25 ("quasi-experiment\$" or "quasi-random\$").ti,ab.
- 26 ((pretest or posttest) adj2 (control or group or design? or study or studies)).ti,ab.
- 27 (before adj1 after adj2 (study or studies or trial? or design?)).ti,ab.
- 28 (intervention? or evaluat\$).ti.
- 29 or/21-28 [52 unique citations were identified after deduping in OVID against MEDLINE, EMBASE, and AARP results]

## Appendix 7. CINAHL 2009

| Search Date: [Monday, 4 May 2009 1:11:04 PM] |  |         |
|--|--|---------|
| #  | Query  | Results |
| 1  | TI polypharm* or AB polypharm* or MW polypharm*  | 1088    |
| 2  | TI "beer* criter*" or AB "beer* criter*" or MW "beer* criter*"   | 51      |
| 3  | TI ( "inappropriat* medicat*" or "medication appropriateness" ) or AB ( "inappropriat* medicat*" or "medication appropriateness" ) or MW ( "inappropriat* medicat*" or "medication appropriateness" )                              | 133     |
| 4  | TI "inappropriat* prescri*" or "suboptim* prescri"   | 46      |
| 5  | TI ( "inappropriat* prescri*" or "suboptim* prescri" ) or AB ( "inappropriat* prescri*" or "suboptim* prescri" )   | 144     |
| 6  | TI ( "sub-optim* prescri*" or "unnecessar* prescri*" ) or AB ( "sub-optim* prescri*" or "unnecessar* prescri*" )   | 20      |
| 7  | TI ( "incorrect* prescri*" or "excess* prescri*" or "multip* prescri*" ) or AB ( "incorrect* prescri*" or "excess* prescri*" or "multip* prescri*" )   | 39      |
| 8  | TI ( "concurrent* prescri*" or "inadvert* prescri*" or "inappropriat* medicat*" ) or AB ( "concurrent* prescri*" or "inadvert* prescri*" or "inappropriat* medicat*" )   | 122     |
| 9  | TI ( "suboptim* medicat*" or "sub-optim* medicat*" or "unnecessar* medicat*" ) or AB ( "suboptim* medicat*" or "sub-optim* medicat*" or "unnecessar* medicat*" )   | 29      |
| 10   | TI ( "incorrect* prescri*" or "incorrect* medicat*" or "suboptim* medicat*" ) or AB ( "incorrect* prescri*" or "incorrect* medicat*" or "suboptim* medicat*" )   | 30      |
| 11   | TI ( "inappropriat* drug*" or "suboptim* drug*" or "sub-optim* drug*" ) or AB ( "inappropriat* drug*" or "suboptim* drug*" or "sub-optim* drug*" )   | 83      |
| 12   | TI ( "unnecessar* drug*" or "incorrect* drug*" or "multip* drug*" or "concurrent* drug*" or "inadvert* drug*" ) or AB ( "unnecessar* drug*" or "incorrect* drug*" or "multip* drug*" or "concurrent* drug*" or "inadvert* drug*" ) | 283     |

(Continued)

|    |  |        |
|----|--|--------|
| 13 | TI ( underprescrib* or "over prescrib*" ) or AB ( underprescrib* or "over prescrib*" )   | 73     |
| 14 | TI "quality prescrib*" or AB "quality prescrib*"   | 2      |
| 15 | TI "prescrib* quality" or AB "prescrib* quality"   | 14     |
| 16 | TI ( "improv* prescrib*" or "prescri* improv*" ) or AB ( "improv* prescrib*" or "prescri* improv*" )   | 67     |
| 17 | TI acove or AB acove   | 6      |
| 18 | TI "Assessing Care of Vulnerable Elders" or AB "Assessing Care of Vulnerable Elders"   | 14     |
| 19 | TI ( "multidrug* prescri*" or "multidrug* regime*" or "multidrug* therap*" or "multidrug* treatment*" ) or AB ( "multidrug* prescri*" or "multidrug* regime*" or "multidrug* therap*" or "multidrug* treatment*" )   | 73     |
| 20 | TI ( "multi-drug* prescri*" or "multi-drug* regime*" or "multi-drug* therap*" or "multi-drug* treatment*" ) or AB ( "multi-drug* prescri*" or "multi-drug* regime*" or "multi-drug* therap*" or "multi-drug* treatment*" )   | 11     |
| 21 | 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20  | 1926   |
| 22 | (MH "Aged+" ) or (MH "Aged, 80 and Over" )   | 203625 |
| 23 | (MH "Aged, Hospitalized" )   | 1343   |
| 24 | MH frail elderly   | 1829   |
| 25 | TI ( elderly or elder or "aged adult*" or geriatric* ) or AB ( elderly or elder or "aged adult*" or geriatric* ) or MW ( elderly or elder or "aged adult*" or geriatric* )   | 45329  |
| 26 | TI ( "old* adult*" or "old* person*" or "old* inpatient*" or "old* patient*" or "old* outpatient*" or "old* people" ) or AB ( "old* adult*" or "old* person*" or "old* inpatient*" or "old* patient*" or "old* outpatient*" or "old* people" ) or TI ( "elder* adult*" or "elder* person*" or "elder* inpatient*" or "elder* patient*" or "elder* outpatient*" or "elder* people" ) or AB ( "elder* adult*" or "elder* person*" or "elder* inpatient*" or "elder* patient*" or "elder* outpatient*" or "elder* people" ) | 31692  |
| 27 | TI veteran* or AB veteran* or MW veteran*  | 7090   |



(Continued)

|    |   |        |
|----|---|--------|
| 28 | TI "medication error*" or AB "medication error" | 1809   |
| 29 | (MH "Medication Errors")                        | 5768   |
| 30 | 28 or 29  | 6011   |
| 31 | 22 or 23 or 24 or 25 or 26 or 27                | 220382 |
| 32 | 21 and 31                                       | 1022   |
| 33 | 21 and 31                                       | 394    |
| 34 | 21 or 30  | 7758   |
| 35 | 31 and 34                                       | 614    |
| 36 | (31 and 34) and (33 or 35)                      | 513    |

## Appendix 8. MEDLINE and EMBASE (revised) 2010

EMBASE, Ovid MEDLINE(R) Daily Update, Ovid MEDLINE(R) (Friday, 21 May 2010 00:17:01 GMT)

- 1 polypharmacy/ or polypharma\$.ti,ab. (6692)
- 2 ((beer\$ or shan? or mcleod?) adj3 criter\$).ti,ab. (293)
- 3 ((concomitant\$ or concurrent\$ or inappropriat\$ or suboptim\$ or sub-optim\$ or unnecessary or incorrect\$ or excess\$ or multip\$ or inadvert\$) adj2 (medicine? or medicat\$ or prescrib\$ or prescription\$ or drug\$)).ti,ab. (25978)
- 4 ((over adj1 (prescrib\$ or prescript\$)) or (over-prescrib\$ or overprescrib\$) or ("or more" adj (medication\$ or prescrib\$ or prescript\$))).ti,ab. (1899)
- 5 ((under adj1 prescrib\$) or underprescrib\$ or under-prescrib\$).ti,ab. (493)
- 6 "medication appropriateness index\$".ti,ab. (77)
- 7 (quality adj2 (prescribing or prescription\$ or medication\$)).ti,ab. (1133)
- 8 (improv\$ adj2 (prescrib\$ or pharmaco\$ or prescription\$)).ti,ab. (5406)
- 9 (Prescrib\$ adj cascade\$).ti,ab. (25)
- 10 ("assessing care of vulnerable elders" or ACOVE).ti,ab. (63)
- 11 ((multi-drug\$ or multidrug\$) adj2 (prescrib\$ or prescription\$ or regimen? or therap\$ or treatment?)).ti,ab. (4569)
- 12 Medication errors/ [ML] (11633)
- 13 medication error/ [EM] (11633)
- 14 or/1-12 [ML Med Errors] (55104)
- 15 or/1-11,13 [EM Med Errors] (55104)
- 16 aged/ or frail elderly/ or very elderly/ or aged hospital patient/ [EM] (2996354)
- 17 exp Aged/ or Geriatrics/ [ML] (3025195)
- 18 (elder\$ or geriatric\$).ti,ab. (290024)
- 19 ((old\$ or aged) adj (person\$ or adult\$ or people or patient\$ or inpatient\$ or outpatient\$)).ti,ab. (147468)
- 20 Veteran/ [EM] (8332)
- 21 Veterans/ [ML] (8332)
- 22 veteran\$.ti,ab. (27822)
- 23 or/16,18-20,22 [EM Aged] (3141205)
- 24 or/17-19,21-22 [ML Aged] (3163848)
- 25 -39 Deleted lines; not used

40 (randomized controlled trial or controlled clinical trial).pt. or randomized.ab. or placebo.ab. or clinical trials as topic.sh. or randomly.ab. or trial.ti. (1092914)  
 41 exp animals/ not humans.sh. (3522468)  
 42 40 not 41 [Cochrane RCT Filter 6.4.d Sens/Precision Maximizing] (1041587)  
 43 (random\$ or factorial\$ or crossover\$ or cross over\$ or cross-over\$ or placebo\$ or (doubl\$ adj blind\$) or (singl\$ adj blind\$) or assign\$ or allocat\$ or volunteer\$).tw. (1500575)  
 44 randomized controlled trial/ or crossover-procedure/ or double-blind procedure/ or single-blind procedure/ [EM] (505385)  
 45 or/43-44 [EM RCT per Cochrane 6.3.2.2] (1593955)  
 46 (random\$ or placebo\$ or double-blind\$).tw. [EM RCT Wong J Med Libr Assoc 94(1) January 2006] (1077137)  
 47 14 and 24 and 42 (1643)  
 48 from 47 keep 646-1643 [MEDLINE Results RCT Filter 1950-] (998)  
 49 from 48 keep 1-998 (998)  
 50 (14 and 24 and 38) not 48 [PolyAge EPOC] (2981)  
 51 from 50 keep 1642-2891 [MEDLINE Results EPOC Filter 1950-] (1250)  
 52 15 and 23 and 45 (2030)  
 53 from 52 keep 1-941 (941) [EMBASE results before filters]  
 54 53 not (42 or 38) (226) [this line excludes results from Medline filters; will revisit in update searches to ascertain advisability of this exclusion]  
 55 from 54 keep 1-226 (226) [EMBASE RCT Results, 1980-]

## Appendix 9. Cochrane Central Register of Controlled Trials (Wiley) 2010

| ID | Search   | Hits |
|----|--|------|
| #1 | (polypharm*)   | 218  |
| #2 | ("assessing care of vulnerable elders" or ACOVE)   | 7    |
| #3 | ("beers criteria" or "beer's criteria")  | 10   |
| #4 | (#1 OR #2 OR #3)   | 230  |
| #5 | (overprescrib* or underprescrib*):ti,ab,kw   | 10   |
| #6 | ((inappropriat* or suboptim* or sub-optim* or unnecessary or incorrect* or excess* or multip* or concurrent* or inadvert*) NEAR/2 (medici* or medicat* or prescrib* or prescription* or drug*)):ti,ab,kw | 1794 |
| #7 | (overprescrip* or underprescrip*):ti,ab,kw   | 6    |
| #8 | ((over NEAR/1 (prescrib* or prescript*)) or (over-prescrib* or overprescrib*) or ("or more" NEXT (medication* or prescrib* or prescript*))) :ti,ab,kw  | 98   |

(Continued)

|     |   |       |
|-----|---|-------|
| #9  | ((under NEAR/1 prescrib*) or underprescrib* or under-prescrib*):ti,ab,kw  | 12    |
| #10 | "medication appropriateness index*":ti,ab,kw  | 14    |
| #11 | (quality NEAR/1 (prescribing or prescription* or medication*)):ti,ab,kw   | 27    |
| #12 | (Prescrib* NEAR/1 cascade*):ti,ab,kw  | 0     |
| #13 | ((multi-drug* or multidrug*) NEAR/2 (prescrib* or prescription* or regimen or regimens or regiment or therap* or treatment or treatments)):ti,ab,kw | 265   |
| #14 | (improv* NEAR/1 (prescrib* or pharmaco* or prescription*)):ti,ab,kw   | 122   |
| #15 | (#5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14)   | 2265  |
| #16 | MeSH descriptor Aged explode all trees  | 1277  |
| #17 | MeSH descriptor Geriatrics, this term only  | 174   |
| #18 | ((old* or aged) NEXT (person* or adult* or people or patient* or inpatient* or outpatient*)):ti,ab  | 5817  |
| #19 | elderly:ti,ab   | 11641 |
| #20 | geriatric*:ti,ab  | 2065  |
| #21 | MeSH descriptor Veterans, this term only  | 368   |
| #22 | veteran*:ti,ab  | 1672  |
| #23 | (#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22)   | 20286 |
| #24 | (#4 OR ( #15 AND #23 ))   | 367   |
| #25 | (#24), from 1800 to 2008  | 213   |
| #26 | (#24), in 2009  | 19    |
| #27 | (#24), in 2010  | 17    |

## Appendix 10. Reviews screened for included studies

- (1) Fulton MM, Allen ER. Polypharmacy in the elderly: a literature review. *Journal of the American Academy of Nurse Practitioners* 2005 Apr;17(4):123-32.
- (2) Garcia RM. Five ways you can reduce inappropriate prescribing in the elderly: a systematic review. *Journal of Family Practice* 2006 Apr;55(4):305-12.
- (3) George J, Elliott RA, Stewart DC. A systematic review of interventions to improve medication taking in elderly patients prescribed multiple medications. *Drugs & aging* 2008;25(4):307-24.
- (4) Hajjar ER, Cafiero AC, Hanlon JT. Polypharmacy in elderly patients. *American Journal of Geriatric Pharmacotherapy* 2007;5(4):345-51.
- (5) Haynes RB, Ackloo E, Sahota N, McDonald HP, Yao X. Interventions for enhancing medication adherence. *Cochrane Database of Systematic Reviews* 2008;2(CD000011).
- (6) Holland R, Desborough J, Goodyer L, Hall S, Wright D, Loke YK. Does pharmacist-led medication review help to reduce hospital admissions and deaths in older people? A systematic review and meta-analysis. *British Journal of Clinical Pharmacology* 2008 Mar;65(3):303-16.
- (7) Huss A, Stuck AE, Rubenstein LZ, Egger M, Clough-Gorr KM. Multidimensional preventive home visit programs for community-dwelling older adults: a systematic review and meta-analysis of randomized controlled trials. *The journals of gerontology Series A, Biological sciences and medical sciences* 2008;63(3):298-307.
- (8) Jano E, Aparasu RR. Healthcare outcomes associated with beers' criteria: a systematic review. *ANN PHARMACOTHER* 2007 Mar;41(3):438-47.
- (9) Kaur S, Mitchell G, Vitetta L, Roberts MS. Interventions that can reduce inappropriate prescribing in the elderly: a systematic review. *Drugs Aging* 2009;26(12):1013-28.
- (10) Maeda K. Systematic review of the effects of improvement of prescription to reduce the number of medications in the elderly with polypharmacy. *Yakugaku Zasshi* 2009 May;129(5):631-45.
- (11) Milton JC, Hill-Smith I, Jackson SH. Prescribing for older people. *BMJ* 2008 Mar 15;336(7644):606-9.
- (12) Rollason V, Vogt N. Reduction of polypharmacy in the elderly: a systematic review of the role of the pharmacist. *Drugs & aging* 2003;20(11):817-32.
- (13) Royal S, Smeaton L, Avery AJ, Hurwitz B, Sheikh A. Interventions in primary care to reduce medication related adverse events and hospital admissions: systematic review and meta-analysis. *Quality & Safety in Health Care* 2006 Feb;15(1):23-31.
- (14) Spinewine A, Schmader KE, Barber N, Hughes C, Lapane KL, Swine C, et al. Appropriate prescribing in elderly people: how well can it be measured and optimised? *Lancet* 2007;370(9582):173-84.
- (15) Wenger NS, Roth CP, Shekelle P, ACOVE I. Introduction to the assessing care of vulnerable elders-3 quality indicator measurement set. *Journal of the American Geriatrics Society* 2007 Oct;55(Suppl 2):S247-s52.
- (16) Yourman L, Concato J, Agostini JV. Use of computer decision support interventions to improve medication prescribing in older adults: a systematic review. *American Journal of Geriatric Pharmacotherapy* 2008 Jun;6(2):119-29..

## HISTORY

Protocol first published: Issue 4, 2009

Review first published: Issue 5, 2012

## CONTRIBUTIONS OF AUTHORS

S Patterson (SP) prepared the protocol under the direction of C Hughes (CH), N Kerse (NK) and C Cardwell (CC). SP, MB and CH are pharmacists, NK is a GP and experienced researcher with an interest in geriatric medicine and CC is a biomedical statistician. MB, CH, NK and CC have been involved in systematic reviews in other areas. SP undertook the database searches and reviewed the literature identified. CH, MB and NK acted as independent co-review authors.

## DECLARATIONS OF INTEREST

None known.

## SOURCES OF SUPPORT

### Internal sources

- Queen's University Belfast, School of Pharmacy, UK.

### External sources

- Research and Development Office, Northern Ireland, UK.  
Fellowship for 2 years, 2 days per week.

## DIFFERENCES BETWEEN PROTOCOL AND REVIEW

As only two studies ([Bucci 2003](#); [Crotty 2004a](#)) reported the primary outcome measure change in the appropriate use of polypharmacy, we used postintervention results of summated MAI scores and the number of Beers drugs per patient in the meta-analyses to compare the effect sizes of the interventions.

## INDEX TERMS

### Medical Subject Headings (MeSH)

\*Medication Therapy Management; \*Polypharmacy; \*Quality Improvement; Drug Prescriptions [standards]; Drug-Related Side Effects and Adverse Reactions; Randomized Controlled Trials as Topic



## MeSH check words

Aged; Humans

**10.5.7 Appendice E7 : Article n° 7 – Health Outcomes and Polypharmacy in Elderly Individuals**

|                          |   |
|--------------------------|---|
| Article n° 7             | <b>Health Outcomes and Polypharmacy in Elderly Individuals</b>  |
| Auteur                   | Frazier, S. C. (2005).  |
| Titre                    | Le titre précise les concepts : résultat de santé et polymédication chez les personnes âgées  |
| Résumé                   | <p>Le problème n'est pas décrit mais l'intention est édictée.</p> <p><b>L'objectif</b> de l'étude est présent (décrire l'étendue de la recherche disponible sur la polymédication et les effets sur la santé chez la population âgée)</p> <p><b>Méthode</b> : une recherche de littérature de « Cumulative Index of Nursing and Allied Health Literature and Medline » a été faite (étude publiée entre 1995 et 2003, qui mettent en lien la polymédication et les effets sur les personnes âgées. Les études proviennent de divers pays (USA, Canada, Australie et Europe)</p> <p><b>Résultats</b> : La polymédication est un prédicteur (ou facteur favorisant) d'hospitalisation, placement en home, mort, hypoglycémie, fractures, mobilité altérée, pneumonie et malnutrition. Les effets de la polymédication sur les personnes âgées sont signifiants.</p> <p><b>Discussion</b> : met en avant la position de l'infirmier dans la réduction des effets de la polymédication. La recherche infirmière sur la polymédication et ses effets et, aidera à définir des « guidelines » pour la prévention et l'intervention.</p> |
| <b>INTRODUCTION</b>      |   |
| Problème de la recherche | <p>Il s'agit d'identifier les effets sur la santé de la polymédication chez la personne âgée.</p> <p>L'article pose 4 questions de recherche :</p> <ul style="list-style-type: none"> <li>• Comment la polymédication est décrite ?</li> <li>• Est-ce que la polymédication est associée à des effets indésirables de médicaments ?</li> <li>• Est-ce que la polymédication est un prédicteur des effets indésirables sur la santé ?</li> <li>• Quels effets sur la santé sont associés à la polymédication chez les personnes âgées ?</li> </ul> <p>Cette revue de littérature est tout à fait appropriée puisque la polymédication n'a pas encore été étudiée sous l'angle des soins infirmiers.</p>  |

|                               |  |
|-------------------------------|--|
|                               | Les infirmiers ont une position unique dans la mise en avant des problèmes liés à la polymédication  |
| Recension des écrits          | Diverses études (enquêtes de santé avec données chiffrées, mais aussi études scientifiques) sont citées dans l'introduction. Elles sont en lien avec le thème et donne un aperçu clair de la situation actuelle. Bien documenté.   |
| Cadre de recherche            | Absence de mise en avant de concepts clés.<br>Absence de références philosophiques ou théoriques.  |
| Buts et question de recherche | Le but de l'étude est clairement énoncé ainsi que les questions de recherches.<br>Il s'agit d'identifier les effets sur la santé de la polymédication chez la personne âgée. Pose la question de la définition de la polymédication.<br><br>L'article pose 4 questions de recherche : <ul style="list-style-type: none"> <li>• Comment la polymédication est décrite ?</li> <li>• Est-ce que la polymédication est associée à des effets indésirables de médicaments ?</li> <li>• Est-ce que la polymédication est un prédicteur des effets indésirables sur la santé ?</li> <li>• Quels effets sur la santé sont associés à la polymédication chez les personnes âgées ?</li> </ul> Les questions de recherches reflètent la recension des écrits : définition de la polymédication, lien avec les effets indésirables et interactions médicamenteuses suivant le nombre de médicaments consommés, effets de la polymédication. |
| <b>METHODE</b>                |  |
| Population et échantillon     | Une recherche de littérature sur différentes bases de données a été conduite (CINAHL, Medline, Pubmed) avec pour mots-clé « polypharmacy OR multiple medications », « elderly OR elders » et « outcomes OR effects »<br><br>Après cette première recherche, une recherche manuelle a été faite afin de sélectionner les articles pour la revue de littérature. Les critères de sélection sont présentés : <ul style="list-style-type: none"> <li>• Investigations originales</li> <li>• Description des effets sur la santé de la population âgée</li> <li>• Pas de doublon</li> <li>• Textes en anglais</li> </ul> Les références des études citées sont complètes.   |

|                                 |   |
|---------------------------------|---|
| Considérations éthiques         | Pas de considération éthique présentée puisqu'il s'agit d'une revue de littérature  |
| Devis de recherche              | <p>La méthode de recherche utilisée a permis de répondre à toutes les questions de départ.</p> <p>L'utilisation de la revue de littérature permet de respecter les critères scientifiques dans le sens où elle compare les différentes recherches sur le sujet. La neutralité est respectée puisqu'il s'agit d'autres recherches qui ne sont pas effectuées par les auteurs.</p> <p>La méthode proposée est pertinente afin d'élaborer une définition de la polymédication par exemple (selon les résultats, la définition varie d'un auteur à l'autre.</p> |
| Modes de collectes de données   | Les étapes de recherche ne sont pas clairement décrites<br>Non, mais ce n'est pas l'objet ici, donc moins essentiel.  |
| Conduite de la recherche        | Le processus de collecte des données n'est pas décrit clairement, seulement en partie.  |
| Analyse des données             | <p>La méthode d'analyse n'est pas décrite, les facteurs pouvant influencer les résultats ne sont pas décrits.</p> <p>Les études recensées sont présentées sous forme d'un tableau avec leurs principaux résultats.</p>  |
| <b>RESULTATS</b>                |   |
| Présentation des résultats      | <p>Les résultats des différentes études retenues sont présentés sous forme de tableaux, complété par un texte narratif.</p> <p>L'auteur n'a pas fait évaluer les données par les participants ou par des experts.</p>   |
| <b>DISCUSSION</b>               |   |
| Interprétations des résultats   | <p>Les résultats sont discutés en fonction de chacune des 4 questions de recherche. Les interprétations sont conformes aux résultats trouvés.</p> <p>Les limites de l'étude ne sont toutefois pas décrites.</p> <p>Les conclusions découlent des résultats.</p>   |
| Conséquences et recommandations | L'auteur n'a pas précisé les conséquences pour la pratique. Ce n'était pas l'intention de départ. Toutefois, il émet plusieurs recommandations de pratique pour les infirmiers et la nécessité de réaliser des recherches d'un point de vue infirmier sur la polymédication.  |



## Health Outcomes and Polypharmacy in Elderly Individuals

### *An Integrated Literature Review*

Susan C. Frazier, MS, NP-C

#### ABSTRACT

The purpose of this integrated literature review was to determine the extent of research available related to polypharmacy and its effect on the health outcomes of the elderly population. A search of the Cumulative Index of Nursing and Allied Health Literature and Medline was conducted for studies published between 1995 and 2003 that linked polypharmacy and outcomes in the elderly population. The 16 studies in this integrative literature review were conducted in the United States, Canada, Australia, and Europe. Polypharmacy was shown to be a statistically significant predictor of hospitalization, nursing home placement, death, hypoglycemia, fractures, impaired mobility, pneumonia, and malnutrition. The effect of polypharmacy on elderly individuals is significant as demonstrated by this literature review. Nurses are in a unique position to monitor and potentially eliminate adverse effects of a complex medication regimen. Nursing research on polypharmacy and its effects on nursing-sensitive outcomes will help define guidelines for prevention and intervention.

The use of multiple medications (i.e., polypharmacy) is common in the elderly population (Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002; Neary & White, 2001). Although they comprise less than 15% of the population, adults older than 65 use one-third of prescription drugs and 40% of all nonprescription medications (U.S. Department of Health and Human Services, 2000a). Twenty-three percent of women and 19% of men older than 65 take at least five prescription drugs. Fifty-seven percent of women take

more than five medications when over-the-counter (OTC) products are included. Older adults are also likely to take herbal, vitamin, and mineral supplements (Kaufman et al., 2002).

The prevalence of polypharmacy in elderly individuals is caused by many factors, including the co-existence of chronic conditions, multiple prescribing providers, the use of more than one pharmacy, and the recent OTC availability of previous prescription drugs (Conry, 2000; Larsen & Martin, 1999). An elderly individual leaves an office visit with

a new prescription for medication 75% of the time (Neary & White, 2001). The reduction of polypharmacy in elderly individuals is one of the goals of Healthy People 2010 (U.S. Department of Health and Human Services, 2002b), making it a national priority.

The safety and efficacy of individuals using multiple medications has not been well investigated (Neary & White, 2001). An increase in the number of medications dramatically increases the number of drug combinations, thereby increasing the risk of adverse drug reactions (ADRs) and drug-drug interactions (Jones, 1997). According to a study by Goldberg (as cited in Ebbesen et al., 2001), the probability of an ADR increases from 13% for two drugs to 82% for more than seven drugs. Nolan and O'Mally (as cited in Flaherty, Perry, Lynchard, & Morley, 2000) report that the potential of an ADR nears 100% when 10 medications are used.

Elderly individuals are especially at risk of complications from polypharmacy. As individuals age, they are less able to effectively metabolize and excrete multiple medications (Conry, 2000; Larsen & Martin, 1999). Approximately 70% to

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# Geriatric Pharmacology

80% of elderly patients experience side effects of medications, and they experience them two to three times more frequently than younger adults (Neary & White, 2001). Older adults are also more likely to suffer from cognitive and sensory impairments, which increase the risk of medication errors (Neary & White, 2001). Medication errors are a major cause of morbidity and mortality (Bedell et al., 2000).

Nurses are the health care providers most involved in administering medications, providing medication instruction, and assessing patient response to medications. This puts nurses in a unique position to address the problem of polypharmacy in elderly individuals. The American Nurses Association (1997), recognizing this position, advocates a reduction in the number of medications whenever possible. Although the association between polypharmacy and health outcomes in elderly individuals has been investigated by other disciplines, it has not been studied from a nursing perspective.

The purpose of this integrated literature review is to identify specific health outcomes empirically associated with polypharmacy in elderly individuals. The research questions are:

- How is polypharmacy defined in the literature?
- Is polypharmacy associated with adverse drug events?
- Is polypharmacy a predictor of adverse health outcomes?
- What health outcomes are associated with polypharmacy in elderly individuals?

## METHOD OF REVIEW

A literature search was conducted using the Cumulative Index of Nursing and Allied Health Literature (CINAHL Information Systems, Glendale, CA), Medline (Medline Industries Inc., Mundelein, IL), and PubMed (U.S. National Institutes of Health,

Bethesda, MD) to identify studies of health outcomes published between 1995 and 2003 related to polypharmacy in elderly individuals and reported in English. The keywords “polypharmacy OR multiple medications” and “elderly OR elders” and “outcomes

met the inclusion criteria. 7 were published in gerontology journals, 5 were published in medical journals, 3 appeared in pharmacy journals, and 1 was published in a nutrition journal. These studies were reviewed for their investigation of the relationships between



OR effects” guided the retrieval of current research studies. These searches yielded 85 reference citations of published peer-reviewed articles.

A hand search of these citations was then conducted to determine which articles met the criteria for review. Studies were included if they were original investigations of the relationship between polypharmacy and a health outcome. These studies also had to describe the health outcome in the elderly population specifically. Two articles reported results from the same investigation, so one was excluded as a duplicate. Reference lists were also checked for additional relevant studies. Of the 16 studies that

polypharmacy and elderly health outcomes.

## FINDINGS

The 16 studies exploring polypharmacy were conducted in a variety of international health care settings in the United States, Canada, Australia, and Europe. Participants studied were:

- Living at home independently (Cohen, Rogers, Burke, & Beilin, 1998; Incalzi et al., 2001; Jacqmin-Gadda, Fourrier, Commenges, & Dartigues, 1998; Jensen, Friedmann, Coleman, & Smiciklas-Wright, 2001; Mitchell, Mathews, Hunt, Cobb, & Watson, 2001; Shorr, Ray, Daugherty, & Griffin, 1997; Veehof, Stewart,

Meyboom-de Jong, & Haaijer-Ruskamp, 1999).

- Hospitalized (Alarcon, Barcena, Gonzalez-Montalvo, Penaloza, & Salgado, 1999; Buajordet, Ebbesen, Erikssen, Brors, & Hilberg, 2001; Courtman & Stallings, 1995; Onder et al., 2002; Satish, Winograd, Chavez, & Bloch, 1996).

- With home care (Flaherty et al., 2000), or in retirement homes (Griep, Mets, Collys, Ponjaert-Kristoffersen, & Massart, 2000; Lord & Menz, 2002).

- In a combination of settings (Langmore et al., 1998).

Sample sizes varied from 81 to 28,411 participants. Twelve studies

et al., 2001). Veehof et al. (1999) distinguished minor (2 to 3 drugs), moderate (4 to 5 drugs), and major (> 5 drugs) polypharmacy. The remaining studies did not define polypharmacy explicitly.

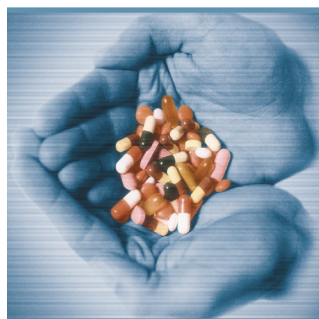
The purpose of the research for 15 of the 16 studies was to determine independent predictors or risk factors for certain health outcomes in the elderly population. Only one (Veehof et al., 1999) examined polypharmacy specifically as a predictor of a particular outcome (i.e., ADR) at the onset of the study. The result of the study was that the incidence of ADRs increased non-significantly

- Risk of malnutrition.
- Aspiration pneumonia.
- Length of hospital stay.
- Fatal adverse drug events.
- General drug-related problems.
- Emergency department visits.
- Quality of life in severely compromised respiratory patients.

Polypharmacy was found to have a statistically significant association with drug-related problems, which is defined as inappropriate drug doses, ADRs, drug interactions, noncompliance, and omission of drug therapy (Courtman & Stallings, 1995). Veehof et al. (1999) found a non-significant positive association between long-term polypharmacy and ADRs.

However, the under-reporting of ADRs is possibly responsible for the non-significance. Two studies conducted in the United States found polypharmacy to be associated with hospital admission (Flaherty et al., 2000; Jensen et al., 2001). A study conducted in Spain (Alarcon et al., 1999) found association with hospital readmission within 6 months of discharge. An Italian study (Onder et al., 2002) reported an association between polypharmacy and ADR-related hospitalizations. Other significant positive associations were found with fatal adverse drug events (Buajordet et al., 2001), emergency room visits (Alarcon et al., 1999), postprandial hypotension (Cohen et al., 1998), risk of fractures (Jacqmin-Gadda et al., 1998), dysphagia (Langmore et al., 1998), malnutrition (Griep et al., 2000), a poor quality of life in patients with chronic respiratory disease (Incalzi et al., 2001), impaired mobility (Lord & Menz, 2002), and serious hypoglycemia in insulin-dependent diabetics (Shorr et al., 1997).

Some associations with health outcomes warrant further research. Although a study conducted in Spain (Alarcon et al., 1999) found polypharmacy to be associated with hospital mortal-



### **Nurses are most involved in administering medications, providing medication instruction, and assessing patient response to medications.**

had between 100 and 1,000 participants and three had more than 2000. In seven studies, participants were 65 or older. The youngest participants were 60 (Cohen et al., 1998; Langmore et al., 1998). The two studies conducted in a Veterans Administration setting excluded women; all of the others had fairly even distributions of men and women participating.

All 16 studies were quantitative correlational studies. Eleven studies had a cross-sectional design and four were longitudinal, measuring outcomes from 6 months to 5 years. Of the seven studies that defined polypharmacy, four defined it as more than five simultaneous medications (Alarcon et al., 1999; Flaherty et al., 2000; Satish et al., 1996; Shorr et al., 1997). Polypharmacy has also been described as more than three drugs (Jensen et al., 2001) or three or more respiratory drugs (Incalzi

with the number of drugs used. However, the investigators defined polypharmacy as "the long-term simultaneous use of two or more drugs; long term is 480 days or more in 2 years" (Veehof et al., 1999, p. 534). Because most ADRs occur within 4 days after taking a new drug (Veehof et al., 1999), this definition affects the internal validity of the study. Another limitation of this study was that ADRs were measured only if they were recognized and reported by the general practitioner. This may have led to under-reporting of ADRs.

As shown in the Table, health outcomes examined in the 16 studies were:

- Mobility.
- Mortality.
- Fractures.
- Hypotension.
- Hypoglycemia.
- Institutionalization.
- Hospital admissions.

**TABLE**

**RESULTS OF RESEARCH ON THE EFFECT OF POLYPHARMACY ON ELDERLY HEALTH OUTCOMES**

| First Author, Year, Country   | Purpose   | Sample and Characteristics  | Definition of Polypharmacy    | Measure of Outcomes   | Results  |
|-------------------------------|---|---|-------------------------------|---|--|
| Alarcon, 1999, Spain          | To investigate which factors predict outcome of elderly patients on hospital discharge and at 6 months                                      | N = 353, patients of acute geriatric ward, mean age = 81.8 years            | ≥ 5 medications on admission  | Mortality, length of stay, nursing home placement, readmissions, emergency department visits as evidenced by chart review or telephone call                             | Polypharmacy is a predictor of mortality, emergency department visits, and hospital readmission  |
| Buajordet, 2001, Norway       | To study patient characteristics and drug regimens associated with fatal adverse drug events (FADEs)  | N = 732, patients who died in internal medicine department                  | ≥ 6 medicines                 | FADEs on examination of medical records by expert panel   | Polypharmacy is associated with a high incidence of FADEs  |
| Cohen, 1998, Australia        | To investigate use of prescription and nonprescription drugs, predictors of drug use, and symptoms of postprandial and postural hypotension | N = 765 men, 846 women, 60 to 102 years, randomly chosen from the community | N/D                           | Self-reported symptoms of postprandial and postural hypotension (weakness, faintness, dizziness) on a questionnaire   | <ol style="list-style-type: none"> <li>1. Symptoms of postprandial hypotension increased with number of drugs used</li> <li>2. Non-compliance with prescribed drugs was related to taking more than two drugs daily or one drug more than twice daily</li> </ol> |
| Courtman, 1995, Canada        | To determine the incidence, types, avoidability, and risk factors associated with drug-related problems (DRPs)                              | N = 150, patients of a medical ward, age > 65 years                         | N/D                           | DRPs contributing to hospital admission— inappropriate drug dosing, adverse drug reactions (ADRs), drug interactions, non-compliance, and lack of required drug therapy | Polypharmacy was a statistically significant risk factor for a DRP   |
| Flaherty, 2000, United States | To examine the relationship between medication use and hospitalization  | N = 833, home care patients, age > 64 years                                 | ≥ 5 medicines recorded by RNs | Hospitalization as documented in home care agency charts  | Polypharmacy is a predictor of hospitalization   |

*Cont. on page 8*



**TABLE (CONTINUED)**

**RESULTS OF RESEARCH ON THE EFFECT OF POLYPHARMACY ON ELDERLY HEALTH OUTCOMES**

| First Author, Year, Country    | Purpose   | Sample and Characteristics  | Definition of Polypharmacy  | Measure of Outcomes   | Results   |
|--------------------------------|---|---|---|---|---|
| Griep, 2000, Belgium           | To explore which age-associated factors are accompanied by increased risk for malnutrition  | <i>N</i> = 81, participants living in retirement homes  | N/D   | Risk of malnutrition as measured by Mini-Nutritional Assessment Score (MNAS)                            | A significant negative correlation between number of drugs taken and the MNAS   |
| Incalzi, 2001, The Netherlands | To compare the effects of asthma and chronic obstructive pulmonary disease (COPD) on health status, to identify correlates of results                               | <i>N</i> = 198 asthma patients, <i>N</i> = 230 COPD patients, age $\geq$ 65 years, multi-center sites | $\geq$ 3 respiratory drugs  | Quality of life measured by Saint George's Respiratory Questionnaire (SGRQ)                             | The number of respiratory drugs are independently correlated with SGRQ scores   |
| Jacqmin-Gadda, 1998, France    | To study risk factors for fractures   | <i>N</i> = 3,216 men and women, age $\geq$ 65 years, in the community, randomly selected              | N/D   | Fractures reported by participants in an interview or mailed questionnaire, and physicians by telephone | 1. The risk of non-hip fractures was associated with polypharmacy 2. Polypharmacy and use of anxiolytic/antidepressive drugs is associated with hip fractures |
| Jensen, 2001, United States    | To compare the association of items from the Level II Nutrition Screen and the Probability of Repeated Admissions questionnaire with the outcome of hospitalization | <i>N</i> = 386, age $\geq$ 65 years, rural population, more than 100 clinic sites                     | $>$ 3 prescription drugs, over-the-counter and/or supplements daily | Hospitalization as evidenced by medical records   | Polypharmacy was significantly associated with hospitalization  |
| Langmore, 1998, United States  | To determine predictors of aspiration pneumonia   | <i>N</i> = 189, male patients of veterans administration, age $\geq$ 60 years                         | N/D   | Increased white blood cell count, fever, new infiltrate on chest x-ray within 4 years                   | Patients with aspiration pneumonia took significantly more medicines than patients without aspiration pneumonia   |

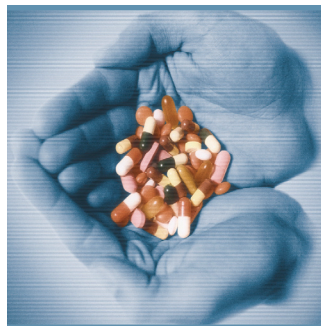
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**TABLE (CONTINUED)**

**RESULTS OF RESEARCH ON THE EFFECT OF POLYPHARMACY ON ELDERLY HEALTH OUTCOMES**

| First Author, Year, Country   | Purpose   | Sample and Characteristics   | Definition of Polypharmacy   | Measure of Outcomes   | Results  |
|-------------------------------|---|--|--|---|--|
| Lord, 2002, Australia         | To determine predictors of impaired mobility  | <i>N</i> = 515, residents of retirement villages                             | N/D  | 6-minute walk distance  | Number of medications used was a significant and independent predictor of performance    |
| Mitchell, 2001, United States | To document the use of medication mismanagement   | <i>N</i> = 499, non-institutionalized, rural population, age $\geq$ 66 years | N/D  | Self-reported mismanagement of medications  | The number of medications currently taken had no effect on mismanagement                 |
| Onder, 2002, Italy            | To identify independent factors predictive of ADR-related hospital admissions   | <i>N</i> = 28,411  | N/D  | ADR-related hospital admissions as reported by patients, nurses, physicians, or found in record reviews   | The number of drugs used was an independent predictor of ADR-related hospital admissions |
| Satish, 1996, United States   | To assess the utility of geriatric targeting criteria in predicting survival and health care utilization                              | <i>N</i> = 507, acutely hospitalized male veterans, age $\geq$ 65 years      | Reported use of $\geq$ 5 prescription drugs  | Survival status, nursing home placement, total hospital days during 1 year using medical records and veterans administration database                         | Polypharmacy predicted nursing home placement  |
| Shorr, 1997, United States    | To determine the incidence and risk factors for developing serious hypoglycemia among older individuals using sulfonyureas or insulin | <i>N</i> = 586, Medicaid enrollees, age $\geq$ 65 years                      | $\geq$ 5 medicines   | Hospitalization, emergency department admissions or death associated with hypoglycemic symptoms and blood glucose of $<$ 50 mg/dl using medical record review | Polypharmacy is an independent risk factor for serious hypoglycemia                      |
| Veehof, 1999, The Netherlands | To examine the association of polypharmacy and actual ADRs  | <i>N</i> = 2185, patients of three general practices, age $>$ 65 years       | Long-term simultaneous use of two or more drugs ( $\geq$ 480 days in 2 years), minor 2 to 3, moderate 4 to 5, major $\geq$ 5 | Incidence of ADRs recognized and reported by general practitioners  | Incidence of ADRs increased non-significantly with number of drugs used long-term        |

ity and mortality 6 months after hospital discharge, a study of male veterans in the United States did not find an association with mortality (Satish et al., 1996). The American study found polypharmacy to have a statistically significant association with nursing home placement, but when patients who came from a nursing home were excluded from the analysis, the association was no longer significant. Polypharmacy was not found to be a predictor



**Because nurses are involved heavily in medication administration, teaching, and assessment, they can play a role in reducing the ill effects of polypharmacy.**

of nursing home placement in the Spanish study (Alarcon et al., 1999). Neither study found polypharmacy to be a predictor of prolonged hospital length of stay.

Two studies differed in whether polypharmacy is associated with medication mismanagement. An Australian study (Cohen et al., 1998) found that omission of medications showed an independent positive association with taking more than two drugs daily or taking drugs more than twice daily. A study conducted in North Carolina that purported to examine medication mismanagement (Mitchell et al., 2001) did not find an association between polypharmacy and medication mismanagement. However, it is arguable if the behaviors described as "noncompliance strategies" in the North Carolina study are mismanagement strategies at all. Instead, the described strategies of using credit at the pharmacy, borrowing money, or asking a family member to buy medications, as well as asking for free samples, may be interpreted as creative ways to remain in compliance.

## DISCUSSION

The reviewed studies support other research that polypharmacy is prevalent in elderly individuals. Non-institutionalized elderly individuals were found to use an average of 4 drugs (Mitchell et al., 2001), and 41% to 65% of elderly individuals used more than 4 drugs daily (Cohen et al., 1998; Jensen et al., 2001). Elderly individuals receiving home care were found to use an average of 5.5 medications (Flaherty et al.,

2000). On admission to a hospital, older patients were found to use an average of 4 (Courtman & Stallings, 1995) to 5.7 medications (Buajordet et al., 2001). One study (Satish et al., 1996) found that 42% of their participants used 5 or more drugs.

Results from 14 of the 16 studies reviewed demonstrated a significant positive correlation between polypharmacy and adverse health outcomes in elderly individuals, although two studies had contradictory findings (Alarcon et al., 1999; Satish et al., 1996). Results from the other two studies (Mitchell et al., 2001; Veehof et al., 1999) did not support the positive correlations with negative health outcomes. However, the internal validity of those two studies is problematic.

One limitation of this integrated literature review is the wide variation in the operationalization of polypharmacy. Monane, Monane, and Semla (1997) suggest defining polymedicine as the use of medications for the treatment of multiple comorbidities and polypharmacy as a negative state with duplicative or inappropriate medica-

tions and likely drug–drug interactions. However, these definitions are not universally accepted.

Alternative explanations for findings affect the internal validity of a study (Polit & Hungler, 1999). It may be that polypharmacy as operationalized in the reviewed studies is merely a marker for those with more severe illness or more comorbidities instead of a true independent correlate. The coexistence of many disease states often requires multiple medications (Dunn, 2002; Monane et al., 1997). Some argue that polypharmacy is even essential in the treatment of elderly individuals (Dunn, 2002; Larsen & Martin, 1999).

According to Alarcon et al. (1999), although polypharmacy was a predictor of adverse health outcomes, neither main diagnosis nor number of diagnoses on hospital admission was a predictor of outcomes. Buajordet et al. (2001) found comorbidity was significantly higher among patients with fatal adverse drug events versus those without them. Cohen et al. (1998) found that the number of drugs increased with the number of diagnoses. Whether comorbidity is an extraneous variable needs more research. Severity of illness was not controlled for, nor examined as, a possible independent correlate. More studies are necessary to clarify this area.

Realizing that multiple medications are often necessary, the U.S. Department of Health and Human Services (2000a) recommends that health care providers, pharmacists, pharmaceutical companies, and patients work together using an integrated, computerized system to maximize benefits and minimize risks associated with medications. Although the technology to integrate the different components of health care is available, it is rarely used.

Because nurses are involved heavily in medication administration, teaching, and assessment, they can play a role in reducing the ill effects of polypharmacy in elderly indi-

viduals by practicing the following (Dunn, 2002):

- Keeping current in the latest drug information.
- Providing thorough patient and family education.
- Accurately reporting the number and types of medications to the prescribing provider.
- Using available technology to review medications for interactions, contraindications, and side effects.

Advanced practice nurses who prescribe medications must follow the Healthy People 2010 recommendations and review medications regularly to eliminate unnecessary or inappropriate medications (U.S. Department of Health and Human Services, 2000b). Neary and White (2001) recommend that agencies adopt a policy of performing automatic chart audits any time a patient is prescribed more than five drugs. At the least, polypharmacy should be considered a predictor of adverse health outcomes for older patients. Patients taking multiple medications warrant more intense nursing observation and possibly earlier intervention.

## CONCLUSION

Further research is needed in which comorbidities and severity of illness are controlled to determine if polypharmacy itself is an independent risk factor for adverse health outcomes. Research from a nursing perspective is needed to explore the association between polypharmacy and other health outcomes and to describe nursing interventions that can prevent the associated adverse health outcomes in elderly individuals.

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**10.5.8 Appendice E8 : Article n° 8 – Interventions to optimise prescribing for older people in care homes (Review)**

|              |  |
|--------------|--|
| Article n° 8 | <b>Interventions to optimise prescribing for older people in care homes (Review)</b>   |
| Auteurs      | Alldred, D. P., Raynor, D. K., Hughes, C., Barber, N., Chen, T. F., & Spoor, P. (2013).  |
| Titre        | Le titre précise la population étudiée (older people) et met également en avant le fait que cela soit une revue (review, intervention review p. 1)   |
| Résumé       | <p>Le résumé présenté fournit des informations structurées où l'on retrouve tous les points :</p> <ul style="list-style-type: none"> <li>• <b>Background</b> : les prescriptions pour les résidents de maisons de retraite sont suboptimales et nécessitent une amélioration. Par conséquent, il est nécessaire d'identifier les interventions efficaces.</li> <li>• <b>Objectifs</b> : Déterminer les effets des interventions afin d'optimiser les prescriptions pour les personnes âgées vivant en maison de retraite.</li> <li>• <b>Méthode de recherche</b> : Recherche dans différentes bases de données (EPOC Group Specialised Register, CENTRAL The Cochrane Library, Cochrane Database of Systematic Reviews, MEDLINE, EMBASE, Ageline, CINHAHL, International Pharmaceutical Abstracts, PsycINFO, conferences proceedings in Web of Science), sources de littératures et trial registries, contact des auteurs des études pertinentes.</li> <li>• <b>Critères de sélection</b> : Essais contrôlés randomisés évaluant les interventions ciblant l'amélioration des prescriptions pour les personnes âgées (<math>\geq 65</math> ans) vivant en établissement de soins institutionnalisés.<br/>Etudes incluses si elles mesuraient 1 ou plusieurs de ces conséquences : effet indésirable, admission en hôpital, mortalité (primaires) ; qualité de vie, problèmes liés à la médication, pertinence de la médication, coûts (secondaires)</li> <li>• <b>Collecte des données et analyse</b> : 2 auteurs ont indépendamment évalué l'éligibilité des études et extrait les données. Un résumé narratif des résultats est présenté.</li> <li>• <b>Principaux résultats</b> : 8 études ont été retenues. 6 sont des essais contrôlés randomisés par grappe et 2 sont des essais de contrôle des patients randomisés.</li> </ul> |

|   |  |
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|   | <p>Les interventions évaluées sont diverses et multiformes :</p> <ul style="list-style-type: none"> <li>○ Revue de la médication pour 7 études.</li> <li>○ Etude de cas multidisciplinaire pour 3 études.</li> <li>○ Élément éducationnel pour 2 études.</li> <li>○ Utilisation des technologies de prise de décision pour 1 étude.</li> </ul> <p>Pas de preuve d'un effet des interventions sur les conséquences primaires de la revue. Aucune étude n'a mesuré la qualité de vie. Preuves que les interventions ont permis d'identifier et résoudre un problème lié à la médication, d'améliorer la médication appropriée. L'effet sur les coûts est incertain.</p> <p><b>Conclusions des auteurs</b> : Aucune conclusion solide ne peut être faite en raison de la variabilité de la conception, des interventions, des conséquences et des résultats des études. Il y a un besoin d'essais contrôlés randomisés par grappe de haute qualité.</p> |
| <b>INTRODUCTION</b>   |  |
| <p style="text-align: center;">Problème de la recherche</p> | <p>Le phénomène est clairement décrit (augmentation de la population âgée et ses conséquences – augmentation des demandes en soins de longue durée, fragilité, vulnérabilité de la population étudiée, changements liés à l'âge)</p> <p>Le problème étudié est pertinent dans le sens où il existe des preuves que les prescriptions pour des personnes en maison de retraite ne sont pas optimales et nécessitent des améliorations.</p> <p>Il est également précisé comment les interventions sont censés avoir un impact sur les conséquences (médication appropriée, médecine bénéfique, surveillances appropriées en soins de longue durée ; avec pour suite une diminution des effets indésirables, une amélioration de la qualité de vie et une réduction des coûts).</p>   |
| <p style="text-align: center;">Recension des écrits</p>     | <p>Une recension des écrits a été entreprise. Elle présente de manière claire l'état actuel de la problématique et s'appuie sur des recherches de différents pays (Royaume-Uni, Etats-Unis, Canada et Australie).</p>  |
| <p style="text-align: center;">Cadre de recherche</p>       | <p>Les différents concepts sont expliqués (vieillesse de la population, maison de retraite).</p> <p>Les auteurs ne se sont pas limités à un médicament ou une classe spécifique de médicament mais ont pris en compte l'ensemble de la médication des résidents de home.</p>   |

|                               |  |
|-------------------------------|--|
|                               | Absence de base théorique philosophique.   |
| Buts et question de recherche | <p>Le but est clairement cité : Déterminer les effets des interventions pour optimiser les prescriptions pour les personnes âgées en maison de retraite.</p> <p>Les hypothèses sont clairement énoncées et sont le reflet logique de la recension des écrits (cf. How the intervention might work dans l'article).</p>   |
| <b>METHODE</b>                |  |
| Population et échantillon     | <p>Pour cette revue, ont été considérées les études de type essais contrôlés randomisés de patients et de grappe.</p> <p>Les participants à ces études étaient des personnes âgées de 65 ans ou plus vivant en établissement de soins institutionnalisés.</p> <p>Les études ciblant une condition médicale spécifique, une classe spécifique de médicament et visant à réduire les erreurs de médications ont été exclues.</p> <p>De même, les interventions financières et réglementaires ont été exclues.</p> <p>Les études ont été incluses si elles présentaient au moins une mesure sur les conséquences primaires ou au moins une mesure sur les conséquences secondaires.</p>   |
| Considérations éthiques       | <p>Une évaluation des risques de biais des études sélectionnées a été faite au moyen de l'outil d'évaluation du risque de biais de The Cochrane Collaboration et reporté sous forme de tableau dans l'article :</p> <ul style="list-style-type: none"> <li>Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Intervention. <i>Cochrane Handbook for Systematic Reviews of Interventions Version 5.0.1</i>/<a href="http://www.cochrane.org/resources/handbook">http://www.cochrane.org/resources/handbook</a>. The Cochrane Collaboration, 2008.</li> </ul> <p>L'évaluation de la qualité des preuves a été faite au moyen des critères GRADE :</p> <ul style="list-style-type: none"> <li>GRADE. Grading of Recommendations Assessment, Development and Evaluation Working Group. <a href="http://www.gradeworkinggroup.org/">http://www.gradeworkinggroup.org/</a>.</li> </ul> <p>La méthode d'analyse des données des études a été examinée de manière critique.</p> |
| Devis de recherche            | La méthode de recherche utilisée (revue de littérature) a permis de répondre à toutes les questions de départ.   |



|                               |   |
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|                               | <p>L'utilisation de la revue de littérature permet de respecter les critères scientifiques dans le sens où elle compare les différentes recherches sur le sujet.</p> <p>La neutralité est respectée puisqu'il s'agit d'autres recherches qui ne sont pas effectuées par les auteurs.</p>  |
| Modes de collectes de données | <p>Les auteurs décrivent leur méthode de recherche des données de manière complète et précise dans l'annexe I.</p> <p>Aucune restriction de langue n'a été faite.</p>   |
| Conduite de la recherche      | <p>Les auteurs décrivent le processus d'extraction et de confirmation des données :</p> <ul style="list-style-type: none"> <li>• 2 auteurs (DPA et DKR) ont analysé les titres et résumés de chaque étude afin de définir si elles correspondent aux critères.</li> <li>• 2 auteurs (DA et DKR) ont ensuite analysé le texte complet des études retenues afin de déterminer si elles correspondaient toujours aux critères.</li> <li>• 2 auteurs (DPA et DKR) ont extrait les détails des articles (type d'étude, population, intervention, mesure des conséquences, ...) en utilisant un outil spécialement créé, basé sur le modèle EPOC.</li> <li>• Si besoin les auteurs des études retenues ont été contactés.</li> </ul> <p>Ces différentes étapes sont résumées sous forme de tableau.</p> |
| Analyse des données           | <p>Les différentes méthodes d'analyse des données et des biais sont décrites de manière claire. Chaque outil utilisé est référencé (EPOC, GRADE, etc.) (p. 7)</p> <p>Les risques de biais pour chaque étude retenue sont décrits sous forme de tableau (p. 13) et de texte narratif (p. 14).</p>  |
| <b>RESULTATS</b>              |   |
| Présentation des résultats    | <p>Un diagramme de flux (p. 9) présente les étapes de choix des études pour la revue.</p> <p>Un résumé de chaque étude retenue est présenté sous forme de tableau. Il contient les points suivants :</p> <ul style="list-style-type: none"> <li>• Méthode</li> <li>• Participants</li> <li>• Interventions</li> <li>• Conséquences</li> <li>• Notes</li> <li>• Risques de biais</li> </ul> <p>Une synthèse de ces points est présentée sous forme de texte narratif (p. 10)</p>   |

|                                      |  |
|--------------------------------------|--|
|                                      | <p>Toutes les études ont été analysées selon les conséquences (outcomes) primaires et secondaires. Une synthèse sous forme de texte narratif est présente pour chaque point (p. 11).</p> <p>Aucune étude retenue n'a toutefois pris en compte la qualité de vie dans ses mesures</p> <p>Un résumé des résultats sous forme de tableau est présent (p. 3). Un texte narratif complète chaque point :</p> <ul style="list-style-type: none"> <li>• <b>Effets indésirables</b> : pas d'évidence d'un effet d'une revue de médication.</li> <li>• <b>Admissions en hôpital</b> : pas d'évidence d'un effet d'une revue de médication.</li> <li>• <b>Mortalité</b> : pas d'évidence d'un effet d'une revue de médication.</li> <li>• <b>Qualité de vie</b> : aucune étude ne l'a mesurée.</li> <li>• <b>Problèmes liés à la médication</b> : une revue de la médication peut conduire à l'identification et la résolution de problèmes liés à la médication.</li> <li>• <b>Justesse de la médication</b> : une revue de médication peut conduire à une amélioration de la justesse de la médication.</li> <li>• <b>Coûts</b> : incertitude sur le fait qu'une revue de la médication diminue les coûts.</li> </ul> <p>Une méta-analyse n'a pas été effectuée en raison de l'hétérogénéité des interventions, résultats et risques de biais.</p> |
| <b>DISCUSSION</b>                    |  |
| <p>Interprétations des résultats</p> | <p>Les résultats sont interprétés en fonction de l'objectif de départ (déterminer les effets des interventions pour optimiser les prescriptions chez les personnes âgées en maison de soins) et selon les différentes conséquences (primary and secondary outcomes). Les conclusions qui en découlent sont logiques et en lien avec les résultats.</p> <p>Les résultats sont similaires à d'autres études (p. 17).</p> <p>Les limites de l'étude ne ressortent pas clairement mais sont présentes :</p> <ul style="list-style-type: none"> <li>• Variabilité des résultats mesurés et qualité de vie non représentée dans aucune étude.</li> <li>• Variation des pratiques d'un pays à l'autre.</li> <li>• L'équipe multidisciplinaire (médecins, infirmiers, pharmaciens) dans l'optimisation des prescriptions pour les personnes en maison de soins joue un rôle significatif. Toutefois, l'efficacité n'a pas été démontrée.</li> </ul>  |

|   |   |
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|   | <ul style="list-style-type: none"> <li>• Les technologies de l'information et la communication sont de plus en plus utilisées pour optimiser les prescriptions. Une seule étude a testé l'impact de ce système sur les décisions.</li> <li>• Les essais contrôlés randomisés par patient ne protègent pas assez de la « contamination » des échantillons ; les effets des interventions ont peut-être été diminués.</li> <li>• Certaines études ont une courte période de suivi, cela a pu limiter la détection des effets.</li> <li>• Aucune étude n'a « aveuglé » les participants ou le personnel. Toutefois, cela était difficilement faisable en raison de la nature des interventions.</li> <li>• Limitation majeure : diversité des résultats mesurés qui diffèrent dans la manière dont ils sont définis, collectés et analysés.</li> </ul>   |
| <p style="text-align: center;"><b>Conséquences et recommandations</b></p> | <p>Une revue médicamenteuse est efficace pour identifier les problèmes liés à la médication et en améliorer la justesse. Il y a par contre un manque de preuve quant à l'efficacité d'une telle intervention sur les autres points (mortalité, hospitalisation, qualité de vie, etc.).</p> <p>Les auteurs recommandent d'effectuer des essais contrôlés randomisés de haute qualité, idéalement essais contrôlés randomisés par grappes afin d'identifier les interventions efficaces pour optimiser les prescriptions des personnes âgées en home.</p> <p>D'autres études sont requises pour investiguer l'efficacité des systèmes d'aide à la décision clinique et l'efficacité des interventions multidisciplinaires.</p> <p>Un travail supplémentaire est nécessaire pour identifier, définir, mesurer, reporter et analyser les conséquences (outcomes) liées au patient (y compris la qualité de vie).</p> <p>⇒ Ceci permettra la réalisation de méta-analyse sur les futurs essais contrôlés randomisés.</p> |

# Interventions to optimise prescribing for older people in care homes (Review)

Allred DP, Raynor DK, Hughes C, Barber N, Chen TF, Spoor P



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[Intervention Review]

# Interventions to optimise prescribing for older people in care homes

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## ABSTRACT

### Background

There is a substantial body of evidence that prescribing for care home residents is suboptimal and requires improvement. Consequently, there is a need to identify effective interventions to optimise prescribing and resident outcomes in this context.

### Objectives

The objective of the review was to determine the effect of interventions to optimise prescribing for older people living in care homes.

### Search methods

We searched the Cochrane Effective Practice and Organisation of Care (EPOC) Group Specialised Register; Cochrane Central Register of Controlled Trials (CENTRAL), *The Cochrane Library* (Issue 11, 2012); Cochrane Database of Systematic Reviews, *The Cochrane Library* (Issue 11, 2012); MEDLINE OvidSP (1980 on); EMBASE, OvidSP (1980 on); Ageline, EBSCO (1966 on); CINAHL, EBSCO (1980 on); International Pharmaceutical Abstracts, OvidSP (1980 on); PsycINFO, OvidSP (1980 on); conference proceedings in Web of Science, Conference Proceedings Citation Index - SSH & Science, ISI Web of Knowledge (1990 on); grey literature sources and trial registries; and contacted authors of relevant studies. We also reviewed the references lists of included studies and related reviews (search period November 2012).

### Selection criteria

We included randomised controlled trials evaluating interventions aimed at optimising prescribing for older people (aged 65 years or older) living in institutionalised care facilities. Studies were included if they measured one or more of the following primary outcomes, adverse drug events; hospital admissions; mortality; or secondary outcomes, quality of life (using validated instrument); medication-related problems; medication appropriateness (using validated instrument); medicine costs.

### Data collection and analysis

Two authors independently screened titles and abstracts, assessed studies for eligibility, assessed risk of bias and extracted data. A narrative summary of results was presented.

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Interventions to optimise prescribing for older people in care homes (Review)

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## Main results

The eight included studies involved 7653 residents in 262 (range 1 to 85) care homes in six countries. Six studies were cluster-randomised controlled trials and two studies were patient-randomised controlled trials. The interventions evaluated were diverse and often multifaceted. Medication review was a component of seven studies, three studies involved multidisciplinary case-conferencing, two studies involved an educational element for care home staff and one study evaluated the use of clinical decision support technology. Due to heterogeneity, results were not combined in a meta-analysis. There was no evidence of an effect of the interventions on any of the primary outcomes of the review (adverse drug events, hospital admissions and mortality). No studies measured quality of life. There was evidence that the interventions led to the identification and resolution of medication-related problems. There was evidence from two studies that medication appropriateness was improved. The evidence for an effect on medicine costs was equivocal.

## Authors' conclusions

Robust conclusions could not be drawn from the evidence due to variability in design, interventions, outcomes and results. The interventions implemented in the studies in this review led to the identification and resolution of medication-related problems, however evidence of an effect on resident-related outcomes was not found. There is a need for high-quality cluster-randomised controlled trials testing clinical decision support systems and multidisciplinary interventions that measure well-defined, important resident-related outcomes.

## PLAIN LANGUAGE SUMMARY

### Interventions to optimise prescribing for older people in care homes

Older people living in care homes (also called nursing homes, residential homes, skilled-nursing facilities, assisted-living facilities or aged-care facilities) have many complex physical and mental health problems. Care home residents are prescribed many medicines compared to people who live in their own homes, with an average of eight medicines being common. International research has shown that these medicines are often not well managed, with some residents prescribed medicines inappropriately. This has the potential to lead to harmful side effects and a loss of benefit. For these reasons, it is important to make sure that care home residents are prescribed **the right medicines at the right doses**.

This review found eight studies involving 7653 residents in 262 care homes in six countries that evaluated interventions to optimise prescribing for care home residents. Most of the interventions had several components, often involving a review of medicines with a pharmacist and doctor. Some interventions included a teaching component and one study used Information Technology.

There was no evidence of benefit of the interventions with respect to reducing adverse drug events (harmful effects caused by medicines), hospital admissions or death. None of the studies looked at quality of life. Problems relating to medicines were found and addressed through the interventions used in the studies. Prescribing was improved based on criteria used to assess the appropriateness of prescribing in two studies.

More high-quality studies need to be done to gather more evidence for these and other types of interventions. Further studies are needed to evaluate new technologies, including computer systems that support prescribing decisions. More work needs to be done to make sure that researchers are consistently measuring outcomes that are important to care home residents.

## SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

| Medication review compared with usual GP care for optimising prescribing for care home residents   |  |                                    |                                 |
|--|--|------------------------------------|---------------------------------|
| <b>Patient or population:</b> older people (aged 65 years or older) living in care homes<br><b>Settings:</b> Institutionalised care facilities in Australia, Netherlands, Sweden, United Kingdom and USA and Canada<br><b>Intervention:</b> Medication review as a single intervention or a component of a multi-faceted intervention<br><b>Comparison:</b> Usual care by general practitioner |  |                                    |                                 |
| Outcomes   | Impact   | No of Participants (studies)       | Quality of the evidence (GRADE) |
| Adverse drug events  | There was no evidence of an effect on adverse drug events                                      | 110 in 85 care homes (1 study)     | ⊕⊕○○<br><b>low</b>              |
| Hospital admissions  | There was no evidence of an effect on hospital admissions                                      | 4306 in 216 care homes (4 studies) | ⊕⊕○○<br><b>low</b>              |
| Mortality  | There was no evidence of an effect on mortality  | 4221 in 131 care homes (3 studies) | ⊕⊕○○<br><b>low</b>              |
| Quality of life  | No studies reported quality of life  | 0 (no studies)                     | -                               |
| Medication-related problems  | Medication review may lead to the identification and resolution of medication-related problems | 6281 in 250 care homes (6 studies) | ⊕⊕○○<br><b>low</b>              |
| Medication appropriateness   | Medication review may lead to an improvement in medication appropriateness                     | 264 in 95 care homes (2 studies)   | ⊕⊕○○<br><b>low</b>              |
| Medicine costs   | It is uncertain whether medication review decreases medication costs                           | 4375 in 141 care homes (4 studies) | ⊕○○○<br><b>very low</b>         |

GRADE Working Group grades of evidence

**High quality:** Further research is very unlikely to change our confidence in the estimate of effect.

**Moderate quality:** Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

**Low quality:** Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

**Very low quality:** We are very uncertain about the estimate.

The [Gurwitz 2008](#) study is not included in the 'Summary of findings' table as medication review was not a component of the intervention.

## BACKGROUND

Globally, the proportion of older people in the population is in-

creasing. The proportion of people aged 60 years and over was 11% in 2009 and this is projected to double by the middle of this



century (United Nations 2009), with developed countries experiencing the fastest rise in number of older people. In the United Kingdom (UK), it is estimated that by 2034 nearly a quarter of the population will be aged 65 years and over. The most rapid rise has been in the 'oldest old' that is those aged 85 years and over; it is projected that by 2034 there will be a 2.5 fold increase in the number of the oldest old, representing 5% of the population (Office for National Statistics 2010). As a consequence, there will continue to be an **increasing demand for long-term care across the world**.

Long-term care may be provided in people's homes or in institutional facilities such as nursing homes or hospitals. The terminology used to describe homes that provide care for older people (defined as 65 years or older (Department of Health 2001)) differs across the world. In the UK the homes are known as 'care homes', in the United States (US) 'long-term care facilities' and in Australia 'aged-care facilities'. Care homes are usually classified into two main categories, those that provide 24 hour nursing care (nursing homes in the UK, skilled-nursing facilities in the US and aged-care facilities providing high-level care in Australia); and those that provide personal care (residential homes in the UK, assisted-living in the US and aged-care facilities providing low-level care in Australia). Some care homes provide both types of care.

Older people living in care homes are often frail, and they are one of the most vulnerable groups in society. They have complex health needs due to multiple co-morbidities and age-related changes in pharmacokinetics and pharmacodynamics (Armour 2002). Polypharmacy, usually defined as greater than four or more medicines (Department of Health 2001; Rollason 2003; Patterson 2012), is common in this setting across the world with residents prescribed an increasing number of medicines over the last decade or so. In the UK, the mean number of medicines prescribed per resident was 4.9 in 1998 (Furniss 2000), 6.9 in 2003 (Zermansky 2006), and by 2007 this had risen to 8.0 (Barber 2009). Many care home residents also have cognitive impairment and this can impede their ability to communicate medicine-related problems (Matthews 2002; Alldred 2007a).

The complexity of prescribing for this population is compounded by multiple clinicians prescribing. This may involve family physicians and community-based consultants (for example old age psychiatrists and geriatricians) in primary care; and secondary care doctors from multiple specialties. In addition, the lack of representation of older people in clinical trials limits the evidence base and further increases the complexity (Beglinger 2008). It is, therefore, perhaps unsurprising that there is extensive evidence that prescribing is suboptimal for care home residents. Inappropriate prescribing, measured using validated, explicit and implicit definitions, has been found to be common in nursing and residential homes in several countries including the US (Beers 1992; Hanlon 1996; Sloane 2002; Gray 2003; Lau 2005; Perri 2005), Canada (Brymer 2003), the UK (Osborne 2003) and Australia (Crotty 2004).

Perri 2005 found that over a one month duration, 47% of 1117 residents of 15 US nursing homes received at least one inappropriate medicine, with 13% of residents having at least one adverse health outcome. Inappropriate prescribing more than doubled the risk of a resident experiencing at least one adverse health outcome (odds ratio (OR) 2.34, 95% confidence interval (CI) 1.61-3.40). Lau 2005 reported that 50% of 3372 US nursing home residents were prescribed at least one inappropriate medicine over one year. The risks of hospitalisation and death were greater in those residents exposed to an inappropriate medicine (OR 1.27, 95% CI 1.09-1.47; OR 1.28, 95% CI 1.05-1.55, respectively). Gray 2003 found that 22% of 282 US residents of residential care facilities were prescribed at least one inappropriate medicine. There is also evidence that care home residents are under-prescribed beneficial drugs and are poorly monitored with respect to their long-term conditions and their medicines (Fahey 2003; Alldred 2007b; Barber 2009).

For the reasons discussed above, care home residents are particularly susceptible to adverse drug events. In two US long-term care facilities, Gurwitz 2005 found 9.8 adverse drug events per 100 resident-months, with 42% being judged as preventable. Drug-related problems have been found to be responsible for 3% to 31% of hospital admissions of older people, and up to half of these are potentially avoidable (Howard 2007).

## Description of the condition

As described above, suboptimal prescribing for older people living in care homes is common and may occur due to the prescribing of inappropriate medicines, the omission of beneficial medicines or the failure to appropriately monitor residents and the effects of their medicines. There are a variety of instruments that can be employed to measure the appropriateness of prescribing in older people (Spinewine 2007). However, the predictive validity of these instruments on health outcomes such as adverse drug events and hospital admissions has not been unequivocally established (Spinewine 2007).

## Description of the intervention

For this review, we were interested in interventions concerned with optimising the whole medication regime for care home residents, not those concentrating solely on isolated drugs or classes such as benzodiazepines or antipsychotics nor those concentrating on one disease state. Financial and regulatory interventions tend to fall into this latter category.

There are several types of interventions that can potentially optimise prescribing in this setting, including:

- professional interventions, for example educational programmes aimed at prescribers;

- organisational interventions, for example medication review services or specialist clinics, case conferencing, information and communication technology (ICT) interventions such as clinical decision support systems.

Medication review interventions may be aimed at specific drugs or the whole regime and can be uni- or multiprofessional, involving physicians, nurses and pharmacists.

### How the intervention might work

Interventions designed to improve prescribing for care home residents may have an impact by discontinuing inappropriate medication; commencing beneficial medicines; and ensuring appropriate monitoring of long-term conditions and medicines. Consequently, this may lead to a reduction in adverse drug events, improved quality of life and a **reduction in medicine costs**.

### Why it is important to do this review

There is a substantial body of evidence that prescribing for care home residents is suboptimal and requires improvement. As well, there are other Cochrane reviews being undertaken which address similar issues in different populations (Soe 2009; Christensen 2011). We evaluated the evidence for interventions to address suboptimal prescribing in this setting to identify how care can be improved for this frail and vulnerable population. We intended to achieve this by determining which interventions were effective and by identifying gaps in the evidence to inform future research.

## OBJECTIVES

The objective of the review was to determine the effect of interventions to optimise overall prescribing for older people living in care homes.

## METHODS

### Criteria for considering studies for this review

#### Types of studies

We included patient-randomised controlled trials (P-RCT) and cluster-randomised controlled trials (C-RCT).

#### Types of participants

We included studies of older people (aged 65 years or older) living in institutionalised care facilities. Institutionalised care facilities include: nursing homes and residential homes (UK); skilled-nursing facilities and assisted-living facilities (US); and aged-care facilities providing low-level and high-level care (Australia). If there was any ambiguity in the description of the institution, we clarified this with the authors of relevant papers. We considered trials for inclusion if they had a majority (80% or more) of participants aged 65 years or more, or if the mean age was greater than 65 years. We excluded studies where the intervention focused on a single medical condition or a specific drug or class of drugs. We also excluded studies where the main focus was to reduce medication errors because such studies have a narrow focus and do not consider the whole medication regime. In addition, they do not seek to optimise prescribing, for example by adhering to evidence-based guidelines or by reducing inappropriate prescribing, but are designed to solely reduce errors.

#### Types of interventions

We assessed interventions aimed at optimising prescribing for care home residents compared with usual care as defined by the study. These interventions potentially included: educational interventions aimed at prescribers; medication review services (uni or multiprofessional, conducted by nurses, pharmacists or physicians); case conferencing; and ICT interventions such as clinical decision support systems. We excluded financial and regulatory interventions.

#### Types of outcome measures

We included a range of outcome measures including patient-related outcomes, health service utilisation, and economic outcomes. Studies were included if they reported at least one primary outcome measure or at least one secondary outcome measure.

#### Primary outcomes

The primary outcome measures for the review were:

1. adverse drug events;
2. hospital admissions;
3. mortality.

#### Secondary outcomes

Secondary outcome measures were:

1. quality of life (using validated instrument);
2. medication-related problems;
3. medication appropriateness (using validated instrument);
4. medicine costs.

## Search methods for identification of studies

Pat Spoor developed the search strategies in consultation with the other authors and with Michelle Fiander, Trials Search Co-ordinator (TSC) for the EPOC Group. We searched the Cochrane Database of Systematic Reviews (Issue 11, 2012) for related systematic reviews, and the databases listed below for primary studies. Searches were conducted in November 2012. Exact search dates for each database are included with the search strategies in Appendix A. When we conducted the scoping searches to prepare for this systematic review, we did not identify any studies for inclusion prior to 1980. Also, since 1980 the care of older people in institutionalised facilities has changed significantly due to residents having greater levels of morbidity with an increase in polypharmacy, leading to greater complexity of care. For these reasons, we searched for studies from 1980 onwards to ensure we had studies of relevance to contemporary practice.

### Electronic searches

- Cochrane Central Register of Controlled Trials (CENTRAL), *The Cochrane Library* (Issue 11, 2012)
- EPOC Group Specialised Register, Reference Manager
- MEDLINE, OvidSP (1980 on)
- EMBASE, OvidSP (1980 on)
- Ageline, EBSCO (1966 on)
- CINAHL (Cumulative Index to Nursing and Allied Health Literature), EBSCO (1980 on)
- International Pharmaceutical Abstracts, OvidSP (1970 on)
- PsycINFO, OvidSP (1980 on)
- Web of Science, Conference Proceedings Citation Index - SSH (ISI Web of Knowledge) (1990 on)
- Web of Science, Conference Proceedings Citation Index - Science (ISI Web of Knowledge) (1990 on)

Search strategies were comprised of keywords and, when available, controlled vocabulary such as MeSH (Medical Subject Headings). The finalised search strategies were developed using an iterative development process in which citations identified by various search terms were screened for relevance by the information specialist. In this manner, individual terms and combinations of terms were assessed as relevant or irrelevant and were included or omitted from the final search strategies. No language restrictions were used. All databases were searched from 1980 on with the exception of Ageline, which was run from 1966 on, and Web of Science Conference Proceedings indices which were searched from 1990 on. A Cochrane filter was used to identify RCTs in MEDLINE (Lefebvre 2011). All search strategies, as run, are provided in Appendix 1.

### Searching other resources

### Grey literature

We conducted a grey literature search to identify studies not indexed in the databases listed above, using the following source:

- Google Scholar scholar.google.com.

For search terms and number of results, see Appendix 2.

### Trials registries

- International Clinical Trials Registry Platform (ICTRP), World Health Organization (WHO) (<http://www.who.int/ictrp/en/>)

For search terms and number of results, see Appendix 3.

We also:

- reviewed reference lists of all included studies, relevant systematic reviews and primary studies;
- contacted authors of relevant studies to clarify reported published information.

## Data collection and analysis

### Selection of studies

Two review authors (DPA and DKR) independently screened titles and abstracts to decide which studies met the inclusion criteria. Any papers not meeting the inclusion criteria were excluded at this stage. If there was uncertainty or disagreement, consensus was reached by discussion with co-review authors. Two review authors (DA and DKR) independently assessed the full text articles to ensure they still met the inclusion criteria. Full text articles not published in English were translated prior to being assessed for inclusion.

### Data extraction and management

Two review authors (DPA and DKR) independently extracted details of articles included in the review, including the study design, the study population, the intervention, usual care, outcome measures used and length of follow-up data, using a specially designed data extraction form based on the EPOC template (EPOC 2009). Where necessary, we contacted authors for missing information or clarification. We intended to use information from the data extraction forms to guide extraction of numerical data for meta-analysis in Review Manager 5 (RevMan 2008). We intended to present data from P-RCTs and C-RCTs using the format in the EPOC working paper on presentation of data (EPOC 2009).

### Assessment of risk of bias in included studies

The internal validity of each included study was assessed by two review authors (DPA and DKR). We used The Cochrane Collaboration's tool for assessing risk of bias (Higgins 2008) based on six standard criteria: adequate sequence generation; concealment of allocation; blinded or objective assessment of primary outcome(s); adequately addressed incomplete outcome data; freedom from selective reporting; freedom from other risk of bias. We used four additional criteria specified by EPOC (EPOC 2009): similar baseline outcome measurements; similar baseline characteristics; reliable primary outcome measures; and adequate protection against contamination. We assessed and reported all included studies in the Cochrane 'Risk of bias' tables.

### Assessment of the quality of the evidence

The quality of the evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) criteria (GRADE 2012).

### Measures of treatment effect

We initially planned to conduct a meta-analysis, however, this was not possible due to heterogeneity (see Results). Therefore, we presented a narrative summary of the results. Wherever possible, we presented results with 95% confidence intervals.

### Unit of analysis issues

We critically examined the methods of analysis of all study types. We may have identified C-RCTs with unit of analysis errors (for example, randomisation by care home with analysis by residents without adjustments for clustering). If unit of analysis issues had been found, we intended to attempt to re-analyse the data and report the intra-cluster correlation co-efficient and adjust for clustering if possible. However, no unit of analysis errors were identified.

### Dealing with missing data

We intended to exclude studies from a meta-analysis if there was differential loss to follow-up between groups, greater than 20%. However, as meta-analysis was not appropriate this did not apply.

### Assessment of heterogeneity

See [Data synthesis](#) section.

### Assessment of reporting biases

We intended to examine funnel plots corresponding to meta-analysis of the primary outcome in order to assess the potential for small study effects such as publication bias. However, this was not possible as meta-analysis was not undertaken.

### Data synthesis

We intended to synthesise the results of the studies depending on the quality, design and heterogeneity, and we intended to pool the results of studies if at least two studies were homogeneous regarding the participants, interventions and outcomes. As stated above, this was not possible and, therefore, a narrative summary was undertaken. We described studies according to setting, type of intervention and study design together with an assessment of the evidence on the theoretical basis for each of the approaches described.

### Subgroup analysis and investigation of heterogeneity

We intended to conduct subgroup analyses for professional and organisational interventions where possible. If we had found that one type of intervention was common, for example medication review, we intended to analyse this separately. If possible, we also planned to undertake subgroup analyses based on the specific nature of the intervention, for example pharmacist-led medication review. However, subgroup analyses were not possible due to heterogeneity.

See [Data synthesis](#) section for the investigation of heterogeneity.

### Sensitivity analysis

We intended to perform sensitivity analysis for pooled results based on the risk of bias. However, as we could not pool results this did not apply.

## RESULTS

### Description of studies

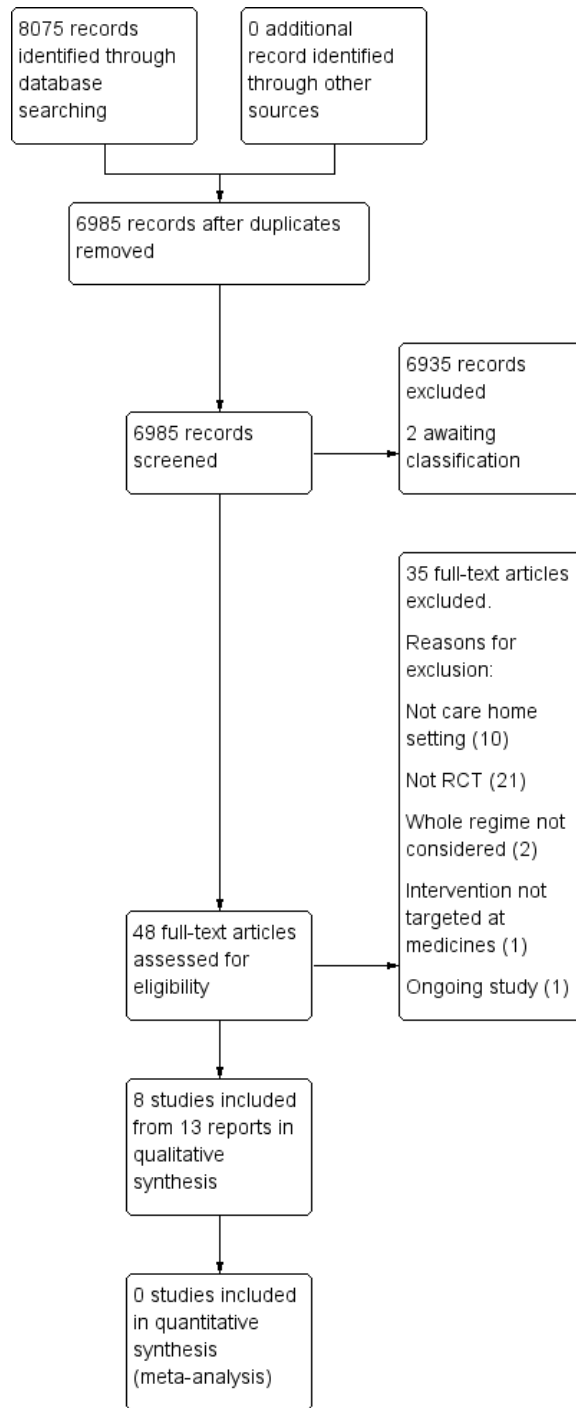
See: [Characteristics of included studies](#); [Characteristics of ongoing studies](#).

See: [Characteristics of included studies](#); [Characteristics of ongoing studies](#); [Table 1](#)

## Results of the search

The search strategy [identified 6985 articles for potential inclusion](#). Following independent screening of titles and abstracts by DPA and DKR, 48 full text articles were assessed for eligibility and eight studies met the inclusion criteria. Two studies are awaiting classification ([Beer 2011](#); [Lapane 2011](#)). See [Figure 1](#) (PRISMA flowchart) for details. The search yielded five related systematic reviews ([Kaur 2009](#); [Ostini 2009](#); [Verrue 2009](#); [LaMantia 2010](#); [Loganathan 2011](#)) and one narrative review ([Markum 2010](#)) and their references were reviewed; no further relevant studies were identified from these.

**Figure 1. Study flow diagram.**



## Included studies

The eight included studies involved 7653 residents in 262 (range 1 to 85) care homes. Three studies were conducted in [Australia](#) (Roberts 2001; Crotty 2004a; Crotty 2004b), two in the UK (Furniss 2000; Zermansky 2006), one in Sweden (Claesson 1998), one in the Netherlands (Strikwerda 1994) and one in the USA and Canada (Gurwitz 2008).

## Design

Six studies were C-RCTs (Strikwerda 1994; Claesson 1998; Furniss 2000; Roberts 2001; Crotty 2004a; Gurwitz 2008) and two studies were P-RCTs (Crotty 2004b; Zermansky 2006). There was a wide range of study duration and follow-up between the studies, ranging from six weeks to two years (see [Table 1](#)).

## Participants

All studies involved older people living in care homes (long-term care facilities). Mean age ranged from 81.2 years (Furniss 2000) to 87.2 years (Gurwitz 2008) and the majority of residents were female (range 59.7% (Crotty 2004a) to 77% (Zermansky 2006)). The study by Roberts 2001 did not report mean age or gender. Strikwerda 1994 studied 196 residents in one nursing home, Claesson 1998 studied 1854 residents in 33 nursing homes, Crotty 2004a studied 154 residents in 10 high-level residential facilities, Crotty 2004b studied 110 residents in 85 long-term care facilities, Furniss 2000 studied 330 residents in 14 nursing homes, Gurwitz 2008 studied 1118 residents in 29 units in two long-term care facilities, Roberts 2001 studied 3230 residents in 52 nursing homes and Zermansky 2006 studied 661 residents in 65 nursing and residential homes for older people.

## Interventions

The interventions evaluated were diverse and often multifaceted. Medication review (conducted by various methods) was a component of seven studies (Strikwerda 1994; Claesson 1998; Furniss 2000; Roberts 2001; Crotty 2004a; Crotty 2004b; Zermansky 2006). Three studies involved multidisciplinary case-conferencing (Claesson 1998; Crotty 2004a; Crotty 2004b) and two studies involved an educational element for care home staff (Roberts 2001; Crotty 2004a). One study evaluated the use of clinical decision support technology (Gurwitz 2008). Other components of interventions included introducing a new professional role to stakeholders (Roberts 2001) and the [transfer of medicines infor-](#)

mation (Crotty 2004b). Further descriptions of interventions are presented below.

Strikwerda 1994 evaluated the effect of community pharmacist feedback to GPs on their patients' prescriptions over a four week period.

Claesson 1998 evaluated the effectiveness of monthly multidisciplinary team meetings between the physician, pharmacist and nurse(s) over 12 months. The aim of the meetings was to discuss and improve the use of drugs. Pharmacists received a total of 65.5 hours of education and training prior to and during the intervention period.

Furniss 2000 investigated the effectiveness of pharmacist-conducted medication review (in addition to usual care by the GP) versus usual care by the GP. The intervention was a single medication review conducted by one pharmacist with access to medical and nursing home records. No details were provided on the education and training of the pharmacist.

The intervention evaluated by Roberts 2001 had three components: (i) introducing a new professional role and relationship building; (ii) nurse education; (iii) medication review by pharmacists holding a postgraduate diploma in clinical pharmacy. Medication reviews were undertaken for a non-random subsample of 500 residents (total intervention residents 905) selected by nursing staff. Most of the contact between pharmacists and GPs was indirect.

Crotty 2004a evaluated the effectiveness of an 'outreach medication advisory service'. This involved a medication review prepared by the pharmacist, followed by two multidisciplinary case conferences held six to 12 weeks apart (with the GP, geriatrician, pharmacist, care staff and an Alzheimer's Association of South Australia representative). No details were provided on the education and training of the pharmacist.

Crotty 2004b investigated the effectiveness of a pharmacist transition co-ordinator for residents who were being discharged from hospital to a long-term care facility. The intervention focused on the transfer of medicines information to the nursing home staff, GP and the community pharmacist. Following this, a medication review was conducted by the community pharmacist contracted to the care home. In addition, the transition pharmacist co-ordinated a multidisciplinary case conference 14 to 28 days after transfer involving him or herself, the GP, community pharmacist and a nurse.

Zermansky 2006 evaluated the effectiveness of a clinical medication review (in addition to usual care by the GP) undertaken by a pharmacist who held a post-graduate clinical pharmacy qualification versus usual care by the GP. The pharmacist reviewed the medicines with the medical and care home records in conjunction with a consultation with the resident (if possible) and a nurse or carer.

The intervention investigated by [Gurwitz 2008](#) was a clinical decision support system in facilities that had computerised provider order entry systems. The clinical decision support system was designed based on previous research on preventable adverse drug events, criteria for suboptimal prescribing in older people and drug-drug interactions. Warning messages were displayed to prescribers in a pop-up box in real time when medicines were entered into the computer provider order entry system. Prescribers were free to either act on alerts or ignore them.

### Outcomes

Outcomes were diverse with differing definitions, methods of data collection, varying time points and different reporting methods. Studies reported measures other than those specified for this review and these are listed in the [Characteristics of included studies](#) tables.

### Primary outcome measures

#### *Adverse drug events*

Only two studies specified adverse drug events as an outcome measure ([Crotty 2004b](#); [Gurwitz 2008](#)). However, [Crotty 2004b](#) did not define adverse drug events. Adverse drug events were the primary outcome measure in the [Gurwitz 2008](#) study and were defined as 'an injury resulting from the use of a drug'; such adverse drug events may have resulted from medication errors or from adverse drug reactions in which there was no error.

#### *Hospital admissions*

Four studies included hospital admissions as an outcome measure ([Furniss 2000](#); [Roberts 2001](#); [Crotty 2004b](#); [Zermansky 2006](#)). [Furniss 2000](#) reported hospital admissions as the number of inpatient days. [Roberts 2001](#) reported the proportion of residents hospitalised and [Zermansky 2006](#) reported the mean number of non-elective hospitalisations per resident. [Crotty 2004b](#) grouped together emergency department visits and hospital readmissions.

#### *Mortality*

Three studies included mortality as an outcome measure ([Furniss 2000](#); [Roberts 2001](#); [Zermansky 2006](#)). [Furniss 2000](#) and [Zermansky 2006](#) reported mortality as the number of deaths over eight and six months, respectively. [Roberts 2001](#) reported the proportion of residents who had died over 12 months together with cumulative survival.

### Secondary outcome measures

#### *Quality of life*

No studies measured quality of life.

#### *Medication-related problems*

Medication-related problems were measured and classified in diverse ways in six studies. [Strikwerda 1994](#) reported the number of pharmacists' recommendations and described their type. [Claesson 1998](#) described the type and frequency of drug-related problems along with pharmacists' recommendations. [Furniss 2000](#) measured the number of pharmacist's recommendations, accepted recommendations by the GP, and the number of treatment changes. Reasons were provided for the pharmacist's recommendations. [Roberts 2001](#) measured the number of medicine changes likely to be due to medication review. [Crotty 2004b](#) identified medication-related problems and classified them into categories. [Zermansky 2006](#) measured the number of changes in medication per participant as the primary outcome; pharmacist's recommendations were identified, collated and classified along with GPs' acceptance of the recommendations.

#### *Medication appropriateness*

Two studies assessed medication appropriateness using a validated tool ([Crotty 2004a](#); [Crotty 2004b](#)). Both studies used the Medication Appropriateness Index (MAI) ([Hanlon 1992](#)).

#### *Medicine costs*

Four studies calculated medicine costs ([Furniss 2000](#); [Roberts 2001](#); [Crotty 2004a](#); [Zermansky 2006](#)). [Furniss 2000](#) calculated drug costs per resident throughout the observation and intervention phases of the study. [Roberts 2001](#) collected yearly drug costs from prescription claims data based on the Australian Pharmaceutical Benefits Scheme. [Crotty 2004a](#) calculated monthly drug costs for all regular medicines based on the Australian Pharmaceutical Benefits Scheme. [Zermansky 2006](#) calculated the 28 day net ingredient cost of repeat medicines per resident.

### Excluded studies

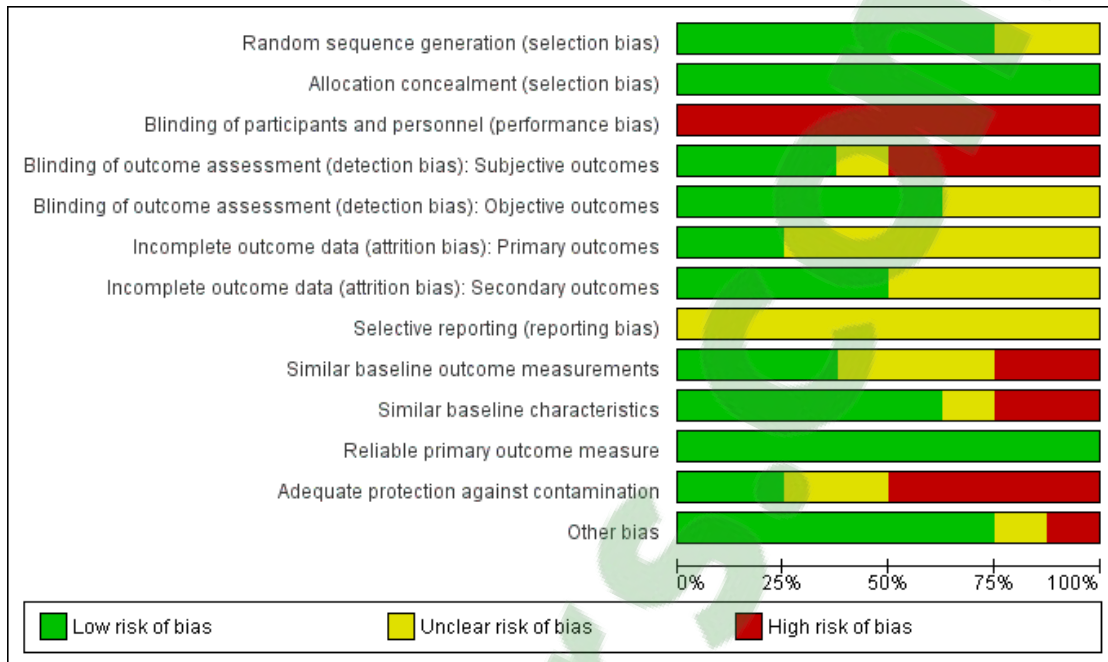
None reported.

### Risk of bias in included studies

Studies were heterogeneous with regard to risk of bias (see [Figure 2](#); [Figure 3](#)). Risk of bias is summarised below for each domain.



**Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.**



**Figure 3. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.**

|                 | Random sequence generation (selection bias) | Allocation concealment (selection bias) | Blinding of participants and personnel (performance bias) | Blinding of outcome assessment (detection bias): Subjective outcomes | Blinding of outcome assessment (detection bias): Objective outcomes | Incomplete outcome data (attrition bias): Primary outcomes | Incomplete outcome data (attrition bias): Secondary outcomes | Selective reporting (reporting bias) | Similar baseline outcome measurements | Similar baseline characteristics | Reliable primary outcome measure | Adequate protection against contamination | Other bias |
|-----------------|---|---|---|--|---|--|--|--------------------------------------|---------------------------------------|----------------------------------|----------------------------------|---|------------|
| Claesson 1998   | ?   | +                                       | -   | -  | ?   | ?  | +  | ?                                    | ?                                     | +                                | +                                | ?   | +          |
| Crotty 2004a    | +   | +                                       | -   | +  | +   | ?  | +  | ?                                    | -                                     | +                                | +                                | +   | +          |
| Crotty 2004b    | +   | +                                       | -   | +  | +   | +  | +  | ?                                    | +                                     | +                                | +                                | -   | +          |
| Furniss 2000    | +   | +                                       | -   | -  | +   | ?  | ?  | ?                                    | -                                     | -                                | +                                | +   | +          |
| Gurwitz 2008    | +   | +                                       | -   | +  | ?   | ?  | ?  | ?                                    | ?                                     | ?                                | +                                | -   | +          |
| Roberts 2001    | +   | +                                       | -   | -  | +   | ?  | ?  | ?                                    | +                                     | +                                | +                                | ?   | -          |
| Strikwerda 1994 | ?   | +                                       | -   | ?  | ?   | ?  | ?  | ?                                    | ?                                     | -                                | +                                | -   | +          |
| Zermansky 2006  | +   | +                                       | -   | -  | +   | +  | +  | ?                                    | +                                     | +                                | +                                | -   | ?          |

## Allocation

Six studies were judged to have a low risk of bias based on random sequence generation (Furniss 2000; Roberts 2001; Crotty 2004a; Crotty 2004b; Zermansky 2006; Gurwitz 2008). The studies by Strikwerda 1994 and Claesson 1998 did not report how the sequence was generated. Four studies utilised computer-generated random or pseudo-random numbers (Furniss 2000; Crotty 2004a; Crotty 2004b; Zermansky 2006) and Roberts 2001 drew from a hat. Allocation was adequately concealed via centralisation in both of the P-RCTs (Crotty 2004b; Zermansky 2006). Due to the remaining six studies having a cluster design, they were deemed to be at low risk of bias with regard to allocation concealment (Strikwerda 1994; Claesson 1998; Furniss 2000; Roberts 2001; Crotty 2004a; Gurwitz 2008).

## Blinding

Due to the nature of the interventions it was not possible to blind participants and personnel in any of the studies and, therefore, performance bias was judged to be high for each study. Three studies blinded outcome assessment for subjective outcomes (Crotty 2004a; Crotty 2004b; Gurwitz 2008) and, therefore, detection bias for these outcomes was low for these studies and high for the remainder. Detection bias was deemed to be low for objective outcomes for studies that reported them.

## Incomplete outcome data

Three studies were deemed at low risk of attrition bias as they reported similar baseline characteristics with a similar number of dropouts for similar reasons (Crotty 2004a; Crotty 2004b; Zermansky 2006). The only outcome in the Claesson 1998 study was a description of medicine-related problems in the intervention group and attrition bias was not relevant. The risk of attrition bias was unclear for four studies due to a lack of information (Strikwerda 1994; Furniss 2000; Roberts 2001; Gurwitz 2008).

## Selective reporting

Although there was no evidence of selective reporting in the studies, that is all outcome measures stated in the methods were reported, research protocols were not available and, therefore, there was insufficient information to permit judgement.

## Other potential sources of bias

## Similar baseline outcome measurements

Three studies (Roberts 2001; Crotty 2004b; Zermansky 2006) were deemed at low risk of bias as baseline outcome measurements were similar. Furniss 2000 was judged to be at high risk of bias because there were fewer deaths in the control group compared with the intervention group. Crotty 2004a was also judged to be at a high risk of bias because of baseline differences in the Medication Appropriateness Index. The three remaining studies were deemed to be at an unclear risk of bias as outcomes were not measured at baseline (Strikwerda 1994; Claesson 1998; Gurwitz 2008).

## Similar baseline characteristics

Five studies reported similar baseline characteristics and were judged to be at low risk of bias (Claesson 1998; Roberts 2001; Crotty 2004a; Crotty 2004b; Zermansky 2006). The study by Strikwerda 1994 reported fewer males in group A and fewer medicines in group B compared to group C and was judged to be at high risk. The study by Furniss 2000 was deemed to be at high risk because in the control group the residents were younger and there were fewer females. Gurwitz 2008 was deemed to be at unclear risk because baseline characteristics of residents were not reported (although units were matched for general characteristics, bed size and general characteristics of residents).

## Reliable primary outcome measure

All eight studies were deemed to have reliable primary outcome measures (although not all the outcome measures were included in this review).

## Adequate protection against contamination

Two studies that were of a cluster design were assessed to be at an unclear risk of adequate protection against contamination because although they were randomised by care home it was unclear whether a GP may have serviced both intervention and control homes (Claesson 1998; Roberts 2001). The study by Crotty 2004a was deemed to be at low risk of contamination because in addition to the cluster design the GPs were checked to avoid contamination between intervention and control residents. The study by Strikwerda 1994 was at high risk because although residents were randomised by GP they all resided in the same nursing home. Furniss 2000 randomised care homes in different geographical areas and was therefore deemed at low risk of contamination. Gurwitz 2008 attempted to limit the crossover of prescribers between intervention and control units, however some prescribers worked simultaneously on both units and consequently the trial was judged to be at high risk of contamination. The two studies that were P-RCTs were deemed to be at high risk as contamination was possible (Crotty 2004b; Zermansky 2006).

## Effects of interventions

See: [Summary of findings for the main comparison](#)

Due to the heterogeneity in interventions, outcomes and risk of bias, it was deemed inappropriate to conduct a meta-analysis. The effectiveness of the interventions are described below.

### Primary outcome measures

#### Adverse drug events

[Crotty 2004b](#) found no evidence of an effect of a pharmacist transition coordinator on adverse drug events (relative risk 1.05, 95% CI 0.66 to 1.68). [Gurwitz 2008](#) tested a clinical decision support system and found no evidence of an effect on all adverse drug events (adjusted rate ratio 1.06, 95% CI 0.92 to 1.23) or preventable adverse drug events (adjusted rate ratio 1.02, 95% CI 0.81 to 1.30).

#### Hospital admissions

[Furniss 2000](#) found fewer inpatient days per resident in the intervention group compared with the control group during the four month intervention phase of the study (0.55 versus 1.26); however, small numbers precluded statistical analysis. In the [Roberts 2001](#) study, no statistically significant difference was found in the mean proportion of residents hospitalised between the intervention and control groups. [Crotty 2004b](#) demonstrated a reduction in the combination of emergency room visits and hospital readmissions with a relative risk ratio of 0.38 (95% CI 0.15 to 0.99) when analysing residents who were alive at follow-up. When residents who had died were included, there was no evidence of an effect on hospital admissions (relative risk 0.58, 95% CI 0.28 to 1.21). [Zermansky 2006](#) showed no evidence of an effect on the mean number of hospitalisations per resident (relative risk 0.75, 95% CI 0.52 to 1.07).

#### Mortality

[Furniss 2000](#) found fewer deaths in the intervention group compared with the control group during the intervention phase of the study (4 versus 14,  $P = 0.028$ ); however when the observation phase of the study was taken into account, the number of deaths in the control and intervention groups were 28 and 26 ( $P$  value not reported), respectively. In the [Roberts 2001](#) study, no statistically significant difference was found in the mean proportion of residents who had died between the intervention and control groups. A survival analysis found a hazard ratio of 0.85 (95% CI 0.75 to 0.96) in favour of the intervention group when analysed by individual residents; however after accounting for the clustering effect this was no longer statistically significant (hazard ratio 0.85, 95% CI 0.68 to 1.06). [Zermansky 2006](#) showed no evidence of

an effect on the number of deaths (relative risk 1.06, 95% CI 0.70 to 1.64).

### Secondary outcome measures

#### Quality of life

No studies evaluated the effect of interventions on this outcome.

#### Medication-related problems

[Strikwerda 1994](#) reported that 122 potential medication-related problems were identified in 61 residents. As a result, nine medicines were discontinued and four medicines had a dose reduction. The most common medication-related problem was a potential interaction (51, 42%), followed by dose (31, 25%), indication (23, 19%) and duration of the prescription (17, 14%).

[Claesson 1998](#) identified 819 drug-related problems in 395 residents (2.1 per resident). The most common problem was 'choice of drug' (348, 43%), with the majority of these being inappropriate according to Swedish Medical Product Agency guidelines. Two hundred and seventy-six (34%) problems were due to 'unclear indication' whereby the team did not know why a drug had been prescribed or the drug had not been adequately re-evaluated. Ninety per cent (737) of the problems discussed were acted upon, with 368 (45%) resulting in stopping the medicine and 162 (20%) led to a change of medicine. Five hundred and thirty-two medicine changes were evaluated with 404 (76%) still in place after a month, 59 (11%) discontinued and previous therapy room restored, and 69 (13%) were difficult to evaluate as partial changes had occurred.

[Furniss 2000](#) made 261 recommendations of which 239 (92%) were accepted by the GP. This resulted in 144 actual treatment changes. Thirty residents did not require a change in therapy, and the mean number of recommendations per resident (for those who needed at least one recommendation) was 2.46 (range 0 to 7). The most common reasons for recommendations were 'indication for the medication no longer present' (85, 33%) and 'safer or more efficacious use of drug' (77, 30%).

[Roberts 2001](#) followed up 137 of the 500 medication reviews conducted and found that 54 (39%) of the residents had changes likely to be due to the review. No further information was provided.

[Crotty 2004b](#) identified medicine-related problems at admission to the long-term care facility for intervention and control residents. The most common issue classified as a medicine-related problem by the authors was that a resident had been appointed a new physician. The next most common problems identified were: discrepancy between medication discharge summary and medication (32, 57% intervention; 26, 48% control); precaution with use (18, 32% intervention; 14, 26% control); no indication for medication (18, 32% intervention; 8, 15% control).

In the study by [Zermansky 2006](#), at least one recommendation was made in 256 (77%, 95% CI 73.1 to 81.7) residents, with a mean of 2.3 recommendations per resident. Six hundred and seventy-two medication-related recommendations were made along with an additional 75 recommendations related to the residents' conditions. The most common recommendation was technical (for example generic switching, amending quantities, removing discontinued items from the repeat prescription) with 225 (30%) recommendations. Following technical reasons, the most common recommendations were to conduct a test to monitor therapy (161, 22%) and to stop a medicine (100, 13%). The GP accepted 565 (76%) of the pharmacist's recommendations and rejected 52 (7%); there was no response to the review or the resident died before the review could be actioned in the remaining cases. The GP actioned 433 (77%) of the accepted recommendations.

### Medication appropriateness

[Crotty 2004a](#) found that, based on the Medication Appropriateness Index (MAI), medication appropriateness improved in the intervention group (MAI mean change 4.1, 95% CI 2.1 to 6.1) compared with the control group (MAI mean change 0.4, 95% CI -0.4 to 1.2). MAI scores were higher at baseline for intervention group residents compared with control residents (mean MAI 7.4, 95% CI 4.5 to 10.3 versus 4.1, 95% CI 2.4 to 5.7). There were no baseline differences in mean MAI scores between the control (3.7, 95% CI 2.2 to 5.2) and intervention groups (3.2, 95% CI 1.8 to 4.6) in the [Crotty 2004b](#) study. Following the intervention, there was no change in MAI in the intervention group (2.5, 95% CI 1.4 to 3.7) whereas the MAI in the control group had worsened (6.5, 95% CI 3.9 to 9.1). The difference in MAI scores at follow-up was statistically significant ( $P = 0.007$ ). The effect of the intervention on MAI scores remained significant when controlled for baseline MAI, Charlson Comorbidity Index and the number of drugs discontinued during hospital admission.

### Medicine costs

The cost of medicines per resident in the observation phase of the [Furniss](#) study was £142.53 in the control group and £159.01 in the intervention group ([Furniss 2000](#)). Following the intervention phase, costs were £141.24 in the control group versus £131.54 in the intervention group, representing a reduction in medicine costs of £27.47 per resident over a four month period. Accounting for the pharmacist's time, the cost saving on medicines in the intervention group was calculated to be £22/resident. [Roberts 2001](#) calculated a drug cost saving of \$AU64 per resident per year in the intervention group compared to the control group. When the cost of the intervention was accounted for, the net cost saving was \$AU16 per resident per year. [Crotty 2004a](#) found no statistically significant difference in mean medicine costs per month per resident between the intervention and control groups

(mean change \$AU5.72 intervention versus \$AU3.37 control,  $P = 0.837$ ). [Zermansky 2006](#) found no evidence of an effect of the intervention on the cost of 28 days repeat medicines per resident (mean difference £ -0.70, 95% CI £-7.28 to £5.71).

## DISCUSSION

### Summary of main results

Eight studies were included in the review and one ongoing study. There was no evidence of an effect of the interventions on any of the primary outcomes of the review that is adverse drug events ([Crotty 2004b](#); [Gurwitz 2008](#)), hospital admissions ([Furniss 2000](#); [Roberts 2001](#); [Crotty 2004b](#); [Zermansky 2006](#)) and mortality ([Furniss 2000](#); [Roberts 2001](#); [Zermansky 2006](#)). No studies included quality of life measures. There was evidence that the interventions led to the identification and resolution of medication-related problems ([Strikwerda 1994](#); [Claesson 1998](#); [Furniss 2000](#); [Roberts 2001](#); [Crotty 2004b](#); [Zermansky 2006](#)). There was evidence from two studies that medication appropriateness was improved ([Crotty 2004a](#); [Crotty 2004b](#)). However, the link between improved medication appropriateness based on the Medication Appropriateness Index and patient-related outcomes is not clear. The evidence for an effect on medicine costs was equivocal with two studies finding a reduction in costs ([Furniss 2000](#); [Roberts 2001](#)) and two studies finding no difference ([Crotty 2004a](#); [Zermansky 2006](#)).

### Overall completeness and applicability of evidence

The review was designed to identify interventions that considered residents' whole medication regimens to optimise prescribing. Consequently, a broad range of interventions (professional and organisational) were eligible for the review and diverse, multifaceted interventions were ultimately implemented to address the objectives of the review.

The interventions were tested in the population of interest; however, there was considerable variability in the outcomes measured with quality of life not represented in any of the included studies. Current practice varies considerably internationally. However, multidisciplinary teams (involving physicians, nurses and pharmacists) play a significant role in optimising prescribing for care home residents and this was reflected in the studies; the majority of interventions involved multidisciplinary teamworking, usually with pharmacists conducting medication reviews. However, the effectiveness of this has not been demonstrated. Information and communication technology is increasingly being employed to optimise prescribing in many settings, and one study tested the impact of a clinical decision support system ([Gurwitz 2008](#)).

## Quality of the evidence

Robust conclusions cannot be drawn from the evidence due to variability in design, interventions, outcomes and results. The review included eight studies of varying quality that included 7653 residents living in 262 care homes in six countries. As medication review was the main intervention or a component of the intervention in seven out of the eight studies, the effects of medication review were summarised in the 'Summary of findings' table ([Summary of findings for the main comparison](#)). The overall quality of the evidence for the outcomes reported was low or very low. The majority of the included studies were cluster-RCTs and this was appropriate given the complex nature of interventions, the difficulty of blinding and the consequential threat of contamination. The patient-RCTs did not adequately protect against contamination and, therefore, the effects of the intervention may have potentially been diluted. Some of the studies had short follow-up periods, which may have potentially limited the detection of effects on outcomes. None of the studies blinded participants and personnel, however this was unlikely to have been achievable due to the nature of the interventions. The interventions tested were complex and multifaceted and none of the studies attempted to disentangle the 'black box' effect, that is to understand the effects of the contributing components. Not all the studies attempted blinding of assessment for subjective outcomes, and this could have been implemented. A major limitation of the evidence was the diversity of outcome measures and the fact that they differed in the way they were defined (if at all), collected and analysed.

## Potential biases in the review process

Bias was minimised when conducting this review by several methods. An extensive literature search was conducted which was guided by EPOC and the included studies from published systematic reviews were screened. Studies were not limited to those in the English language. Two review authors independently screened titles and abstracts, assessed studies for eligibility, evaluated risk of bias and extracted data.

## Agreements and disagreements with other studies or reviews

Five previously published systematic reviews ([Kaur 2009](#); [Ostini 2009](#); [Verrue 2009](#); [LaMantia 2010](#); [Loganathan 2011](#)) and one narrative review ([Markum 2010](#)) related to the objectives of this review were identified. No further studies were identified from these reviews and the conclusions were similar, that is mixed results were obtained from the several intervention types tested in heterogeneous studies.

## AUTHORS' CONCLUSIONS

### Implications for practice

The interventions implemented in the studies in this review led to the identification of medication-related problems, confirming that suboptimal prescribing is prevalent in this context. The majority of medication-related problems were resolved through the interventions employed. In addition, evidence from two studies suggested that the appropriateness of medication could be improved through multifaceted interventions involving medication review by pharmacists, transfer of information and multidisciplinary case conferencing. Despite the identification and resolution of medication-related problems, and improvements in medication appropriateness, there is a lack of evidence on how this translates to improvements in resident-related outcomes, namely adverse drug events, hospital admissions, mortality and quality of life. The effect of interventions on medicine costs was unclear, with two studies showing a reduction in costs and two studies showing no difference.

### Implications for research

High-quality, adequately powered RCTs, ideally using cluster designs, need to be conducted to identify effective interventions to optimise prescribing for older care home residents. More studies are needed to investigate the effectiveness of clinical decision support systems as well as multidisciplinary interventions in this context. Further work is required to develop consensus on identifying, defining, measuring, reporting and analysing important resident-related outcomes, including quality of life. This will enable meta-analyses to be conducted on future RCTs.

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\* Indicates the major publication for the study

## CHARACTERISTICS OF STUDIES

### Characteristics of included studies [ordered by study ID]

#### Claesson 1998

|                     |  |
|---------------------|--|
| Methods             | Cluster-RCT (randomised by nursing home)<br>Total study duration: 14 months  |
| Participants        | 1854 residents<br>33 nursing homes<br>Setting: nursing homes<br>Age: Average 83 years<br>Gender: Intervention 70% female; control 67% female<br>Country: Sweden<br>Date of study: 1994/95  |
| Interventions       | The aim of the regular multidisciplinary meetings was to discuss and improve the use of drugs in nursing homes, and to decrease the use of drugs which, according to the advice of the workshop arranged by the Swedish Medical Products Agency, could cause confusion and impaired memory. In group discussions, the physician, pharmacist, one or more of the nursing home nurses, and in many cases, one or more of the assistant nurses and nurse aides reviewed the drug use of all residents on a monthly basis over a period of one year. The length and frequency of the meetings were adjusted by the participants to local conditions. The therapy changes that were discussed were thus based on the physician's medical knowledge, the pharmacist's pharmaceutical knowledge, and the nurses' and other staff's knowledge about the patients' social and functional status. The selected pharmacists were educated prior to and during the intervention period. This education took the form of lectures and workshops, which took place on five occasions, twice before the intervention started and three times during the intervention period, for a total of 65.5 hours. The lectures were given by recognised experts, including clinical pharmacists, geriatricians, gerontologists, nurses and two community pharmacists with experience in nursing home consulting. Topics covered were gerontology/geriatrics (12.5 hours), drug use in the elderly (23.5 hours) and basic training in collaborative methods (18.5 hours). In addition, the pharmacists worked with patient cases in small groups, covering all the areas mentioned above (11 hours). In addition to the formal education, the pharmacists formed regional networks. The networking took place locally, whenever the pharmacist felt a need to have it. In order to make the networks constructive, the whole group was instructed by an educational specialist on one occasion |
| Outcomes            | Medication-related problems<br>Not used for this review:<br>Drug use   |
| Notes               | Supported by the National Corporation of Swedish Pharmacies and the Swedish Pharmaceutical Society   |
| <i>Risk of bias</i> |  |
| <b>Bias</b>         | <b>Authors' judgement</b> <b>Support for judgement</b>   |

**Clackson 1998** (Continued)

|   |              |   |
|---|--------------|---|
| Random sequence generation (selection bias)                               | Unclear risk | Homes were matched in pairs then each randomised to control or intervention. [Attempted to contact author for further information but unsuccessful] |
| Allocation concealment (selection bias)                                   | Low risk     | Cluster design  |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk    | Blinding not conducted  |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | High risk    | Blinding not conducted  |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Unclear risk | No objective outcomes   |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Unclear risk | Not measured in this study  |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Low risk     | Medication-related problems described for residents receiving intervention  |
| Selective reporting (reporting bias)                                      | Unclear risk | Insufficient information to permit judgement  |
| Similar baseline outcome measurements                                     | Unclear risk | Medication-related problems not measured at baseline  |
| Similar baseline characteristics  | Low risk     | Similar baseline characteristics reported   |
| Reliable primary outcome measure  | Low risk     | Drug use  |
| Adequate protection against contamination                                 | Unclear risk | Cluster design. [Attempted to contact author for further information but unsuccessful]  |
| Other bias  | Low risk     | Appears to be free of other sources of bias   |

**Crotty 2004a**

|               |   |
|---------------|---|
| Methods       | Cluster-RCT (randomised by care facility)<br>Total study duration: 3 months   |
| Participants  | 10 facilities (5 intervention, 5 control). 154 residents (50 intervention, 54 control, 50 within-facility control)<br>Setting: High-level residential aged-care facilities (nursing homes)<br>Age: Intervention mean 85.3, control mean 83.6, within-facility control mean 84.6<br>Gender: Intervention male 22 (44%), control male 23 (43%), within-facility control male 17 (34%)<br>Country: Australia<br>Date of Study: 1999 [Author contacted]   |
| Interventions | Outreach geriatric medication advisory service, case conferencing and medication review<br>GPs were invited to attend two multidisciplinary case conferences conducted 6-12 weeks apart. The resident's GP, a geriatrician, a pharmacist, residential care staff and a representative of the Alzheimer's Association of South Australia attended the case conferences, which were held at the facility. Residential care staff expanded on any issues in the case notes that required discussion and the Alzheimer's Association of South Australia representative discussed non-pharmacological management of dementia-related behaviour. Each case conference was chaired by the GP, who used their medical records in addition to case notes from the facility. A problem list was developed by the GP in conjunction with the care staff and a medication review was conducted prior to each case conference. All facilities in the study, including those in the control group, received a half-day workshop provided by the Alzheimer's Association of South Australia, which examined the use of a toolkit in the management of challenging behaviours |
| Outcomes      | Measured at baseline and three months post-intervention:<br>Medication appropriateness (MAI)<br>Drug costs (based on Australian Government Pharmaceutical Benefits Scheme)<br>Not used in this review:<br>Nursing Home Behaviour Problem Scale (NHBPS)<br>Number of drugs   |
| Notes         | Funded by The Quality Use of Medicines Evaluation Programme 2000-2001, Health and Aged Care, General Practice National Innovations Funding Pool 1999-2000, Health and Aged Care   |

***Risk of bias***

| Bias  | Authors' judgement | Support for judgement   |
|---|--------------------|---|
| Random sequence generation (selection bias) | Low risk           | Computer-generated random numbers used  |
| Allocation concealment (selection bias)     | Low risk           | A researcher independent to the investigators generated the random sequence and cluster design. Staff were asked to "nominate" 20 residents from intervention sites and 10 residents from control sites. From |

|   |              |   |
|---|--------------|---|
|   |              | the 20 intervention, 10 were randomised to intervention and ten to within-facility control using sequential sealed opaque envelopes   |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk    | No blinding conducted   |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | Low risk     | Assessed by independent pharmacist blinded to allocation [author contacted]   |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Low risk     | No blinding conducted, however outcomes not likely to be influenced by lack of blinding   |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Unclear risk | Not measured in this study  |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Low risk     | Reasons for attrition reported (all due to deaths) and no statistically significant difference found in the proportion of residents lost between groups. Described as intention-to-treat analysis by authors  |
| Selective reporting (reporting bias)                                      | Unclear risk | Insufficient information to permit judgement  |
| Similar baseline outcome measurements                                     | High risk    | There were differences in the Medication Appropriateness Index between groups at baseline: Control 4.1 (95% CI 2.4-5.7); Within-facility control 6.0 (95% CI 3.1-9.0); Intervention 7.4 (95% CI 4.5-10.3)   |
| Similar baseline characteristics  | Low risk     | Similar baseline characteristics reported   |
| Reliable primary outcome measure  | Low risk     | Medication Appropriateness Index  |
| Adequate protection against contamination                                 | Low risk     | Cluster design. Randomised by care facility. GPs were checked to avoid contamination between intervention and control residents [author contacted]. No significant differences found between the within-facility control and the control groups, therefore no evidence of a carry-over effect of the intervention |

**Crotty 2004a** (Continued)

|            |          |   |
|------------|----------|---|
| Other bias | Low risk | Appears to be free of other sources of bias |
|------------|----------|---|

**Crotty 2004b**

|               |  |
|---------------|--|
| Methods       | RCT (randomised by patient)<br>Total study duration: 8 weeks   |
| Participants  | 110 patients (56 intervention, 54 control) from three hospitals discharged to 85 long-term facilities<br>Setting: Long-term care facilities<br>Age: Mean 82.7, s.d. 6.4<br>Gender: 67 women (60.9%), 43 men (39.1%)<br>Country: Australia<br>Date of study: October 2002 to July 2003  |
| Interventions | Pharmacist transition coordinator.<br>The intervention focused on transferring information on medications to care providers in the long-term care facilities, including the nursing staff, the family physician and the accredited community pharmacist. On the patient's discharge from the hospital to the long-term care facility both the family physician and the community pharmacist were faxed a medication transfer summary compiled by the transition pharmacist and signed by the hospital medical officer. This communication supplemented the usual hospital discharge summary and included specific information on changes to medications that had been made in the hospital and aspects of medication management that required monitoring<br>After transfer of the patient to the long-term care facility, the transition pharmacist coordinated an evidence-based medication review that was to be performed by the community pharmacist contracted to the facility within 10 to 14 days of the transfer. The transition pharmacist also coordinated a case conference involving him or herself, the family physician, the community pharmacist and a registered nurse at the facility within 14 to 28 days of the transfer. At this case conference, the transition pharmacist provided information concerning medication use and appropriateness<br>The usual hospital discharge process received by the control group included a standard hospital discharge summary. |
| Outcomes      | Measured at baseline and eight weeks post-discharge:<br>Adverse drug events (not defined)<br>Hospital admissions (emergency department visits and hospital readmissions)<br>Medication-related problems<br>Medication appropriateness (MAI)<br>Not used for this review:<br>Falls<br>Worsening mobility<br>Worsening behaviours<br>Increased confusion<br>Worsening pain   |

|   |  |  |
|---|--|--|
| Notes   | Funded by the Australian Commonwealth Department Of Health and Ageing National Demonstration Hospitals Program |  |
| <b>Risk of bias</b>   |  |  |
| <b>Bias</b>   | <b>Authors' judgement</b>  | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                               | Low risk   | Study biostatistician provided a computer-generated allocation sequence using block randomisation  |
| Allocation concealment (selection bias)                                   | Low risk   | Randomisation was coordinated by a centralised hospital pharmacy service   |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk  | No blinding conducted  |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | Low risk   | Independent pharmacists blinded to allocation assessed Medication Appropriateness Index (MAI)  |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Low risk   | No blinding conducted, however outcomes not likely to be influenced by lack of blinding  |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Low risk   | Similar attrition in both groups with similar reasons for dropouts. Described as intention-to-treat by authors                           |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Low risk   | Similar attrition in both groups with similar reasons for dropouts. Described as intention-to-treat by authors                           |
| Selective reporting (reporting bias)                                      | Unclear risk   | Insufficient information to permit judgement   |
| Similar baseline outcome measurements                                     | Low risk   | Similar Medication Appropriateness Index scores at baseline. Other outcomes not measured at baseline                                     |
| Similar baseline characteristics  | Low risk   | Similar baseline characteristics reported except more pre-admission medications discontinued during hospitalisation in the control group |
| Reliable primary outcome measure  | Low risk   | Medication Appropriateness Index   |

**Crotty 2004b** (Continued)

|   |           |  |
|---|-----------|--|
| Adequate protection against contamination | High risk | Randomised by patient therefore contamination possible |
| Other bias                                | Low risk  | Appears to be free of other sources of bias            |

**Furniss 2000**

|               |   |
|---------------|---|
| Methods       | Cluster-RCT (randomised by care home)<br>Total study duration: 8 months   |
| Participants  | 330 residents (172 control, 158 intervention); 14 homes (7 matched pairs)<br>Setting: Nursing homes<br>Age: Control mean 78.9 sd 13.7; intervention mean 83.5 sd 9.2<br>Gender: Control 115 (67%) females; intervention 125 (79%) females<br>Country: UK<br>Date of study: Not stated   |
| Interventions | Medication review by pharmacist<br>Medication review by the study pharmacist in the GP's surgery, at the nursing home or (in exceptional circumstances) over the telephone. The pharmacist collected details of current medication for each resident from the medicines administration record chart in the home, together with a brief medical history and any current problems identified by the home staff. Three weeks after the medication review, the homes were revisited, to ascertain whether there had been any immediate problems with the changes in medication and to see if the suggested changes have been implemented  |
| Outcomes      | Measured at time 0 (beginning of study), time 1 at four months (beginning of intervention) and at time 2 at eight months (end of intervention):<br>Hospital admissions ("inpatient days")<br>Mortality<br>Medication-related problems (number of pharmacist recommendations, acceptance of recommendations by the GP, number of treatment changes)<br>Medication costs (not defined, £ sterling)<br>Not used for this review:<br>Mini-Mental State Examination (MMSE)<br>Geriatric Depression Scale (GDS)<br>Brief Assessment Schedule Depression Cards (BASDEC)<br>Crichton-Royal Behaviour Rating Scale (CRBRS)<br>Number of drugs per resident<br>Type of drugs<br>Reason for neuroleptic use<br>Use of primary and secondary care resources<br>Number of accidents<br>Falls |
| Notes         | Funded by the North West NHS Executive  |

***Risk of bias***



| Bias  | Authors' judgement | Support for judgement   |
|---|--------------------|---|
| Random sequence generation (selection bias)                               | Low risk           | Computer-generated pseudo random numbers used   |
| Allocation concealment (selection bias)                                   | Low risk           | Homes were randomised at the start of the start of a four-month observation phase. Cluster design   |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk          | No blinding described   |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | High risk          | No blinding conducted   |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Low risk           | No blinding conducted, however outcomes not likely to be influenced by lack of blinding   |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Unclear risk       | Insufficient reporting of attrition/exclusions to permit judgement  |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Unclear risk       | Insufficient reporting of attrition/exclusions to permit judgement  |
| Selective reporting (reporting bias)                                      | Unclear risk       | Insufficient information to permit judgement  |
| Similar baseline outcome measurements                                     | High risk          | 14 (8.1%) deaths in control group versus 22 (13.9%) deaths in intervention group at baseline. No baseline measurements of other primary outcomes of this review   |
| Similar baseline characteristics  | High risk          | Slightly fewer residents in the intervention group (158) versus control (172). In the control group, residents were younger (mean 78.9 s.d. 13.7 versus mean 83.5 s.d. 9.2) and there were fewer females (67% versus 79%) |
| Reliable primary outcome measure  | Low risk           | Crichton-Royal Behaviour Rating Scale   |
| Adequate protection against contamination                                 | Low risk           | Randomised by care home (which were in different geographical areas)  |

**Furniss 2000** (Continued)

|            |          |   |
|------------|----------|---|
| Other bias | Low risk | Appears to be free of other sources of bias |
|------------|----------|---|

**Gurwitz 2008**

|               |   |  |
|---------------|---|--|
| Methods       | Cluster-RCT (randomised by care unit within two long-term care facilities)<br>Total study duration: 12 months   |  |
| Participants  | 1,118 resident in 29 units in two long-term care facilities<br>Setting: Long-term care facilities<br>Age: Average 87.2 years<br>Gender: 71.3% female<br>Country: US and Canada<br>Date of study: 2006-7 [Author contacted]  |  |
| Interventions | Computerised provider order entry with clinical decision support<br>A team of geriatricians, pharmacists, health services researchers and information system specialists designed the clinical decision support system<br>The team reviewed the types of preventable adverse drug events based on previous research and widely accepted published criteria for suboptimal prescribing in elderly people available at the time of this study. All serious drug-drug interactions from a standard pharmaceutical drug interaction database were also reviewed and alerts were included for a limited number of more than 600 potentially serious interactions that were reviewed. For residents on the intervention units, the alerts were displayed in a pop-up box to prescribers in real time when a drug order was entered. The pop-up boxes were informational; they did not require specific actions from the prescriber and did not produce or revise orders automatically. On the control units, the alerts were not displayed to the prescribers |  |
| Outcomes      | Measured throughout study period (resident-months):<br>Adverse drug event (“an injury resulting from the use of a drug” includes medication error and adverse drug reaction)<br>Severity of adverse drug event<br>Preventability of adverse drug event  |  |
| Notes         | Supported by the Agency for Healthcare Research and Quality.  |  |

***Risk of bias***

| Bias  | Authors' judgement | Support for judgement   |
|---|--------------------|---|
| Random sequence generation (selection bias) | Low risk           | Block randomisation used. Within each block, units were randomly assigned using the random function in Microsoft Excel®. [Author contacted] |
| Allocation concealment (selection bias)     | Low risk           | Cluster design  |

|   |              |   |
|---|--------------|---|
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk    | Not conducted   |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | Low risk     | Outcome assessors were blind to allocation  |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Unclear risk | No objective outcomes   |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Unclear risk | Insufficient reporting of attrition/exclusions to permit judgement  |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Unclear risk | Not measured in this study  |
| Selective reporting (reporting bias)                                      | Unclear risk | Insufficient information to permit judgement  |
| Similar baseline outcome measurements                                     | Unclear risk | No baseline measurements of adverse drug effects  |
| Similar baseline characteristics  | Unclear risk | Baseline characteristics not reported, however, units were matched for bed size and general characteristics of residents and the unit   |
| Reliable primary outcome measure  | Low risk     | Number of adverse drug events   |
| Adequate protection against contamination                                 | High risk    | Cluster design. Efforts were made to limit crossover of prescribers between intervention and control units, however, some prescribers worked simultaneously on both intervention and control units. In an effort to assess the possibility that this may have led to changes in behaviour in the control group, the rate of responses to "unseen" alerts in the control units during the first versus the last quarter of the study was assessed at one of the study sites. The rate of response was lower in the last quarter, suggesting that prescribers did not adopt new habits due to seeing alerts on intervention units |
| Other bias  | Low risk     | Appears to be free of other sources of bias   |

**Roberts 2001**

|               |   |
|---------------|---|
| Methods       | Cluster-RCT (randomised by care home)<br>Total study duration: Two years  |
| Participants  | 3230 residents (905 intervention, 13 homes); 2325 control, 39 homes)<br>Setting: Nursing homes<br>Age:<br>Intervention <60 2.0%, 60-69 6.6%, 70-79 21.9%, 80-89 47.4%, 90-99 20.7%, ≥ 100 1.7%<br>Control <60 2.6%, 60-69 5.4%, 70-79 22.3%, 80-89 46.7%, 90-99 21.1%, ≥ 100 1.6%<br>Gender: Not reported<br>Country: Australia<br>Date of Study: Not reported  |
| Interventions | Three phase intervention: introducing a new professional role to stakeholders with relationship building; nurse education; and medication review by pharmacists.<br>The clinical pharmacy service model introduced to each nursing home was supported with activities such as focus groups facilitated by a research nurse, written and telephone communication, and face-to-face professional contact between nursing home staff and clinical pharmacists on issues such as drug policy and specific resident problems, together with education and medication review by pharmacists holding a postgraduate diploma in clinical pharmacy. This was a multifaceted intervention directly targeting nursing homes. Most of the contact with GPs was indirect, using the existing relationships between nursing homes and visiting GPs. A number of focus groups and personal interviews about the project were conducted with GPs. In intervention homes, problem-based education sessions (6±9 seminars totalling approximately 11 h per home) were provided to nurses. Sessions addressed basic geriatric pharmacology and some common problems in long-term care (depression, delirium and dementia, incontinence, falls, sleep disorders, constipation and pain). Sessions were supported by wall charts, bulletins, telephone calls and clinical pharmacy visits, averaging 26 h contact per home over the study. Written, referenced drug regimen reviews were prepared by the clinical pharmacists for 500 individual residents selected by the nursing home staff. The reviews highlighted the potential for: (1) adverse drug effects, (2) ceasing one or more drugs, (3) adding drugs, (4) better use of specific drug therapy, particularly psychoactive drugs, (5) nondrug interventions, and (6) adverse effect and drug response monitoring. Initial reports (61% of total) were audited by a geriatrician before dissemination. Reports were placed in each resident's nursing home records, made available to the resident's GP and discussed with nursing staff. Drugs commonly targeted in reviews and education sessions included laxatives, histamine H2-receptor antagonists, allopurinol, quinine, antibacterials, paracetamol, nonsteroidal anti-inflammatory drugs (NSAIDs) and psychoactive drugs |
| Outcomes      | Measured at baseline and 12 months post-intervention:<br>Hospital admissions (not defined)<br>Mortality (survival also assessed at 22 months)<br>Medication-related problems<br>Medication costs (per resident per year based on prescription claims data)<br>Not used for this review:<br>Adverse events (from incident reports)<br>Resident Classification Instrument (RCI)   |

**Roberts 2001** (Continued)

|   |  |  |
|---|--|--|
|   | Drug use   |  |
| Notes   | Supported by the Commonwealth Government of Australia under the Pharmaceutical Education Program |  |
| <b>Risk of bias</b>   |  |  |
| <b>Bias</b>   | <b>Authors' judgement</b>  | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                               | Low risk   | Homes were assigned to intervention or control by being "drawn from a hat"                                     |
| Allocation concealment (selection bias)                                   | Low risk   | Cluster design   |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk  | No blinding conducted  |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | High risk  | No blinding reported   |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Low risk   | No blinding reported, however outcomes not likely to be influenced by lack of blinding                         |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Unclear risk   | Insufficient reporting of attrition/exclusions to permit judgement   |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Unclear risk   | Insufficient reporting of attrition/exclusions to permit judgement   |
| Selective reporting (reporting bias)                                      | Unclear risk   | Insufficient information to permit judgement   |
| Similar baseline outcome measurements                                     | Low risk   | Slight imbalance in mortality and hospitalisations at baseline; however this was accounted for in the analysis |
| Similar baseline characteristics  | Low risk   | Similar baseline characteristics reported  |
| Reliable primary outcome measure  | Low risk   | Mortality and Resident Classification Instrument (RCI)   |
| Adequate protection against contamination                                 | Unclear risk   | Cluster design. [Attempted to contact author for further information but no response]                          |

**Roberts 2001** (Continued)

|            |           |   |
|------------|-----------|---|
| Other bias | High risk | Medication reviews were undertaken for a non-random subsample of 500 residents (total intervention residents 905) selected by nursing staff |
|------------|-----------|---|

**Strikwerda 1994**

|               |   |
|---------------|---|
| Methods       | RCT (randomised by GP)<br>Total study duration: 6 weeks   |
| Participants  | 196 residents<br>One nursing home<br>Age: mean 84.5 years (59-100)<br>Gender: 25% male<br>Country: Netherlands<br>Date of study: 1993   |
| Interventions | Feedback on GP prescribing from community pharmacist<br>Group A received usual care, group B GPs issued with a medication list used by their patients, group C GPs received a medication list plus feedback from community pharmacist |
| Outcomes      | Medication-related problems<br>Not used for this review: drug use   |
| Notes         |   |

***Risk of bias***

| <b>Bias</b>   | <b>Authors' judgement</b> | <b>Support for judgement</b>                 |
|---|---------------------------|--|
| Random sequence generation (selection bias)                               | Unclear risk              | Insufficient information to permit judgement |
| Allocation concealment (selection bias)                                   | Low risk                  | Cluster design                               |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk                 | No blinding conducted                        |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | Unclear risk              | Insufficient information to permit judgement |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Unclear risk              | Not measured in this study                   |

**Strikwerda 1994** (Continued)

|  |              |   |
|--|--------------|---|
| Incomplete outcome data (attrition bias)<br>Primary outcomes   | Unclear risk | Not measured in this study  |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes | Unclear risk | Insufficient information to permit judgement  |
| Selective reporting (reporting bias)                           | Unclear risk | Insufficient information to permit judgement  |
| Similar baseline outcome measurements                          | Unclear risk | No baseline measurements of medication-related problems   |
| Similar baseline characteristics                               | High risk    | Most baseline characteristics similar, however fewer males in group A and fewer medicines per resident in group B |
| Reliable primary outcome measure                               | Low risk     | Drug use  |
| Adequate protection against contamination                      | High risk    | Randomised by GP, however control and intervention residents resided in the same nursing home                     |
| Other bias   | Low risk     | Appears to be free of other sources of bias   |

**Zermansky 2006**

|               |  |
|---------------|--|
| Methods       | RCT (randomised by patient)<br>Total study duration: 6 months  |
| Participants  | 661 (331 intervention, 330 control) care home residents, 65 care homes<br>Setting: Nursing and residential homes for older people<br>Age: Intervention mean 85.3 (IQR 81-90); control mean 84.9 (IQR 80-90)<br>Gender: Intervention 75 (22.7%) male; control 79 (23.9%) male<br>Country: UK<br>Date of study: 2002   |
| Interventions | Medication review by a single pharmacist.<br>A clinical medication review was conducted by the study pharmacist who held a postgraduate qualification in clinical pharmacy within 28 days of randomisation. It comprised a review of the GP clinical record and a consultation with the resident and carer. The pharmacist formulated recommendations with the resident and carer and passed them on a written proforma to the GP for acceptance and implementation. GP acceptance was signified by ticking a box on the proforma. Control patients received usual GP care |
| Outcomes      | Measured at baseline and six months $\pm$ three weeks post-randomisation:<br>Hospital admissions (non-elective)<br>Mortality   |

|   |   |  |
|---|---|--|
|   | Medication-related problems<br>Medicine costs (cost of 28 days of repeat medicines per participant)<br>Not used for this review:<br>Number of changes in medicines per participant<br>Number of medicines per participant<br>Recorded medication reviews<br>Falls<br>SMMSE<br>Barthel index<br>Number of GP consultations |  |
| Notes   | Funded by The Health Foundation, 90 Long Acre, London WC2 9RA (Registered Charity Number 286967)  |  |
| <b>Risk of bias</b>   |   |  |
| <b>Bias</b>   | <b>Authors' judgement</b>   | <b>Support for judgement</b>   |
| Random sequence generation (selection bias)                               | Low risk  | Patients were randomised in randomly sized blocks of 2 to 8 patients using an algorithm written in Visual Basic in Microsoft Access    |
| Allocation concealment (selection bias)                                   | Low risk  | Not reported in paper. Allocation was concealed to the research pharmacist and nurse data collector by statistician [Author contacted] |
| Blinding of participants and personnel (performance bias)<br>All outcomes | High risk   | Open design, no blinding attempted   |
| Blinding of outcome assessment (detection bias)<br>Subjective outcomes    | High risk   | No blinding conducted  |
| Blinding of outcome assessment (detection bias)<br>Objective outcomes     | Low risk  | No blinding conducted, however outcomes not likely to be influenced by lack of blinding  |
| Incomplete outcome data (attrition bias)<br>Primary outcomes              | Low risk  | Similar attrition in both groups with similar reasons for dropouts. Described as intention-to-treat by authors                         |
| Incomplete outcome data (attrition bias)<br>Secondary outcomes            | Low risk  | Similar attrition in both groups with similar reasons for dropouts. Described as intention-to-treat by authors                         |



|   |              |   |
|---|--------------|---|
| Selective reporting (reporting bias)      | Unclear risk | Insufficient information to permit judgement  |
| Similar baseline outcome measurements     | Low risk     | Similar baseline measurements for hospital admissions and medicine costs  |
| Similar baseline characteristics          | Low risk     | Similar baseline characteristics reported   |
| Reliable primary outcome measure          | Low risk     | Number of changes in medication   |
| Adequate protection against contamination | High risk    | Randomised by patient therefore contamination possible  |
| Other bias                                | Unclear risk | Sample size calculation indicated that 1600 residents were required, however, only 661 residents were recruited |

### Characteristics of ongoing studies [ordered by study ID]

#### Desborough

|                     |  |
|---------------------|--|
| Trial name or title | Multi-professional clinical medication reviews in care homes for the elderly: study protocol for a randomised controlled trial with cost effectiveness analysis  |
| Methods             | Cluster RCT (randomised by care home)<br>Total Study Duration: 12 months   |
| Participants        | Residents of 30 care homes for older people (average age >65)  |
| Interventions       | Intervention homes will receive a multi-professional medication review at baseline and at 6 months, with follow-up at 12 months. Control homes will receive usual care (support they currently receive from the National Health Service), with data collection at baseline and 12 months   |
| Outcomes            | Emergency hospital admissions and Accident and Emergency (A&E) visits (number of admissions in six months per patient)<br>Mortality<br>Potentially inappropriate prescribing (number of drugs which match the STOPP criteria at each data collection point)<br>Medication costs (mean drug costs per patient - net ingredient costs for 28 days)<br>Not used for this review:<br>Number of falls (mean per patient per month)<br>Utilisation of primary care, secondary care and personal social services health professional time (GP, nurse and other) |
| Starting date       | 2011   |
| Contact information |  |

**Desborough** *(Continued)*

| Notes |  |
|-------|--|
|-------|--|

## DATA AND ANALYSES

This review has no analyses.

## ADDITIONAL TABLES

**Table 1. Summary of study characteristics**

| Study,Country, Design   | Participants  | Intervention   | Outcome measures  | Duration  |
|---|---|--|---|-----------|
| <a href="#">Claesson 1998</a><br>Sweden<br>Cluster-RCT        | 1854 residents in 33 nursing homes                        | Multidisciplinary meetings with physician, pharmacist and nurse(s)   | Medication-related problems   | 14 months |
| <a href="#">Crotty 2004a</a><br>Australia<br>Cluster-RCT      | 154 residents in 10 nursing homes                         | Multidisciplinary case conferencing with GP, a geriatrician, a pharmacist, residential care staff and an Alzheimer's Association representative                                | Medication Appropriateness Index  | 3 months  |
| <a href="#">Crotty 2004b</a><br>Australia<br>Patient-RCT      | 110 patients discharged to 85 long-term care facilities   | Pharmacist transition co-ordinator. Transfer of medicines information to nursing staff, family physician and community pharmacist plus medication review and case conferencing | Adverse drug events<br>Hospital admissions<br>Medication-related problems<br>Medication Appropriateness Index | 8 weeks   |
| <a href="#">Furniss 2000</a><br>UK<br>Cluster-RCT             | 330 residents in 14 nursing homes                         | Medication review by a single pharmacist   | Hospital admissions<br>Mortality<br>Medication-related problems<br>Medicine costs                             | 8 months  |
| <a href="#">Gurwitz 2008</a><br>USA/Canada<br>Cluster-RCT     | 1118 residents in 29 units in 2 long-term care facilities | Computerised provider order entry with clinical decision support   | Adverse drug events   | 12 months |
| <a href="#">Roberts 2001</a><br>Australia<br>Cluster-RCT      | 3230 residents in 52 nursing homes                        | Introduction of new professional role, nurse education and medication review by pharmacists  | Hospital admissions<br>Mortality<br>Medication-related problems<br>Medicine costs                             | 24 months |
| <a href="#">Strikwerda 1994</a><br>Netherlands<br>Cluster-RCT | 196 residents in 1 nursing home                           | Feedback on GP prescribing from community pharmacist   | Medication-related problems   | 6 weeks   |

**Table 1. Summary of study characteristics** (Continued)

|                                     |                                |  |   |          |
|-------------------------------------|--------------------------------|--|---|----------|
| Zermansky 2006<br>UK<br>Patient-RCT | 661 residents in 65 care homes | Medication review by a single pharmacist | Hospital admissions<br>Mortality<br>Medication-related problems<br>Medicine costs | 6 months |
|-------------------------------------|--------------------------------|--|---|----------|

## APPENDICES

### Appendix I. Electronic database search strategies

**Cochrane Database of Systematic Reviews** Issue 11, 2012, Wiley

Search run 16<sup>th</sup> November 2012

Number of results: 6

- #1 MeSH descriptor Polypharmacy, this term only (71)
- #2 (polypharm\*):ti,ab,kw (158)
- #3 (multi-drug\* or multidrug\*) NEAR/2 (therapy or therapies or prescribing or treatment or regime\*):ti,ab,kw (263)
- #4 (beer NEAR/2 criter\*):ti,ab,kw (9)
- #5 (appropriate or optim\* or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excessive or multiple or concurrent\*) NEAR/2 (medicine\* or medication\* or prescription\* or drug\*):ti,ab,kw (1415)
- #6 (over NEAR/1 prescrip\*) or (overprescrib\* or overprescript\*):ti,ab,kw (29)
- #7 (under NEAR/1 prescrip\*) or (underprescrib\* or underprescript\*):ti,ab,kw (6)
- #8 “medication appropriateness index”:ti,ab,kw (15)
- #9 (quality NEAR/1 (prescribing or prescription\* or medication\*)):ti,ab,kw (30)
- #10 (improv\* NEAR/1 (prescrib\* or prescription\* or pharmaco\*)):ti,ab,kw (147)
- #11 “case conferencing”:ti,ab,kw (9)
- #12 MeSH descriptor Medication Therapy Management, this term only (18)
- #13 “medication\* management”:ti,ab,kw or “medication\* therapy management”:ti,ab,kw or “medication\* strategy”:ti,ab,kw or “medication\* strategies”:ti,ab,kw or (medication\* NEAR/2 review\*):ti,ab,kw (408)
- #14 “drug regimen review”:ti,ab,kw or (drug NEAR/1 utilization NEAR/2 (review\* or evaluat\*)):ti,ab,kw (126)
- #15 MeSH descriptor Drug Utilization Review, this term only (102)
- #16 “drug related problem\*”:ti,ab,kw or (prescription\* NEAR/2 pattern\*):ti,ab,kw or “Assessing care of vulnerable elders”:ti,ab,kw or (acove):ti,ab,kw or (stopp):ti,ab,kw (122)
- #17 “start screening tool”:ti,ab,kw or “Screening Tool of Older Person’s Prescriptions”:ti,ab,kw or “Screening Tool to Alert doctors to Right Treatment”:ti,ab,kw (0)
- #18 MeSH descriptor Medication Errors, this term only (163)
- #19 (pharmaceutical\* or pharmacist\* or prescrib\*):ti,ab,kw (11159)
- #20 MeSH descriptor Pharmaceutical Preparations, this term only (225)
- #21 MeSH descriptor Pharmacists, this term only (325)
- #22 MeSH descriptor Pharmacists’ Aides, this term only (5)
- #23 MeSH descriptor Prescription Drugs, this term only (45)
- #24 MeSH descriptor Drug Prescriptions, this term only (402)
- #25 MeSH descriptor Pharmaceutical Services, this term only (93)
- #26 MeSH descriptor Drug Toxicity, this term only (359)
- #27 (pharmacotherap\*):ti,ab,kw (6758)
- #28 MeSH descriptor Drug Therapy, this term only (425)

- #29 MeSH descriptor Drug Monitoring, this term only (907)
- #30 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29) (21231)
- #31 MeSH descriptor Homes for the Aged, this term only
- #32 "home\* for the aged":ti,ab,kw or (aged NEAR/2 (care or nursing or healthcare or residential) NEAR/2 (facility or facilities or home\*)):ti,ab,kw or (geriatric or elderly) NEAR/2 (facility or facilities or care home\*):ti,ab,kw
- #33 MeSH descriptor Nursing Homes explode all trees (401)
- #34 MeSH descriptor Hospitals, Veterans, this term only (274)
- #35 (#31 OR #32 OR #33 OR #34) (1525)
- #36 (care or convalescent) NEXT (home or homes or center\* or centre\* or facility or facilities):ti,ab,kw (2086)
- #37 (skilled or intermediate) NEXT (nursing facility or nursing facilities):ti,ab,kw (0)
- #38 (resident\* NEAR/2 (care or facility or facilities)):ti,ab,kw (466)
- #39 (nursing or group or residential) NEXT (home or homes):ti,ab,kw (1763)
- #40 (longterm or long term) NEAR/3 (care or facility or facilities):ti,ab,kw (1904)
- #41 MeSH descriptor Long-Term Care, this term only (963)
- #42 MeSH descriptor Residential Facilities, this term only (116)
- #43 (assisted living):ti,ab,kw (437)
- #44 MeSH descriptor Halfway Houses, this term only (17)
- #45 (#36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44) (5838)
- #46 MeSH descriptor Aged explode all trees (499)
- #47 MeSH descriptor Geriatrics, this term only (175)
- #48 (gerontol\* or ageing or aging or elder\* or geriatric\* or seniors or old age or older or late\* life):ti,ab,kw (310000)
- #49 (older NEXT (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)):ti,ab,kw (5427)
- #50 MeSH descriptor Veterans explode all trees (379)
- #51 (veteran\*):ti,ab,kw (1874)
- #52 (#46 OR #47 OR #48 OR #49 OR #50 OR #51) (310561)
- #53 (#45 AND #52) (4152)
- #54 (#30 AND ( #35 OR #53 )) (6)

**Cochrane Central Register of Controlled Trials (CENTRAL) Issue 11, 2012, Wiley**

Search run 16<sup>th</sup> November 2012

Number of results: 281

- #1 MeSH descriptor Polypharmacy, this term only (71)
- #2 (polypharm\*):ti,ab,kw (158)
- #3 (multi-drug\* or multidrug\*) NEAR/2 (therapy or therapies or prescribing or treatment or regime\*):ti,ab,kw (263)
- #4 (beer NEAR/2 criter\*):ti,ab,kw (9)
- #5 (appropriate or optim\* or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excessive or multiple or concurrent\*) NEAR/2 (medicine\* or medication\* or prescription\* or drug\*):ti,ab,kw (1415)
- #6 (over NEAR/1 prescript\*) or (overprescrib\* or overprescript\*):ti,ab,kw (29)
- #7 (under NEAR/1 prescript\*) or (underprescrib\* or underprescript\*):ti,ab,kw (6)
- #8 "medication appropriateness index":ti,ab,kw (15)
- #9 (quality NEAR/1 (prescribing or prescription\* or medication\*)):ti,ab,kw (30)
- #10 (improv\* NEAR/1 (prescrib\* or prescription\* or pharmaco\*)):ti,ab,kw (147)
- #11 "case conferencing":ti,ab,kw (9)
- #12 MeSH descriptor Medication Therapy Management, this term only (18)
- #13 "medication\* management":ti,ab,kw or "medication\* therapy management":ti,ab,kw or "medication\* strategy":ti,ab,kw or "medication\* strategies":ti,ab,kw or (medication\* NEAR/2 review\*):ti,ab,kw (408)
- #14 "drug regimen review\*":ti,ab,kw or (drug NEAR/1 utilization NEAR/2 (review\* or evaluat\*)):ti,ab,kw (126)
- #15 MeSH descriptor Drug Utilization Review, this term only (102)
- #16 "drug related problem\*":ti,ab,kw or (prescription\* NEAR/2 pattern\*):ti,ab,kw or "Assessing care of vulnerable elders":ti,ab,kw or (acove):ti,ab,kw or (stopp):ti,ab,kw (122)
- #17 "start screening tool":ti,ab,kw or "Screening Tool of Older Person's Prescriptions":ti,ab,kw or "Screening Tool to Alert doctors to Right Treatment":ti,ab,kw (0)

- #18 MeSH descriptor Medication Errors, this term only (163)
- #19 (pharmaceutical\* or pharmacist\* or prescrib\*):ti,ab,kw (11159)
- #20 MeSH descriptor Pharmaceutical Preparations, this term only (225)
- #21 MeSH descriptor Pharmacists, this term only (325)
- #22 MeSH descriptor Pharmacists' Aides, this term only (5)
- #23 MeSH descriptor Prescription Drugs, this term only (45)
- #24 MeSH descriptor Drug Prescriptions, this term only (402)
- #25 MeSH descriptor Pharmaceutical Services, this term only (93)
- #26 MeSH descriptor Drug Toxicity, this term only (359)
- #27 (pharmacotherap\*):ti,ab,kw (6758)
- #28 MeSH descriptor Drug Therapy, this term only (425)
- #29 MeSH descriptor Drug Monitoring, this term only (907)
- #30 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29) (21231)
- #31 MeSH descriptor Homes for the Aged, this term only
- #32 "home\* for the aged":ti,ab,kw or (aged NEAR/2 (care or nursing or healthcare or residential) NEAR/2 (facility or facilities or home\*)):ti,ab,kw or (geriatric or elderly) NEAR/2 (facility or facilities or care home\*):ti,ab,kw
- #33 MeSH descriptor Nursing Homes explode all trees (401)
- #34 MeSH descriptor Hospitals, Veterans, this term only (274)
- #35 (#31 OR #32 OR #33 OR #34) (1525)
- #36 (care or convalescent) NEXT (home or homes or center\* or centre\* or facility or facilities):ti,ab,kw (2086)
- #37 (skilled or intermediate) NEXT (nursing facility or nursing facilities):ti,ab,kw (0)
- #38 (resident\* NEAR/2 (care or facility or facilities)):ti,ab,kw (466)
- #39 (nursing or group or residential) NEXT (home or homes):ti,ab,kw (1763)
- #40 (longterm or long term) NEAR/3 (care or facility or facilities):ti,ab,kw (1904)
- #41 MeSH descriptor Long-Term Care, this term only (963)
- #42 MeSH descriptor Residential Facilities, this term only (116)
- #43 (assisted living):ti,ab,kw (437)
- #44 MeSH descriptor Halfway Houses, this term only (17)
- #45 (#36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44) (5838)
- #46 MeSH descriptor Aged explode all trees (499)
- #47 MeSH descriptor Geriatrics, this term only (175)
- #48 (gerontol\* or ageing or aging or elder\* or geriatric\* or seniors or old age or older or late\* life):ti,ab,kw (310000)
- #49 (older NEXT (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)):ti,ab,kw (5427)
- #50 MeSH descriptor Veterans explode all trees (379)
- #51 (veteran\*):ti,ab,kw (1874)
- #52 (#46 OR #47 OR #48 OR #49 OR #50 OR #51) (310561)
- #53 (#45 AND #52) (4152)
- #54 (#30 AND ( #35 OR #53 )) (281)

**Cochrane Highly Sensitive Search Strategy for identifying randomised trials in MEDLINE: sensitivity-maximizing version (2008 revision); Ovid format**

- 1 randomized controlled trial.pt.
- 2 controlled clinical trial.pt.
- 3 randomized.ab.
- 4 placebo.ab.
- 5 drug therapy.fs.
- 6 randomly.ab.
- 7 trial.ab.
- 8 groups.ab.
- 9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
- 10 exp animals/ not humans.sh.
- 11 9 not 10

**MEDLINE, 1980-, OvidSP**

Search run 16<sup>th</sup> November 2012 [database last updated November, week 2, 2012]

Number of results: 1381

- 1 polypharmacy/ (1998)
- 2 polypharm\*.ti,ab. (2606)
- 3 ((multi-drug\* or multidrug\*) adj2 (therapy or therapies or prescribing or treatment or regime\*).ti,ab. (2285)
- 4 (beer\* adj1 criter\*).ti,ab. (187)
- 5 ((appropriate or optim\* or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excessive or multiple or concurrent\*) adj2 (medicine? or medication? or prescription\* or drug\*).ti,ab. (16485)
- 6 ((over adj1 prescrip\*) or (overprescrib\* or overprescript\*).ti,ab. (542)
- 7 ((under adj prescrip\*) or (underprescrib\* or underprescript\*).ti,ab. (215)
- 8 medication appropriateness index.ti,ab. (52)
- 9 (quality adj (prescribing or prescription? or medication?)).ti,ab. (70)
- 10 (improv\* adj (prescrib\* or prescription? or pharmaco\*).ti,ab. (1512)
- 11 case conferencing.ti,ab. (40)
- 12 medication therapy management/ (445)
- 13 (medication? management or medication? therapy management or medication? strategy or medication? strategies or (medication? adj2 review\*).ti,ab. (2391)
- 14 drug regimen review\*.ti,ab. (52)
- 15 drug utilization review/ (2780)
- 16 (drug adj utili?ation adj2 (review\* or evaluat\*).ti,ab. (348)
- 17 drug related problem?.ti,ab. (702)
- 18 ((prescribing or prescription?) adj2 pattern?).ti,ab. (2205)
- 19 Assessing care of vulnerable elders.ti,ab. (43)
- 20 acove.ti,ab. (30)
- 21 stopp.ti,ab. (43)
- 22 start screening tool.ti,ab. (10)
- 23 Screening Tool of Older Person's Prescriptions.ti,ab. (11)
- 24 Screening Tool to Alert doctors to Right Treatment.ti,ab. (9)
- 25 Medication Errors/ (9580)
- 26 (pharmaceutical? or pharmacist? or prescrib\*).ti,ab. (142522)
- 27 pharmaceutical preparations/ (45187)
- 28 Pharmacists/ (9723)
- 29 Pharmacists' Aides/ (489)
- 30 Prescription Drugs/ (2261)
- 31 Drug Prescriptions/ (20951)
- 32 Pharmaceutical Services/ (3895)
- 33 drug toxicity/ (5710)
- 34 pharmacotherap\*.ti,ab. (18959)
- 35 drug therapy/ (33168)
- 36 drug monitoring/ (12728)
- 37 or/1-36 [Prescribing/medication terms] (279642)
- 38 Homes for the Aged/ or "homes for the aged".tw. (10633)
- 39 exp Nursing Homes/ or nursing home?.tw. (30522)
- 40 (aged adj2 (care or nursing or healthcare or residential) adj2 (facility or facilities or home?)).ti,ab. (268)
- 41 ((geriatric or elderly) adj2 (facility or facilities or care home?)).ti,ab. (296)
- 42 Hospitals, Veterans/ (5454)
- 43 or/38-42 [Care facilities- aged terms] (40335)
- 44 ((care or convalescent) adj (home? or center? or centre? or facility or facilities)).ti,ab. (26613)
- 45 ((skilled or intermediate) adj (nursing facility or nursing facilities)).ti,ab. (1272)
- 46 (resident\* adj2 (care or facility or facilities)).ti,ab. (4925)
- 47 ((nursing or group or residential) adj home?).ti,ab. (20829)
- 48 Long-Term Care/ (20740)
- 49 ((longterm or long term) adj3 (care or facility or facilities)).ti,ab. (14906)

50 (healthcare adj2 (facility or facilities)).ti,ab. (1717)  
 51 Residential Facilities/ (4463)  
 52 Assisted Living Facilities/ (772)  
 53 assisted living.ti,ab. (1104)  
 54 Halfway houses/ (1011)  
 55 or/44-54 [Other residential care terms] (78047)  
 56 exp aged/ (2179029)  
 57 Geriatrics/ (26019)  
 58 (gerontol\* or ageing or aging or elder\* or geriatric\* or seniors or old age or older or late\* life).ti,ab. (466530)  
 59 (older adj (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)).ti,ab. (63257)  
 60 veterans/ (8246)  
 61 veteran\*.ti,ab. (18509)  
 62 or/56-61[Elderly terms] (2404467)  
 63 randomized controlled trial.pt. (342057)  
 64 controlled clinical trial.pt. (85675)  
 65 random\*.ti,ab. (586198)  
 66 drug therapy.fs. (1586933)  
 67 trial.ab. (253559)  
 68 groups.ab. (1144975)  
 69 or/63-68 (3059105)  
 70 exp animals/ not humans.sh. (3811050)  
 71 69 not 70 [RCT filter] (2598604)  
 72 37 [Prescribing/medication terms] and 43 [Care facilities- aged terms] (2126)  
 73 37 [Prescribing/medication terms] and 55 [Other residential care terms] (4013)  
 74 73 [Prescribing/medication terms and Other residential care terms] and 62 [Elderly terms] (2258)  
 75 (72 or 74) and 71 [RCT filter] (1399)  
 76 limit 75 to yr="1980 -Current" (1381)

#### EMBASE, 1980- , OvidSP

Search run 16<sup>th</sup> November 2012 [Database last updated week 45, 2012]

Number of results: 3530

1 polypharmacy/ (5545)  
 2 polypharm\*.ti,ab. (4282)  
 3 ((multi-drug\* or multidrug\*) adj2 (therapy or therapies or prescribing or treatment or regime\*)).ti,ab. (3512)  
 4 (beer\* adj1 criter\*).ti,ab. (338)  
 5 ((appropriate or optim\* or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excessive or multiple or concurrent\* or adverse) adj2 (medicine? or medication? or prescription\* or prescrib\* or drug\*)).ti,ab. (46912)  
 6 ((over adj1 prescrip\*) or (over adj1 prescrib\*) or (overprescrib\* or overprescript\*)).ti,ab. (1197)  
 7 ((under adj prescrip\*) or (under adj prescrib\*) or (underprescrib\* or underprescript\*)).ti,ab. (488)  
 8 medication appropriateness index/ or medication appropriateness index.ti,ab. (74)  
 9 (quality adj (prescribing or prescription? or medication?)).ti,ab. (103)  
 10 (improv\* adj (prescrib\* or prescription? or pharmaco\*)).ti,ab. (2123)  
 11 case conferencing.ti,ab. (53)  
 12 medication therapy management/ (1228)  
 13 (medication? management or medication? therapy management or drug therapy management or medication? strategy or medication? strategies or (medication? adj2 review\*)).ti,ab. (4178)  
 14 drug regimen review\*.ti,ab. (84)  
 15 (drug adj utilization adj2 (review\* or evaluat\*)).ti,ab. (574)  
 16 drug utilization/ (15587)  
 17 ((drug or medication) adj related problem?).ti,ab. (1548)  
 18 ((prescribing or prescription?) adj2 pattern?).ti,ab. (3426)  
 19 Assessing care of vulnerable elders.ti,ab. (50)  
 20 Assessing care of vulnerable elders.mp. (50)



21 "Assessing Care of Vulnerable Elders"/ (1)  
 22 acove.ti,ab. (46)  
 23 stopp.ti,ab. (130)  
 24 start screening tool.ti,ab. (22)  
 25 Screening Tool of Older Person's Prescriptions.ti,ab. (25)  
 26 Screening Tool to Alert doctors to Right Treatment.ti,ab. (21)  
 27 medication error/ (11089)  
 28 (pharmaceutical? or pharmacist? or prescrib\*).ti,ab. (247238)  
 29 drug/ (40640)  
 30 pharmacist/ or pharmacy technician/ (41871)  
 31 prescription drug/ (2125)  
 32 prescription/ (98072)  
 33 pharmacy/ (47765)  
 34 pharmacotherap\*.ti,ab. (30503)  
 35 exp drug therapy/ (1657001)  
 36 drug monitoring/ (38809)  
 37 drug toxicity/ (51048)  
 38 "drug use"/ (65381)  
 39 or/1-38 [Prescribing/medication terms] (2094786)  
 40 home for the aged/ or "home? for the aged".ti,ab. (11978)  
 41 ((care or convalescent) adj (home? or center? or centre? or facility or facilities)).ti,ab. (36574)  
 42 public hospital/ (27380)  
 43 exp Nursing Homes/ (39622)  
 44 ((skilled or intermediate) adj (nursing facility or nursing facilities\*)).ti,ab. (1585)  
 45 ((aged or geriatric or elderly) adj2 (care home? or facility or facilities or residential)).ti,ab. (1081)  
 46 or/40-45 [Care facilities -aged terms] (104001)  
 47 (resident\* adj2 (care or facilit\*)).ti,ab. (6504)  
 48 ((nursing or group or residential) adj home\*).ti,ab. (27136)  
 49 long term care/ (83560)  
 50 ((longterm or long term) adj3 (care or facilit\*)).ti,ab. (20505)  
 51 residential home/ (5457)  
 52 residential home\*.ti,ab. (926)  
 53 assisted living facility/ (953)  
 54 assisted living.ti,ab. (1356)  
 55 (life care cent\* or continued care cent\* or extended care facilit\*).ti,ab. (523)  
 56 halfway house/ (1240)  
 57 or/40-55 [Care facilities - general] (200251)  
 58 exp aged/ (2136072)  
 59 GERIATRICALS/ (34537)  
 60 (aged or elder\* or geriatric\* or seniors or old age or older or late\* life).ti,ab. (904844)  
 61 (old\* adj (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)).ti,ab. (127968)  
 62 veteran/ (8498)  
 63 veteran\*.ti,ab. (23699)  
 64 or/58-63 [Elderly terms] (2696684)  
 65 57 and 64 (70919)  
 66 clinical trial/ (882811)  
 67 randomized controlled trial/ (335600)  
 68 randomization/ (60313)  
 69 single blind procedure/ (16719)  
 70 double blind procedure/ (116669)  
 71 Crossover procedure/ (35906)  
 72 randomi?ed controlled trial\*.ti,ab. (81408)  
 73 RCT.tw. (10604)

- 74 random allocation.ti,ab. (1267)  
 75 randomly allocated.ti,ab. (18323)  
 76 allocated randomly.ti,ab (1885)  
 77 (allocated adj2 random).ti,ab. (869)  
 78 single blind\*.ti,ab. (13170)  
 79 double blind\*.ti,ab. (142385)  
 80 ((treble or triple) adj2 blind\*).ti,ab. (388)  
 81 prospective study/ (220972)  
 82 or/66-81 (1227757)  
 83 case study/ or case report.ti,ab. (287404)  
 84 abstract report/ or letter/ (870000)  
 85 or/83-84 (1153094)  
 86 82 not 85 [SIGN RCT filter minus placebo] (1196147)  
 87. 39 and (46 or 65) and 86 (3579)  
 88 limit 87 to yr="1980 -Current (3530)

### EPOC Group, Specialised Register, Reference Manager

Search run November 2012

Number of results: 565

- |    |                    |   |
|----|--------------------|---|
| 1  | All Non-Indexed    | {prescrib\*} OR {prescription\*} OR {medication\* use} OR {drug therapy\*} OR {polypharmacy}                                |
| 2  | AND Title, primary | {improv\*} OR {optimi\*} OR {rational} OR {irrational} OR {evidence\*}  |
| 3  | OR Keywords [7]    | {prescrib\*} AND {practice\*}   |
| 4  | OR Keywords [7]    | {prescrib\*} AND {improv\*}   |
| 5  | OR Keywords [7]    | {prescrib\*} AND {compliance\*}   |
| 6  | OR Abstract [25]   | {rational} AND {prescrib\*}   |
| 7  | OR Abstract [25]   | {irrational} AND {prescrib\*}   |
| 8  | OR Abstract [25]   | {improv\* prescrib\*} OR {optim\*prescrib\*} OR {rational prescrib\*} OR {irrational prescrib\*} OR {reduc\*overprescrib\*} |
| 9  | OR Abstract [25]   | {reduc\*} AND {medication\*use\*}   |
| 10 | OR Title, primary  | {improv\*} AND {medicine\*}   |
| 11 | OR All Non-Indexed | unnecessary prescrib\*  |
| 12 | OR Abstract [25]   | {polypharmacy\*} AND {reduc\*}  |
| 13 | OR Keywords [7]    | {prescrib\*} AND {adher\*}  |
| 14 | OR Keywords [7]    | medication adherence*   |

OR ALL Non-Indexed fields : ACOVE or STARTT found one more citation; total 565 -

### Ageline,1966-, EBSCO

Search run November 2012

Number of results: 186

- S1 TI ( prescribing or polypharm\* or pharmacist\* ) or SU ( prescribing or polypharm\* )  
 S2 TX (appropriat\* w2 prescrib\*) OR (inappropriat\* w2 prescrib\*) or (optim\* w2 prescrib\*) or (suboptim\* w2 prescrib\*) or (sub-optim\* w2 prescrib\*) or (unnecessary n2 medicat\*) or (unnecessary n2 prescrib\*) or TX medication\* w2 appropriat\* or (appropriat\* w2 medicat\*) OR (inappropriat\* w2 medicat\*) or (optim\* w2 medicat\*) or (suboptim\* w2 medicat\*) or (sub-optim\* w2 medicat\*) or overprescrib\* or overmedicat\* or "over-medicat\*\*"  
 S3 TX "Assessing care of vulnerable elders" or TX "Screening Tool of Older Person's Prescriptions" OR TX "Screening Tool to Alert doctors to Right Treatment" OR TX "start screening tool" or "beers criteria" or "beer's criteria"  
 S4 TX overprescrib\* or inappropriat\* prescribe\*  
 S5 DE "Nursing Homes" OR TX "nursing home" or TX "nursing homes"

S6 TX ( care w2 home\* OR care w2 facility or care w2 facilities ) or TX ( "homes for the aged" or "old age home\*" ) or TX ("geriatric homes")

S7 TX nursing w2 home\*

S8 S5 or S6 or S7

S9 (drug w1 therap\*) or (drug w2 utili\*)

S10 SU (prescription or prescriptions or pharma\*)

S11 DE "Medication Errors"

S12 SU drug OR SU drugs or SU medication\*

S13 TI medication error\*

S14 (S9 or S10 or S11 or S12 or S13) AND S8

S15 (S1 or S2 or S3 or S4) and S8

S16 SU ( trial or trials ) or SU studies or TI ( study or trial ) or TX ( control w3 area or control w3 cohort\* or control w3 compar\* or control w3 condition\* or control w3 group\* or control w3 intervention\* or control w3 participant\* or control\* w3 study ) or TX ( random\* OR controlled )

S17 (S14 OR S15) AND S16

### CINAHL (Cumulative Index to Nursing and Allied Health Literature), 1980- , EBSCO

Search run 16<sup>th</sup> November 2012

Number of results: 407

S1 MH polypharmacy (1,327)

S2 TI polypharmacy or AB polypharmacy (784)

S3 TI beer\* n1 criter\* or AB beer\* n1 criter\* (113)

S4 TI (appropriate N2 medici\* or optim\* N2 medici\* or inappropriat\* N2 medici\* or suboptim\* N2 medici\* or sub-optim\* N2 medici\* or unnecessary N2 medici\* or incorrect\* N2 medici\* or in-correct\* N2 medici\* or excess\* N2 medici\* or multip\* N2 medici\* or concurrent\* N2 medici\* ) or AB (appropriate N2 medici\* or optim\* N2 medici\* or inappropriat\* N2 medici\* or suboptim\* N2 medici\* or sub-optim\* N2 medici\* or unnecessary N2 medici\* or incorrect\* N2 medici\* or in-correct\* N2 medici\* or excess\* N2 medici\* or multip\* N2 medici\* or concurrent\* N2 medici\* ) or TI (appropriate N2 medicat\* or optim\* N2 medicat\* or inappropriat\* N2 medicat\* or suboptim\* N2 medicat\* or sub-optim\* N2 medicat\* or unnecessary N2 medicat\* or incorrect\* N2 medicat\* or in-correct\* N2 medicat\* or excess\* N2 medicat\* or multip\* N2 medicat\* or concurrent\* N2 medicat\* ) or AB (appropriate N2 medicat\* or optim\* N2 medicat\* or inappropriat\* N2 medicat\* or suboptim\* N2 medicat\* or sub-optim\* N2 medicat\* or unnecessary N2 medicat\* or incorrect\* N2 medicat\* or in-correct\* N2 medicat\* or excess\* N2 medicat\* or multip\* N2 medicat\* or concurrent\* N2 medicat\* ) or TI ( appropriate N2 prescription\* or optim\* N2 prescription\* or inappropriat\* N2 prescription\* or suboptim\* N2 prescription\* or sub-optim\* N2 prescription\* or unnecessary N2 prescription\* or incorrect\* N2 prescription\* or in-correct\* N2 prescription\* or excess\* N2 prescription\* or multip\* N2 prescription\* or concurrent\* N2 prescription\* ) or AB (appropriate N2 prescription\* or optim\* N2 prescription\* or inappropriat\* N2 prescription\* or suboptim\* N2 prescription\* or sub-optim\* N2 prescription\* or unnecessary N2 prescription\* or incorrect\* N2 prescription\* or in-correct\* N2 prescription\* or excess\* N2 prescription\* or multip\* N2 prescription\* or concurrent\* N2 prescription\* ) or TI (appropriate N2 drug\* or optim\* N2 drug\* or inappropriat\* N2 drug\* or suboptim\* N2 drug\* or sub-optim\* N2 drug\* or unnecessary N2 drug\* or incorrect\* N2 drug\* or in-correct\* N2 drug\* or excess\* N2 drug\* or multip\* N2 drug\* or concurrent\* N2 drug\* ) or AB ( inappropriat\* N2 drug\* or suboptim\* N2 drug\* or sub-optim\* N2 drug\* or unnecessary N2 drug\* or incorrect\* N2 drug\* or in-correct\* N2 drug\* or excess\* N2 drug\* or multip\* N2 drug\* or concurrent\* N2 drug\* ) (2,747)

S5 TI (over n2 prescript\* or overprescrib\* or overprescript\* ) or AB (over n2 prescript\* or overprescrib\* or overprescript\* ) (369)

S6 TI ("under prescript\*" or underprescrib\* or underprescript\* ) or AB ("under prescript\*" or underprescrib\* or underprescript\* ) (55)

S7 TI "medication appropriateness index\*" or AB "medication appropriateness index\*" (19)

S8 TI (quality n2 prescription\* or quality n2 medication\* ) or AB (quality n2 prescription\* or quality n2 medication\* ) (234)

S9 TI (improv\* n2 prescription\* or improv\* n2 pharmaco\* ) or AB (improv\* n2 prescription\* or improv\* n2 pharmaco\* ) (458)

S10 TI "Assessing care of vulnerable elders" or AB "Assessing care of vulnerable elders" (31)

S11 TI acove or AB acove (20)

- S12 TI ( multi-drug\* N3 therap\* or multi-drug\* N3 treatment or multi-drug\* N3 regime\*) or AB ( multi-drug\* N3 therap\* or multi-drug\* N3 treatment or multi-drug\* N3 regime\*) or TI (multidrug\* N3 therap\* or multidrug\* N3 treatment or multidrug\* N3 regime\*) or AB (multidrug\* N3 therap\* or multidrug\* N3 treatment or multidrug\* N3 regime\*) (236)
- S13 MH Medication Errors (7,779)
- S14 TI (pharmaceutical\* or prescribing) or AB (pharmaceutical\* or prescribing) (13,361)
- S15 MH Pharmacists (4,050)
- S16 (MH "Pharmacy Technicians") (175)
- S17 (MH "Drugs, Prescription") (9,130)
- S18 (MH "Prescriptions, Drug") (3,631)
- S19 (MH "Pharmacy Service") or (MH "Pharmaceutical Care") (2,408)
- S20 TI pharmacist\* or AB pharmacist\* (4,235)
- S21 (MH "Medication Management (Iowa NIC)") OR (MH "Medication Managements (Iowa NIC) (Non-Cinahl)") (2)
- S22 MH drug toxicity (2,766)
- S23 TI (stopp or start screening tool) or AB (stopp or start screening tool) (18)
- S24 TI "Screening Tool of Older Person's Prescriptions" or AB "Screening Tool of Older Person's Prescriptions" (0)
- S25 TI "Screening Tool to Alert doctors to Right Treatment" or AB "Screening Tool to Alert doctors to Right Treatment" (2)
- S26 TI medication\* N2 management or AB medication\* N2 management or TI medication N2 review\* or AB medication N2 review\* or TI medication\* N2 strateg\* or AB medication\* N2 strateg\* (1,888)
- S27 TI pharmacotherap\* or AB pharmacotherap\* (3,118)
- S28 (MH "Drug Therapy") (4,741)
- S29 (MH "Drug Utilization") (3,385)
- S30 TI "drug utili\*ation" N2 review\* or AB "drug utili\*ation" N2 review\* or TI "drug utili\*ation" N2 evaluat\* or AB "drug utili\*ation" N2 evaluat\* (64)
- S31 MH drug monitoring (3,216)
- S32 TI "drug regimen review\*" or AB "drug regimen review\*" (11)
- S33 "case conferencing" (18)
- S34 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32 or S33 (54,600)
- S35 TI "homes for the aged" or AB "homes for the aged" or MH Housing for the elderly (1,713)
- S36 TI (care W1 home\*) or AB (care W1 home\*) or TI (care W1 center\*) or AB (care W1 center\*) or TI (care W1 centre\*) or AB (care W1 centre\*) or TI ( care W1 facilit\*) or AB ( care W1 facilit\*) or TI (convalescent W1 home\*) or AB (convalescent W1 home\*) or TI (convalescent W1 center\*) or AB (convalescent W1 center\*) or TI (convalescent W1 centre\*) or AB (convalescent W1 centre\*) or TI ( convalescent W1 facilit\*) or AB ( convalescent W1 facilit\*) (13,654)
- S37 (MH "Hospitals, Veterans") (2,768)
- S38 MH Nursing Homes+ or MW Nursing Home (30,352)
- S39 TI skilled W1 "nursing facilit\*" or AB skilled W1 "nursing facilit\*" or TI intermediate W1 "nursing facilit\*" or AB intermediate W1 "nursing facilit\*" (788)
- S40 TI aged N2 "care facilit\*" or AB aged N2 "care facilit\*" or TI aged N2 "care home\*" or AB "aged care home\*" or TI aged N2 "nursing facilit\*" or AB aged N2 "nursing facilit\*" or TI "aged nursing home\*" or AB "aged nursing home\*" or TI aged N1 "healthcare facilit\*" or AB aged N1 "healthcare facilit\*" (374)
- S41 TI resident\* N2 care or AB resident\* N2 care or TI resident\* N2 facilit\* or AB resident\* N2 facilit\* (4,317)
- S42 TI ( nursing N1 home\* or group N1 home\* or residential N1 home\* ) or AB ( nursing N1 home\* or group N1 home\* or residential N1 home\* ) (14,133)
- S43 TI aged N2 "residential facilit\*" or AB aged N2 "residential facilit\*" or TI "aged residential home\*" or AB "aged residential home\*" or Ti geriatric N2 facilit\* or AB geriatric N2 facilit\* or TI geriatric\* N1 "care home\*" or AB geriatric\* N1 "care home\*" or TI elderly N2 facilit\* or AB "elderly facilit\*" or Ti elderly N2 "care home\*" or AB elderly N2 "care home\*" (188)
- S44 TI ( longterm N3 care or longterm N3 facilit\* ) or AB ( longterm N3 care or longterm N3 facilit\* ) or TI ( long-term N3 care or long-term N3 facilit\* ) or AB ( long-term N3 care or long-term N3 facilit\* ) (9,794)
- S45 MH Residential Facilities or MH Long Term Care (17,180)
- S46 "residential home\*" or healthcare N2 facilit\* (1,263)
- S47 MH Assisted Living (1,674)
- S48 TI "Assisted Living" or AB "Assisted Living" (1,179)

S49 TI ( "life care cent\*" or "continued care cent\*" or "extended care facilit\*" ) or AB ( "life care cent\*" or "continued care cent\*" or "extended care facilit\*" ) (143)

S50 (MH "Halfway Houses") (91)

S51 S36 or S39 or S41 or S42 or S44 or S45 or S46 or S47 or S48 or S49 or S50 (45,450)

S52 (MH "Aged+") (296,100)

S53 MH Geriatrics (2,120)

S54 TI ( ageing or aging or gerontol\* or elder\* or geriatric\* or seniors or "old age" or "late\* life" ) or AB ( ageing or aging or gerontol\* or elder\* or geriatric\* or seniors or "old age" or "late\* life" ) (70,753)

S55 TI ( old\* N1 person\* or old N1 people or old N1 adult\* or old N1 patient\* or old N1 inpatient\* or old N1 outpatient\* ) or AB ( old\* N1 person\* or old N1 people or old N1 adult\* or old N1 patient\* or old N1 inpatient\* or old N1 outpatient\* ) (6,592)

S56 MH veterans (5,462)

S57 TI veterans or AB veterans (5,981)

S58 (S35 or S37 or S38 or S40 or S43) (34,427)

S59 S52 or S53 or S54 or S55 or S56 or S57 (323,035)

S60 S51 and S59 (21,251)

S61 S58 or S60 (45,614)

S62 (MH "Clinical Trials") (76,194)

S63 PT clinical trial (51,892)

S64 TX clinic\* n1 trial\* (109,676)

S65 TX ( (singl\* n1 blind\*) or (singl\* n1 mask\*) ) or TX ( (doubl\* n1 blind\*) or (doubl\* n1 mask\*) ) or TX ( (tripl\* n1 blind\*) or (tripl\* n1 mask\*) ) or TX ( (trebl\* n1 blind\*) or (trebl\* n1 mask\*) ) (541,676)

S66 TX "randomi\* control\* trial\*" (33,534)

S67 MH Random Assignment (28,601)

S68 TX "random\* allocat\*" (2,249)

S69 MH Quantitative Studies (8,242)

S70 TX "allocat\* random\*" (111)

S71 S62 or S63 or S64 or S65 or S66 or S67 or S68 or S69 or S70 (647,032)

S72 S34 and S61 and S71 (407)

## International Pharmaceutical Abstracts, 1980-, OvidSP

Search run 16<sup>th</sup> November 2012

Number of results: 703

1 polypharm\*.ti,ab,hw. (810)

2 (beer\* adj1 criter\*).ti,ab,hw. (108)

3 ((appropriate or optim\* or adverse or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excess\* or multip\* or concurrent\*) adj2 (medicine? or medication? or prescription\* or drug\*)).ti,ab,hw. (25362)

4 ((over adj1 prescrip\*) or (overprescrib\* or overprescript\*)).ti,ab,hw. (17859)

5 ((under adj1 prescrip\*) or (underprescrib\* or underprescript\*)).ti,ab,hw. (17835)

6 medication appropriateness index\*.ti,ab,hw. (34)

7 (quality adj1 (prescription\* or medication\*)).ti,ab,hw. (237)

8 (improv\* adj1 (prescription\* or pharmaco\*)).ti,ab,hw. (339)

9 prescrib\*.ti,ab,hw. (17663)

10 Assessing care of vulnerable elders.ti,ab. (2)

11 acove.ti,ab. (0)

12 ((multi-drug\* or multidrug\*) adj2 (therapy or therapies or treatment or regime\*)).ti,ab,hw. (217)

13 Medication Error?.ti,ab,hw. (3154)

14 pharmaceutical\*1.ti,ab. (32258)

15 pharmacist\*.ti,ab,hw. (47739)

16 (pharmacy adj (technician? or aide?)).ti,ab,hw. (1661)

17 (Prescription adj2 drug?).ti,ab,hw. (4857)

18 Drug distribution system?.ti,ab,hw. (1890)  
 19 (medication? management or medication? therapy management or medication? strategy or medication? strategies or (medication?  
 adj2 review?)).ti,ab,hw. (1868)  
 20 drug toxicity.ti,ab,hw. (456)  
 21 Screening Tool of Older Person's Prescriptions.ti,ab. (3)  
 22 Screening Tool to Alert doctors to Right Treatment.ti,ab. (6)  
 23 (pharmaceutical adj (preparation? or care)).ti,ab,hw. (7739)  
 24 pharmacotherap\*.ti,ab,hw. (3820)  
 25 drug therap\*.ti,ab,hw. (8197)  
 26 (drug adj utilization adj2 (review\* or evaluat\*)).ti,ab,hw. (4848)  
 27 drug monitoring.ti,ab,hw. (1813)  
 28 drug regimen review\*.ti,ab,hw. (194)  
 29 case conferencing.ti,ab,hw. (0)  
 30 or/1-29 [Prescribing/medication terms] (122563)  
 31 Home? for the Aged.ti,ab,hw. (13)  
 32 (aged adj2 (care or nursing or healthcare or residential) adj2 (facility or facilities or home?)).ti,ab,hw. (30)  
 33 ((geriatric or elderly) adj2 (facility or facilities or care home?)).ti,ab,hw. (44)  
 34 or/31-33 [Aged care homes] (82)  
 35 ((skilled or intermediate) adj nursing facilit\*).ti,ab,hw. (207)  
 36 (resident\* adj2 (care or facilit\*)).ti,ab. (371)  
 37 ((nursing or group or residential) adj home?).ti,ab. (1296)  
 38 ((longterm or long term) adj3 (care or facilit\*)).ti,ab. (1407)  
 39 residential home?.ti,ab,hw. (52)  
 40 assisted living.ti,ab,hw. (101)  
 41 (life care cent\* or continued care cent\* or extended care facilit\*).ti,ab,hw. (64)  
 42 Halfway house\*.ti,ab. (3)  
 43 or/31-40 [Other residential care] (2911)  
 44 (ageing or aging or gerontol\* or elder\* or geriatric\* or seniors or old age or late? life).ti,ab,hw. (13967)  
 45 (old\* adj (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)).ti,ab. (3200)  
 46 veteran\*.ti,ab. (1377)  
 47 or/44-46 [Elderly terms] (17017)  
 48 43 and 47 (1089)  
 49 30 and (34 or 48) (720)  
 50 limit 49 to yr="1980 -Current" (703)

## PsycINFO, 1980-, OvidSP

Search run 19<sup>th</sup> November 2012 [Database last updated November, week 2, 2012]

Number of results: 905

1 Polypharmacy/ (639)  
 2 polypharm\*.ti,ab. (1043)  
 3 (beer\* adj1 criter\*).ti,ab. (57)  
 4 ((appropriate or optim\* or adverse or inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\*  
 or excess\* or multip\* or concurrent\*) adj2 (medicine? or medication? or prescription\* or drug\*)).ti,ab. (3911)  
 5 ((over adj1 prescript\*) or (overprescrib\* or overprescript\*)).ti,ab. (136)  
 6 ((under adj1 prescript\*) or (underprescrib\* or underprescript\*)).ti,ab. (35)  
 7 medication appropriateness index\*.ti,ab. (14)  
 8 (quality adj1 (prescription\* or medication\*)).ti,ab. (39)  
 9 (improv\* adj1 (prescription\* or pharmaco\*)).ti,ab. (94)  
 10 (drug related problem? or (prescription adj2 pattern?)).ti,ab. (509)  
 11 Assessing care of vulnerable elders.ti,ab. (37)  
 12 acove.ti,ab. (25)

13 ((multi-drug\* or multidrug\*) adj2 (therapy or therapies or treatment or regime\*)),ti,ab. (57)

14 Medication Errors.ti,ab. (259)

15 (pharmaceutical? or pharmacist? or prescrib\*).ti,ab. (23625)

16 Pharmacists/ (721)

17 (pharmacy adj (technician? or aide?)).ti,ab. (14)

18 Prescription Drugs/ (2137)

19 drug therapy/ (97624)

20 "Prescribing (Drugs)"/ (2486)

21 medication? related problem?.ti,ab. (35)

22 stopp.ti,ab. (12)

23 (medication? management or medication? therapy management or medication strategy or medication? strategies or (medication adj2 review?)).ti,ab. (1031)

24 Toxicity/ (2181)

25 start screening tool.ti,ab. (3)

26 Screening Tool of Older Person's Prescriptions.ti,ab. (4)

27 Screening Tool to Alert doctors to Right Treatment.ti,ab. (3)

28 (medication adj2 (management or review\*)).ti,ab. (1136)

29 pharmacotherap\*.ti,ab. (9354)

30 ((drug adj utili?ation adj2 (review\* or evaluat\*)) or drug related problem?).ti,ab. (353)

31 Monitoring/ (4623)

32 drug regimen review\*.ti,ab. (3)

33 case conferencing.ti,ab. (22)

34 or/1-33 [Medication or prescribing terms] (126093)

35 Treatment Facilities/ (947)

36 Homes for the Aged.ti,ab. (168)

37 (aged adj2 (care or nursing or healthcare or residential) adj2 (facility or facilities or care home?)).ti,ab. (192)

38 ((geriatric or elderly) adj2 (facility or facilities or care home?)).ti,ab. (121)

39 exp Nursing Homes/ (6128)

40 or/36-39 [Aged care facilities tems] (6489)

41 ((care or convalescent) adj (home? or center? or centre\*? or facility or facilities)).ti,ab. (6787)

42 ((skilled or intermediate) adj nursing facilit\*).ti,ab. (292)

43 (resident\* adj2 (care or facilit\*)).ti,ab. (4850)

44 ((nursing or group or residential) adj home\*).ti,ab. (9558)

45 Long Term Care/ (2840)

46 ((longterm or long term) adj3 (care or facilit\*)).ti,ab. (5467)

47 Residential Care Institutions/ (7893)

48 residential home\*.ti,ab. (376)

49 Assisted Living/ (457)

50 assisted living.ti,ab. (675)

51 (life care cent\* or continued care cent\* or extended care facilit\*).ti,ab. (56)

52 Halfway Houses/ (271)

53 or/41-52 [Other care homes] (28264)

54 exp Aging/ (33115)

55 Geriatrics/ (6190)

56 Geriatric Patients/ (10088)

57 Gerontology/6870

58 (gerontol\* or ageing or aging or elder\* or geriatric\* or seniors or "old age" or older or late\* life).ti,ab. (157409)

59 (old\* adj (person\* or people or adult\* or patient\* or inpatient\* or outpatient\*)).ti,ab. (41520)

60 veteran\*.ti,ab. (11445)

61 or/54-60 [Aged terms] (176363)

62 53 and 61 (9117)

63 34 and (40 or 62) (921)

64 limit 63 to yr="1980 -Current" (905)

## Web of Science, Conference Proceedings Citation Index- Science, 1990-, (ISI Web of Knowledge)

Search run 16<sup>th</sup> November 2012

Number of results: 50

#1 Topic=(polypharm\* or (beer\* SAME criter\*)) OR Topic=((((inappropriat\* or suboptim\* or sub-optim\* or unnecessary or incorrect\* or in-correct\* or excess\* or multip\* or concurrent\*) SAME (medici\* or medicat\* or prescrib\* or prescription\* or drug\*)))) OR Topic=((((over SAME (prescrib\* or prescript\*) or (overprescrib\* or overprescript\*)))) OR Topic=((((under SAME (prescrib\* or prescript\*) or (underprescrib\* or underprescript\*)))) OR Topic=((medication appropriateness index\*)) OR Topic=(quality SAME (prescribing or prescription\* or medication\*)))) OR Topic=((improv\* SAME (prescrib\* or prescription\* or pharmaco\*))) OR Topic=((prescrib\* SAME cascade\*)) (19750)

#2 Topic=(Assessing care of vulnerable elders) OR Topic=(acove) OR Topic=((multi-drug\* or multi drug or multidrug\*)) OR Topic=(Medication Errors) OR Topic=(pharmaceutical preparations) OR Topic=((pharmaceutical or pharmaceuticals)) OR Topic=((pharmacist\* or pharmacy technician\*)) OR Topic=(Prescription Drugs or Drug Prescriptions) OR Topic=(medication therapy management) OR Topic=(drug toxicity) OR Topic=(stopp start) OR Topic=(Screening Tool of Older Person's Prescriptions) OR Topic=(Screening Tool to Alert doctors to Right Treatment) OR Topic=((medication SAME (management or review\*))) OR Topic=((pharmaco-therap\*)) OR Topic=(drug therapy) OR Topic=((drug utilization SAME (review\* or evaluat\*))) OR Topic=(drug monitoring) OR Topic=(drug regimen review\*) OR Topic=(case conferencing) (31664)

#3 #2 OR #1 (46729)

#4 TS=(("homes for the aged") OR TS=(("care home" or "convalescent home" or "care center\*" or "convalescent center\*" or "care centre\*" or "convalescent center\*" or "care facilit\*" or "convalescent facilit\*")) OR TS=(("nursing home\*" or "group home\*" or "residential home\*")) OR TS=(("skilled nursing facilit\*" or "intermediate nursing facilit\*")) OR TS=(("aged care facilit\*") OR TS=(resident\* SAME (care or facilit\*)) OR TS=((longterm or long term or long-term) SAME (care or facilit\*))) OR TS=(("assisted living") OR TS=(("life care cent\*" or "continued care cent\*" or "extended care facilit\*")) OR TS=(Halfway houses) (13434)

#5 TS=(("aged or elder\* or geriatric\* or seniors or "old age" or older or "late\* life")) OR TS=(("old\* person\*" or "old\* people" or "old\* adult\*" or "old\* patient\*" or "old\* inpatient\*" or "old\* outpatient\*")) OR TS=(("veteran\*") (68647)

#6 TS=(random\* or RCT\*) (152549)

#7 #6 AND #5 AND #4 AND #3 Databases=CPCI-S, CPCI-SSH Timespan=1990-01-01 - 2012-11-28

Lemmatization=Off (50)

## Appendix 2. Google scholar search strategy

Searched 16<sup>th</sup> November 2012

Number of results: 59

(prescription\* or prescribing or drug\* or medicine\* or medication\* or pharma\* or polypharmacy) and (residential or care home\* or care facilit\* or nursing home\*) and (elder\* or aged\* or old\* or seniors or geriatric\* or gerontol\*) Books excluded. No date limit.

## Appendix 3. WHO trial registry search strategy

Search run 26<sup>th</sup> November 2012 [Database last updated 26<sup>th</sup> November 2012]

Number of results: 2

Each term 1 was searched with each possible combination of the other terms (2-4). Terms were combined using AND

| Term 1     | Term 2            | Term 3  | Term 4       |
|------------|-------------------|---------|--------------|
| Randomised | Nursing homes     | elderly | drugs        |
| Randomized | Residential homes | old     | medication   |
| RCT        |                   |         | pharmacy     |
| Randomly   |                   |         | polypharmacy |



## CONTRIBUTIONS OF AUTHORS

David Alldred conceived and co-ordinated the review and is the guarantor of the review. David Alldred prepared the protocol with support and advice from Carmel Hughes, Nick Barber, David Raynor, Pat Spoor and Tim Chen. Pat Spoor designed the search strategy with input from David Alldred and ran the searches. All authors were involved in the retrieval of papers. David Alldred and David Raynor screened the search results, assessed retrieved papers against the eligibility criteria, appraised the quality of the papers and extracted data from the papers. David Alldred was responsible for entering data into RevMan and drafting the review with input from all authors.

## DECLARATIONS OF INTEREST

David Alldred and David Raynor are co-authors on a study that was included in this review ([Zermansky 2006](#)).

## SOURCES OF SUPPORT

### Internal sources

- School of Healthcare, University of Leeds, UK.

Funding was provided for the services of Ms Pat Spoor to develop the search strategy and run the searches.

### External sources

- No sources of support supplied

## DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We intended to pool results and conduct meta-analyses if studies were homogeneous. However, as studies were heterogeneous, this was not undertaken. Similarly, subgroup analyses were not possible.

## INDEX TERMS

### Medical Subject Headings (MeSH)

\*Homes for the Aged; \*Nursing Homes; Drug Prescriptions [\*standards]; Inappropriate Prescribing [\*prevention & control]; Medication Reconciliation; Quality Improvement [\*standards]; Randomized Controlled Trials as Topic

### MeSH check words

Aged; Humans

**10.5.9      Appendice E9 : Article n° 9 – Interventions to optimise  
prescribing in care homes : systematic review**

|                          |   |
|--------------------------|---|
| Article n° 9             | <b>Interventions to optimise prescribing in care homes : systematic review</b>  |
| Auteurs                  | Loganathan, M., Singh, S., Franklin, B. D.,<br>Bottle, A., & Majeed, A. (2011).   |
| Titre                    | Les concepts clé sont précisés (intervention to optimise prescribing) mais pas la population étudiée.   |
| Résumé                   | <p>Présence d'un résumé qui contient les points suivants :</p> <ul style="list-style-type: none"> <li>• <b>Background</b> : Prescrire des médicaments à des personnes âgées est un processus complexe et peut augmenter le risque de prescriptions inappropriées. Leur but est d'analyser les effets des interventions afin d'optimiser les prescriptions dans les homes.</li> <li>• <b>Méthode</b> : Revue systématique d'articles dans MEDLINE, EMBASE, International Pharmaceutical Abstracts et la Cochrane Library. Un screening et une évaluation de la qualité méthodologique ont été entrepris.</li> <li>• <b>Résultats</b> : 16 études remplissent les critères. 4 stratégies d'intervention sont identifiées : formation du personnel, rencontres multidisciplinaires, revue des médicaments par un pharmacien, système informatisé d'aide à la décision clinique.</li> <li>• <b>Conclusion</b> : Les résultats sont variés et il n'y a pas de stratégies d'intervention qui ont été prouvées efficaces. Toutefois, la formation semble plus prometteuse. Une approche multifacettes et des protocoles clairs sont nécessaires pour améliorer la prescription.</li> </ul> |
| <b>INTRODUCTION</b>      |   |
| Problème de la recherche | <p>Le but de la revue est d'interpréter les résultats d'études qui ont évalué n'importe quel type de stratégie pour améliorer les prescriptions en home.</p> <p>Le phénomène est pertinent dans le sens où les auteurs précisent que les personnes âgées ont souvent plus de comorbidités, des changements liés à l'âge dans la pharmacocinétique et pharmacodynamique et sont polymédiqués.</p>  |

|                               |  |
|-------------------------------|--|
|                               | Actuellement, peu de recherches ont été entreprises pour évaluer les interventions dans les homes afin de réduire les prescriptions inappropriées.   |
| Recension des écrits          | Les auteurs citent plusieurs études afin d'appuyer leurs affirmations (les personnes âgées se voient prescrire plus de médicaments que les personnes plus jeunes, les personnes en home sont plus vulnérables aux prescriptions inappropriées, etc.)   |
| Cadre de recherche            | Les différents concepts liés à l'étude (prescription, intervention) ne sont pas définis clairement. La recherche ne s'inscrit pas dans un cadre de référence théorique.  |
| Buts et question de recherche | Le but est énoncé de façon claire et précise (voir problème de recherche). Toutefois, les questions de recherche, les hypothèses, les variables clés ne sont pas citées.   |
| <b>METHODE</b>                |  |
| Population et échantillon     | <p>Une recherche de littérature sur différentes bases de données à été conduite (MEDLINE, EMBASE, International Pharmaceutical Abstracts, Cochrane Library) ; différents mots-clés sont utilisés (cf. p. 152, figure 1 de l'article).</p> <p>Les articles trouvés ont ensuite été évalués selon le titre et le résumé afin de déterminer s'ils rentrent dans les critères d'inclusion :</p> <ul style="list-style-type: none"> <li>• Etudes contrôlées randomisées ou non randomisées.</li> <li>• Age moyen des résidents <math>\geq 65</math> ans.</li> <li>• Home.</li> <li>• Etudes évaluant des effets d'une intervention sur les prescriptions ; ayant pour but d'améliorer les prescriptions appropriées ou réduire les prescriptions inappropriées</li> <li>• Etudes en anglais.</li> <li>• Etudes publiées entre 1990 et avril 2010.</li> </ul> <p>Les études publiées uniquement en tant que résumé ont été exclues.</p> <p>Dans cette revue, les prescriptions inappropriées sont définies comme étant :</p> <ul style="list-style-type: none"> <li>• L'utilisation de médicaments qui ont plus de risques que de bénéfices.</li> <li>• La prescription d'une dose ou d'une durée inappropriées.</li> <li>• La présence d'interaction médicament-médicament ou médicament-pathologie cliniquement significatives.</li> </ul> |

|                                      |  |
|--------------------------------------|--|
|                                      | <ul style="list-style-type: none"> <li>• Une sous-utilisation de médicaments potentiellement bénéfiques.</li> <li>• La duplication des agents thérapeutiques.</li> </ul>   |
| <b>Considérations éthiques</b>       | Pas de considération éthique présentée puisqu'il s'agit d'une revue de littérature.  |
| <b>Devis de recherche</b>            | <p>La méthode de recherche utilisée dans cet article est une revue de littérature. Les auteurs ont interrogé différentes bases de données (MEDLINE, EMBASE, Cochrane, International Pharmaceutical Abstracts) au moyen de différents mots-clés. Les mots-clés sont précisés dans le diagramme de recherche présentés en page 152 (Search terms used for Medline).</p> <p>La méthode de recherche utilisée a permis de répondre à toutes les questions de départ.</p> <p>L'utilisation de la revue de littérature permet de respecter les critères scientifiques dans le sens où elle compare les différentes recherches sur le sujet. La neutralité est respectée puisqu'il s'agit d'autres recherches qui ne sont pas effectuées par les auteurs.</p> |
| <b>Modes de collectes de données</b> | Un diagramme de recherche de littérature est présenté en page 152 de l'article.  |
| <b>Conduite de la recherche</b>      | <p>Le processus de récolte de données est décrit :</p> <ul style="list-style-type: none"> <li>• 2 auteurs ont effectué la recherche dans les bases de données puis évalué les titres et résumés afin d'identifier les études qui correspondent aux critères.</li> <li>• Les détails spécifiques des textes ont ensuite été extraits.</li> <li>• Des mesures de résultats ont été effectuées afin de déterminer s'il était possible de faire une méta-analyse.</li> </ul>   |
| <b>Analyse des donnés</b>            | <p>Une évaluation de la qualité de chaque étude retenue a été faite au moyen de l'outil de Downs and Black modifié (score) :</p> <ul style="list-style-type: none"> <li>• Downs SH, Black N. The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. J Epidemiol Community Health 1998; 52: 377-84.</li> </ul> <p>Le score a été complété par deux auteurs (reviewers) indépendants.<br/>Un plus haut score reflète une étude de meilleure qualité.</p>   |

| RESULTATS                     |  |
|-------------------------------|--|
| Présentation des résultats    | <p>Les résultats sont présentés sous forme de texte narratif et un tableau synthétise les études trouvées. Les études sont classées par catégories d'intervention :</p> <ol style="list-style-type: none"> <li>1. Formation du personnel (8 études).</li> <li>2. Revue des médicaments par un pharmacien (3 études).</li> <li>3. Rencontre en équipe multidisciplinaire (3 études).</li> <li>4. Utilisation de support informatique pour la prise de décision clinique (2 études).</li> </ol> <p>Une méta-analyse n'a pas pu être effectuée en raison de l'hétérogénéité des résultats mesurés.</p>  |
| DISCUSSION                    |  |
| Interprétations des résultats | <p>Les résultats sont discutés en fonction de chacune des 4 catégories et correspondent au but fixé au départ :</p> <ul style="list-style-type: none"> <li>• <b>Formation du personnel :</b> catégorie avec la plus forte évidence. La formation du personnel augmente les bonnes prescriptions. Différents types de moyens ont été utilisés. <ul style="list-style-type: none"> <li>○ Formation continue pour les médecins prescripteurs.</li> <li>○ Séminaire pour les infirmiers-ères.</li> <li>○ Education thérapeutique de la famille du patient</li> </ul> </li> </ul> <p>Cette revue montre également que former à la fois les infirmiers-ères et les médecins est plus efficace que former uniquement les médecins. De même, les audits et feed-back n'ont qu'un impact limité sur les pratiques professionnelles et les résultats des soins.</p> <ul style="list-style-type: none"> <li>• <b>Utilisation de support informatique pour la prise de décision clinique :</b> La littérature sur les supports informatiques d'aide à la décision clinique est considérable. La sécurité avec les médicaments est améliorée lorsque les prescriptions sont informatisées. Il y a donc un effet positif. Toutefois, la revue de littérature ne met pas en évidence une différence significative quant à la réduction des effets indésirables au moyen de support informatique d'aide à la décision. Les effets indésirables sont plus rares que les prescriptions inappropriées.</li> <li>• <b>Rencontre en équipe multi-disciplinaire :</b> Ces rencontres sont utilisées pour améliorer la communication entre les professionnels et optimiser les soins. La revue de littérature a mis en évidence 2 études qui démontrent un changement significatif dans les effets liés à la médication.</li> </ul> |

|  |   |
|--|---|
|  | <ul style="list-style-type: none"> <li>• <b>Revue des médicaments par un pharmacien :</b> De toute la revue de littérature, une étude seulement a mis en évidence un effet significatif de l'intervention du pharmacien sur les prescriptions. Cela est probablement dû à un choix inapproprié de la variable. En effet, c'est le changement dans le nombre de médicaments pris qui a été mesuré pour évaluer l'efficacité de l'intervention alors que le dosage a pu être diminué seulement.</li> </ul> <p>Les conclusions découlent logiquement des résultats et les limites sont clairement décrites :</p> <ul style="list-style-type: none"> <li>• Catégorisation des articles pas toujours simple.</li> <li>• Termes de recherche limités et articles en Anglais uniquement.</li> <li>• Certaines études peuvent être considérées comme « vieille » dans la revue (protocoles de prescription et formation des médecins ont évolués). Les auteurs pensent que les stratégies de ces études sont toujours d'actualité.</li> <li>• Difficulté de généraliser les résultats d'un pays à l'autre en raison des différences dans les définitions, la formation du personnel et la supervision des thérapies médicamenteuses.</li> </ul> |
| <p>Conséquences et recommandations</p> | <p>S'appuyant sur cette revue de littérature, les auteurs recommandent des programmes de formation adaptés et qui utilisent plusieurs techniques complémentaires afin d'être efficaces. Les formations peuvent être facilement et efficacement implémentées ; les connaissances ne sont pas spécifiques au patient.</p> <p>La mise en place d'outils informatiques d'aide à la décision et des prescriptions informatisées. Cela demande des ressources conséquentes et peut par conséquent, limiter son applicabilité dans les homes.</p> <p>Les auteurs soulignent l'efficacité des rencontres multidisciplinaires et de la formation du personnel, incluant les pharmaciens, en dépit du manque de preuves d'une revue de la médication par un pharmacien uniquement. Ils soulignent également le caractère transférable de la documentation sur la revue de médicaments en hôpital pour les homes.</p> <p>En raison de l'augmentation croissante de la population âgée, il est nécessaire d'avoir des directives de prescription claires.</p> <p>Finalement, ils recommandent l'exploration d'une combinaison de 2 ou plusieurs stratégies d'intervention</p>   |

|  |  |
|--|--|
|  | <p>afin d'améliorer les prescriptions chez les personnes âgées.</p> <p>En conclusion, les auteurs soulignent le caractère complexe et la limitation des évidences pour améliorer les prescriptions dans les homes. De même, ils estiment que la formation incluant une formation continue montrent le plus de promesses.</p> <p>Enfin, une combinaison de plusieurs stratégies d'intervention sont les plus recommandées afin d'améliorer les prescriptions.</p> |
|--|--|

## SYSTEMATIC REVIEW

# Interventions to optimise prescribing in care homes: systematic review

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## Abstract

**Background:** prescribing for older people is a complex process and can elevate the risk of inappropriate prescribing, with potentially severe consequences. With a growing ageing population, strategies to improve prescribing in care homes are essential. Our aim was to review systematically the effects of interventions to optimise prescribing in care homes.

**Method:** databases searched were MEDLINE, EMBASE, International Pharmaceutical Abstracts and the Cochrane Library from 1990. Search terms included were 'nursing home', 'residential home', 'inappropriate prescribing', 'education' and 'intervention'. Two independent reviewers undertook screening and methodological quality assessment, using the Downs and Black rating scale.

**Results:** the search strategy retrieved 16 studies that met the inclusion criteria. Four intervention strategies were identified: staff education, multi-disciplinary team (MDT) meetings, pharmacist medication reviews and computerised clinical decision support systems (CDSSs). Complex educational programmes that focused on improving patients' behavioural management and drug prescribing were the most studied area, with six of eight studies highlighting an improvement in prescribing. Mixed results were found for pharmacist interventions. CDSSs were evaluated in two studies, with one showing a significant improvement in appropriate drug orders. Two of three studies examining MDT meetings found an overall improvement in appropriate prescribing. A meta-analysis could not be performed due to heterogeneity in the outcome measures.

**Conclusion:** results are mixed and there is no one interventional strategy that has proved to be effective. Nevertheless, education including academic detailing seems to show most promise. A multi-faceted approach and clearer policy guidelines are likely to be required to improve prescribing for these vulnerable patients.

**Keywords:** *systematic review, nursing home, inappropriate prescribing, intervention trial, pharmacist, multi-disciplinary, elderly*

## Introduction

Prescribing in older people is a complex process. Older people often have multiple co-morbidities, age-related pharmacokinetic and pharmacodynamic changes and polypharmacy [1]. Drug safety profiles may have improved in modern medicines provided drugs are prescribed and used appropriately. However, randomised controlled trials of drug treatment for common conditions in the elderly often focus on a single-disease process; they often do not take into account co-morbidities and other factors that may affect the response to treatment; for example, drug–drug

interactions and the effect of the drug on other disease processes [2].

Older people are prescribed more medication than younger people. In England, for instance, while younger people received an average of 9.5 items per year, people aged 60 and over received an average of 42.4 items in 2007 [3]. This almost doubled over a 10 year period; the corresponding figure in 1997 was 22.3 prescription items [3]. With a growing older population, use of prescription medication is projected to rise further as chronic conditions, such as diabetes and hypertension will require more intensive therapy. These high levels of



medication use may lead to increased risk of inappropriate prescribing (IP).

Care home patients are particularly vulnerable to IP: they are more fragile, unable to detect errors in their prescriptions and receive interventions from multiple sources [4]. These patients are therefore at risk of sub-optimal prescribing, particularly overprescribing, receiving up to four times as many prescriptions compared with older people living in the community [5] and prone to 'prescribing cascades' [6]. In the UK, the average number of medications taken at one time by care home residents is between six and seven, with over 20% of patients using more than 10 medications [7–9]. IP in care homes is commonly associated with adverse drug reactions, hospital admissions, mortality and unnecessary health care utilisation [9,10]. With 16% of the population over the age of 65 and an estimated 410,000 older people living in UK nursing and residential homes [11], improving prescribing quality in care homes is important.

While there is evidence on interventions to minimise IP in hospitals, outpatient settings and primary care, little has been done to evaluate interventions in care homes. Reviews have been published in recent years on interventions designed to reduce IP in older people [12, 13] and one has examined pharmacists' interventions to optimise medication use in nursing homes [13]. The purpose of our review was to interpret the results of studies that have evaluated any type of strategy to improve prescribing in care homes. This is the first systematic review examining a range of different types of interventions solely based in care home settings.

## Methods

### Data sources and search strategy

The search strategy aimed to retrieve papers on interventions to improve prescribing in care homes (residential, nursing and mixed homes; defined in Supplementary data, available in *Age and Ageing* online). Databases used were OVIDSP (MEDLINE and EMBASE), International Pharmaceutical Abstracts and the Cochrane Library. We combined three groups of keywords: those relating to the care home setting, those relating to IP and those relating to interventions (Figure 1). All retrieved articles were initially reviewed by title and abstract to find potentially relevant papers. The reference lists for articles that met the inclusion criteria were then reviewed to identify any further papers.

### Study selection

Selected papers were assessed against the following inclusion criteria: (i) randomised or non-randomised controlled studies; (ii) residents' mean age  $\geq 65$ ; (iii) care home-based setting; (iv) evaluated the effect of an intervention on prescribing, aimed at improving appropriate prescribing or reducing IP; (v) written in English; (vi) published between 1990 and April 2010. Studies published only as abstracts

were excluded. In this review, IP in older people was defined as (i) use of medicines that pose more risk than benefit (particularly when safer alternatives exist); (ii) prescribing of inappropriate dose or duration of drugs; (iii) presence of clinically significant drug–drug and drug–disease interactions; (iv) under-use of potentially beneficial medications (v) or duplication of agents [14].

### Data extraction and quality assessment

Two reviewers performed the search and then screened the titles and abstracts independently to identify studies that met the inclusion criteria. Any discrepancies were resolved by discussion or a third independent reviewer. Relevant full text articles were then reviewed to extract specific details. Outcome measures were examined to assess whether a meta-analysis could be performed.

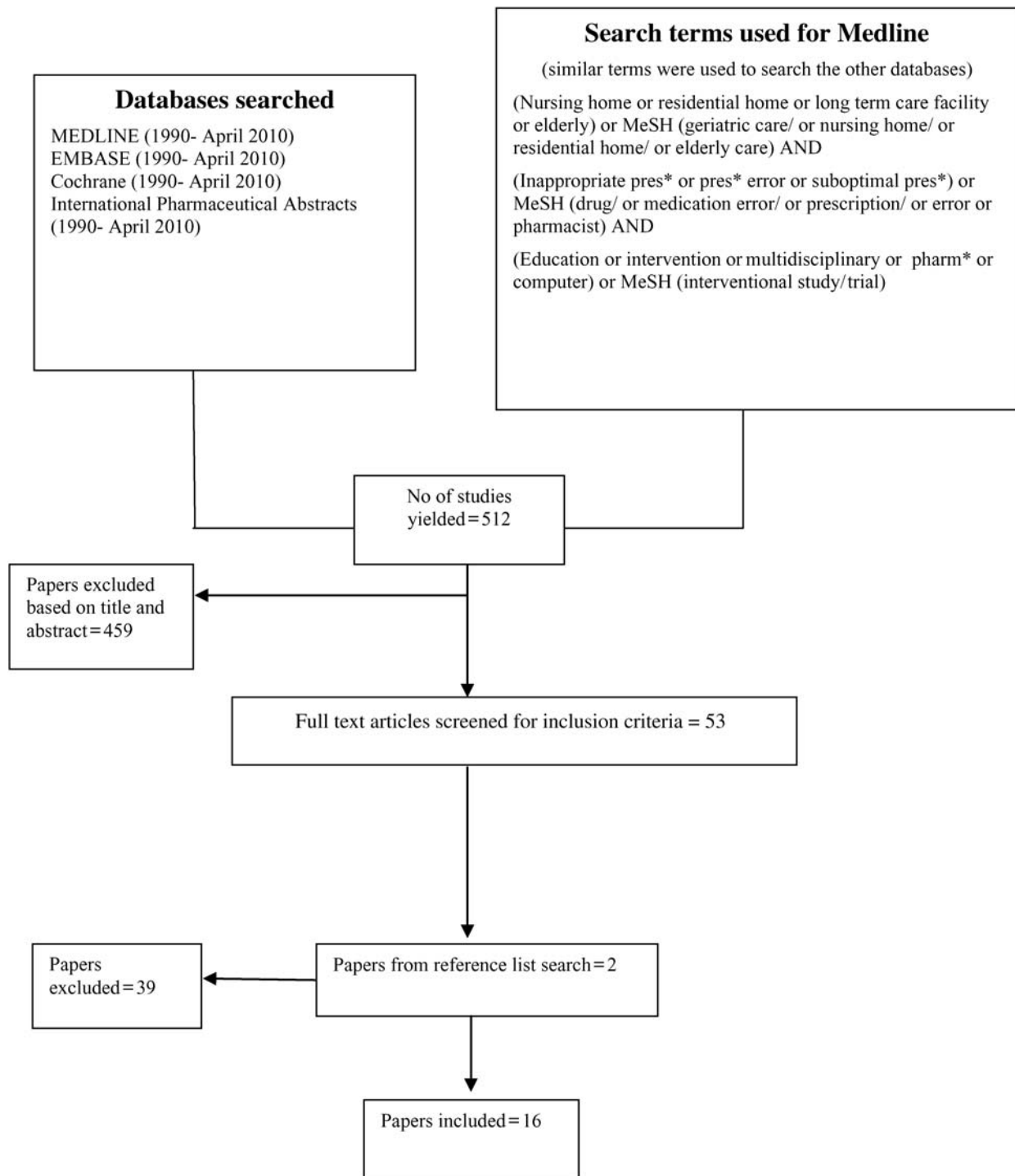
A quality assessment was conducted for each study using a modification of the Downs and Black tool [15]. The published tool comprises 27 items with a maximum score of 32; the last item evaluating the power of the study is scored out of 5. However, in line with previous studies [16], this was omitted due to its potential ambiguity; hence, the maximum score in our review was 27. Scoring was completed by two independent reviewers and discrepancies were resolved through discussion or by a third independent reviewer. Higher scores reflected better study quality.

## Results

A total of 512 articles were identified, of which 16 met the inclusion criteria. Studies were conducted in nursing homes, residential homes, long-term care facilities and mixed homes. Overlaps between some of the interventions exist. However, for the purpose of this review, interventions were grouped into one of the following four groups; staff education (prescribers and/or care home staff;  $n = 8$ ), multi-disciplinary team (MDT) meetings (usually chaired by the prescribing physician;  $n = 3$ ), pharmacist medication reviews ( $n = 3$ ) and computerised clinical decision support systems (CDSSs;  $n = 2$ ). Mean quality scores are presented in Supplementary data, available in *Age and Ageing* online; studies were generally of high quality with mean scores of 20 and above. Two had much lower scores, one due to potential selection bias [17] and one due to potential confounding in a partially controlled before-and-after study [18]. Meta-analysis could not be performed due to heterogeneity in the outcomes measured.

### Staff education

Eight studies (Table 1) reviewed the impact of educational interventions; six showed statistically significant improvements in prescribing quality [18–23]. Academic detailing was used in six of the eight studies, sometimes combined with additional strategies. This is an educational outreach



**Figure 1.** Schematic diagram of the literature search.

programme by an expert, involving face-to-face education with prescribers to discuss relevant clinical practice.

Fossey *et al.* (UK), Meador *et al.* (USA) and Ray *et al.* (USA) evaluated the effect of enhanced psychosocial care training on neuroleptic use, focusing on behaviour management [19–21]. They reported decreased numbers of residents on neuroleptics, reduced antipsychotic doses and reduced days on antipsychotics, respectively. Eide *et al.* (Norway), in their before-and-after study with additional

post-intervention concurrent controls, described the effects of a pharmacist-led education programme on the prescribing of hypnotics [18]. Of six outcome measures assessed, only one showed a significant improvement. Avorn *et al.* (USA) focused on geriatric psychopharmacology, where a comprehensive educational outreach programme led by a pharmacist focused on reducing the overall use of psychotics by improving the selectivity of their use [22]. The intervention resulted in decreased mean psychoactive drug use

Table 1. Summary of studies within the category of staff education

| Intervention    | Author (country, year)                 | Design and setting   | Age        | Inclusion and exclusion criteria  | Description of intervention  | Outcomes  | Follow-up | Statistically significant findings <sup>a</sup>   |
|-----------------|--|--|------------|---|--|---|-----------|---|
| Staff education | Fossey J <i>et al.</i> (UK, 2006) [19] | Cluster RCT, 349 NHR; 12 NHRs (four each in London, Newcastle and Oxford)                    | Median=82  | Inclusion: NHRs with a minimum 25% of residents with dementia taking neuroleptics                             | Training and support to NH staff on alternatives to neuroleptic use and behavioural management techniques<br>Led by psychologist/nurse/OT<br>Old age psychiatrist telephoned to provide/wrote prescribing recommendations  | Proportion of NHR prescribed neuroleptics   | 12 months | Average reduction in proportion of NHR taking neuroleptics (19.1%, 95% CI 0.5–37.7%, $P = 0.045$ )  |
|                 | Eide <i>et al.</i> (Norway, 2010) [18] | Before-and-after study with additional post-intervention concurrent control, 266 NHR; 5 NHRs | Mean =86.5 | Baseline data from 1995's study, post-intervention in 2000 with additional concurrent data from control homes | Results from baseline data on poor use of hypnotics sent to physicians, nurses and directors of the institutions<br>AD: pharmacists held meetings with physicians and nurses to discuss use of hypnotics; information described as six simple 'rules' (e.g. avoid administration early in the evening)       | Change in use of hypnotics  | 5 years   | Higher proportion of patients in 2000 versus 1995 who used high-dose hypnotics<br>Proportion of patients who received hypnotics before 9 p.m. reduced; 44.3% versus 13.3% in 2000 ( $P < 0.01$ )  |
|                 | Avorn <i>et al.</i> (USA, 1992) [22]   | Cluster RCT, 823 NHR; 12 NHRs  | N/A        | Exclusion: NHRs with atypically high/low levels of psychotropics  | Sessions on geriatric pharmacology, e.g. alternatives to sedation in behaviour problems/insomnia<br>Face-to-face education to nurses<br>Leaflets to all physicians of NHR<br>AD: physicians invited for separate session with pharmacist if their prescribing was above threshold during baseline evaluation | Total drug use of hypnotics/benzodiazepines/anti-psychotics, psychoactive drug use scores       | 5 months  | 27% (intervention) versus 8% (control) in mean psychoactive drug use<br>32% (intervention) versus 14% (control) had antipsychotics discontinued<br>Greater reduction in no. of days of antipsychotics use per patient per month in intervention versus control<br>Greater no. of non-recommended hypnotics discontinued and substituted with acceptable drugs/stopped completely (45% versus 21%) |
|                 | Rovner <i>et al.</i> (USA, 1996) [25]  | RCT, 89 NHRs; 250 bed intermediate care NHRs   | Mean =81.6 | Inclusion: residents with both behavioural disorders and dementia   | Implementation of new prescribing guidelines according to protocol for psychotropic drug management led by study psychiatrist<br>Weekly 1 h educational rounds led by psychiatrist on patients' medical status/behaviours  | Composite behavioural disorder—measured as present/absent, antipsychotics use and restraint use | 6 months  | None  |

Continued

Table I. Continued

| Intervention | Author<br>(country, year)                   | Design and setting                       | Age           | Inclusion and exclusion<br>criteria   | Description of intervention  | Outcomes   | Follow-up | Statistically significant<br>findings <sup>a</sup>  |
|--------------|---|--|---------------|---|--|--|-----------|---|
|              | Stein <i>et al.</i> (USA,<br>2001) [23]     | Cluster RCT, 147 NHR;<br>10 pairs of NHs | >65           | Inclusion: NHs with high<br>proportion of residents<br>on NSAIDs (at least 8%<br>on NSAIDs each<br>month), NHR with<br>>1.2 g ibuprofen dose<br>equivalents per day for<br>at least 4 of the past 7<br>days   | 30 min structured training session for<br>staff (60–65% attendance)<br>Telephone conversations ( $n = 8$ )/<br>primary care physicians visited ( $n =$<br>27) by study physician (educational<br>message included risks and benefits<br>of NSAIDs, algorithm for stopping<br>NSAIDs treatment, or substituting<br>with paracetamol or topical<br>analgesia and non-pharmacological<br>methods for muscular pain<br>management)   | NSAIDs and paracetamol<br>use  | 3 months  | Decrease in mean no. of<br>days of NSAIDs use<br>from 7.0–1.9 days<br>(intervention) versus<br>7.0–6.2 days (control),<br>$P = 0.0001$<br>Increase in paracetamol<br>use by 3.1 days<br>(intervention) versus<br>0.31 days (control),<br>$P = 0.0001$ |
|              | Meador <i>et al.</i><br>(USA, 1997)<br>[20] | Cluster RCT, 1311 NHR;<br>12 NHs         | Mean<br>=83.5 | Inclusion: NHs with<br>antipsychotic use<br>prevalence 20%, mean<br>dose $\geq 100$ mg<br>thioridazine equivalents,<br>not specialised in<br>psychiatric patients, no<br>programme to withdraw<br>antipsychotic drugs,<br>NHR for at least 6<br>months after date of<br>study | AD: a 45–60 min visit by<br>geropsychiatrist to all physicians to<br>discuss risk and benefits of<br>antipsychotics, physicians received<br>referral card with summary of key<br>points and flow chart for<br>antipsychotic withdrawal<br>Five to six 1 h programmes for NH<br>staff over a 1 week period, staffs<br>received professionally designed<br>manuals that described behaviour<br>management programme<br>Follow-up session after 4 weeks<br>Evening meeting for families when<br>requested | Change in days of<br>antipsychotic use per<br>100 days of stay,<br>withdrawal from<br>antipsychotics, reduction<br>in antipsychotic dose by<br>50% or more | 6 months  | Decrease in antipsychotic<br>use from 25.3 per 100<br>days to 19.7 per 100<br>days, 23% NHRs had<br>their antipsychotic dose<br>reduced by 50% relative<br>to control ( $P = 0.014$ )   |

|   |  |            |  |   |  |           |   |
|---|--|------------|--|---|--|-----------|---|
| Ray <i>et al.</i> (USA, 1993) [21]          | Controlled before-and-after, 378 NHR; 4 rural NHs  | Mean =81.9 | Inclusion: 2 homes with point prevalence of antipsychotic use >25% and stable for 6 months, 2 comparable homes as controls | AD: old age psychiatrist educated physicians on risks/benefits of antipsychotics, reference card with recommendations and flow chart for drug withdrawal given<br>Six 1 h sessions for NH staff in 3 weeks (held multiple times to enable all staff to attend)<br>Behaviour management programme explained via role play and case examples<br>Manual for weekly follow-up sessions<br>A 4 h consultation by NH management specialist to home's administrator addressing quality care<br>Evening meetings with families to address concerns and explain programme<br>8 weeks' post intervention, meeting held with home medical director, director of nursing, psychiatrist and nurse educator to discuss difficult patients | Changes in administration of psychotropic drugs, physical restraint use, frequency of behaviour problems | 13 months | Days on antipsychotics decreased by 72% (intervention) versus 13% (control) ( $P < 0.001$ )<br>Intervention: 44 of 63 (70%) patients on antipsychotics attempted withdrawal and successful in 30 (48%); control: withdrawal attempted in 13 of 59 (22%) patients and successful in 7 (12%), $P < 0.001$ |
| Crotty <i>et al.</i> (Australia, 2004) [24] | Cluster RCT, 715 NHR; 20 residential facilities-10 hostels (low care) and 10 NHs (high care) | Mean =84.1 | Inclusion: each pair matched from different regions in Adelaide to avoid having homes where the same GP was looking after  | AD: intervention physicians received two 30 min visits by pharmacists, pharmacists visited each facility to speak to staff including physicians re: reducing psychotropic medication, nurses received four 2 h sessions on management of dementia behavioural symptoms, medication management, and fall prevention<br>Discussed benefits of aspirin for those with stroke risk, use of warfarin for AF and treatment for HTN  | Change in percentage of falls, change in psychotropics/warfarin/antihypertensives/aspirin prescriptions  | 7 months  | None  |

AD, academic detailing; ADE, adverse drug events; ADLs, Activities of Daily Living; ADR, adverse drug reaction; AF, atrial fibrillation; CDSSs, computerised clinical decision support systems; CI, confidence interval; Cr, creatinine clearance; GP, general practitioner; HTN, hypertension; MAI, Mean Appropriateness Index; MDT, multi-disciplinary team; NHBPS, Nursing Home Behaviour Problem Scale; NHR, nursing home residents; NHs, nursing homes; NSAIDs, non-steroidal anti-inflammatory drugs; OBRA, Omnibus Reconciliation Act; OT, occupational therapist; RCT, randomised controlled trials; SMPA, Swedish Medical Product Agency; SSRI, selective serotonin re-uptake inhibitors; TCA, tricyclic antidepressants.

\*Only significant improvement in prescribing described.

scores, a scoring tool developed by the authors. Stein *et al.* (USA) assessed the effect of a 30 min structured training session on non-steroidal anti-inflammatory drugs (NSAIDs) prescribing and found decreased NSAIDs use [23].

Neither the studies of Crotty *et al.* (Australia) [24], which focused on falls and stroke prevention using pharmacist-led education, or Rovner *et al.* (USA) [25] which evaluated the effect of educational round by a psychiatrist, resulted in statistically significant changes in prescribing.

### Pharmacist medication reviews

Three studies (Table 2) investigated the impact of pharmacist-led interventions on prescribing [26–28]. Various strategies were used: a single medication review plus consultation with carer and patient, and a clinical pharmacy programme utilising a number of different interventions. Only one of the studies reported statistically significant changes: Zermansky *et al.* (UK) assessed effects of a clinical medication review and reported significant changes in the number and type of medication (medications discontinued and commenced), but the total number of medications used remained the same.

Furniss *et al.* (UK) examined the effects of medication review by a pharmacist and assessed appropriateness of prescribing of neuroleptics based on the USA's Omnibus Reconciliation Act (OBRA) 1987 guidelines [27]. There was a decline in the number of drugs prescribed with corresponding savings in drug costs, although this was not statistically different. Roberts *et al.* (Australia) examined the impact of a clinical pharmacy programme [28]. The intervention was threefold; relationship building with stakeholders, nurse education, and medication review by clinical pharmacists. No significant differences in drug use (total drugs and subcategories) or morbidity indices (hospitalisation rates, adverse drug events) were identified.

### Multi-disciplinary team meetings

Three studies (Table 2) evaluated the effect of MDT meetings on prescribing and two showed statistically significant findings [29, 30].

With a sample representing 5% of Swedish nursing homes, Schmidt *et al.* examined the impact of monthly MDT meetings on adherence to the 1994 Swedish Medical Product Agency (SMPA) prescribing guidelines [29]. The SMPA guidelines, which provide recommendations on the use of psychotropics, were available to all physicians in Sweden but were actively distributed to physicians in the intervention homes. The intervention resulted in a significant decrease in the prescribing of several psychoactive drugs. Crotty *et al.* (Australia) conducted MDT meetings in the presence of a representative from the Alzheimer's Association of South Australia. The Medication Appropriateness Index (MAI) was used to assess the appropriateness of medication [30]. A within-facility control was

also set up to assess any 'carry-over' effect. A significant improvement in appropriateness of prescribing and no evidence of 'carry-over' effect to other residents were demonstrated in the intervention homes.

King *et al.* (Australia) carried out a controlled before-and-after study where cases for discussion were selected by their GPs who then led a 30 min case discussion and management plan. No significant changes were reported in medication use, cost and mortality [17].

### Computerised clinical decision support systems

Two studies (Table 2) evaluated the effects of CDSSs on prescribing in the elderly [31, 32]. One examined the effect of a CDSS on the appropriateness of drug orders in patients with renal insufficiency in Canada, and identified significantly more appropriate drug orders [31].

Gurwitz *et al.* (USA) identified no effects on the overall number of adverse drug events after implementation of a CDSS for 12 months [32].

### Discussion

We identified 16 studies, grouped into one of four categories. Only one study used more than one intervention [28], although we categorised it as pharmacist review since this was the main component of the intervention. Multi-faceted interventions may be expected to be more powerful than using individual tools alone [33].

### Staff education

Staff education, especially academic detailing, has the strongest evidence, with half of the studies having evaluated this intervention strategy and six of eight showing improvements in prescribing. The six 'successful' studies employed interactive techniques: academic detailing with face-to-face interaction between the prescribing physician and a group of experts, workshops for nurses, and family education. This review found that educating both physicians and nurses proved to be effective; previous work demonstrated that educating physicians alone was not as effective [34]. Two studies did not show any significant improvement in prescribing quality [24, 25]. Crotty *et al.* presented physicians with stroke management and psychotropic use guidelines together with audit results [24]. Audits' limited effect is consistent with a Cochrane review which showed that audit and feedback have only a small to moderate impact on professional practice and healthcare outcomes [35]. Other limitations in the study, when compared with the more 'successful' studies, were fewer educational sessions and poor attendance by participating GPs. Rovner *et al.* had several flaws in their study design. The study had a small sample size and was conducted in a single 250-bed intermediate-level nursing home with risk of 'cross-over' effects between control and intervention groups [25].

**Table 2.** Summary of studies within the category of pharmacist medication reviews, MDT meetings and CDSSs

| Intervention                  | Author (country, year)                             | Design and setting   | Age            | Inclusion and exclusion criteria   | Description of intervention  | Outcomes   | Follow-up | Statistically significant findings <sup>a</sup>  |
|-------------------------------|--|--|----------------|--|--|--|-----------|--|
| Pharmacist medication reviews | Zermansky <i>et al.</i><br>(UK, 2006) [26]         | RCT, 661 residents;<br>65 homes (13<br>nursing, 38<br>residential and 14<br>mixed) | Mean<br>=85.1  | Inclusion: residents on<br>one or more repeat<br>medicines<br>Exclusion: in another trial,<br>terminally ill, already<br>on pharmacist-<br>conducted medication<br>review  | Medication review of records by pharmacist<br>Consultation with patient and carer<br>Written recommendations to GP for<br>approval and implementation  | No. of changes in<br>medication per<br>participant, no.<br>and cost of repeat<br>medication,<br>mortality, falls,<br>hospital<br>admissions, GP<br>consultations                           | 6 months  | Increase in mean no.<br>of drug changes<br>per patient: 3.1 for<br>intervention versus<br>2.4 for control ( $P$<br>< 0.0001) |
|                               | Furniss <i>et al.</i><br>(UK, 2000) [27]           | Cluster RCT, 330<br>NHR; 14 NHs  | Mean<br>=81.2  | Each pair matched from<br>different areas in South<br>Manchester to avoid<br>having homes looked<br>after by the same GP   | Regular review by pharmacist at GPs<br>surgery, NH or over telephone<br>Medical history, current medication details<br>and problems identified by NH staff<br>noted<br>NHs revisited 3 weeks post-medicine review<br>to ascertain whether there were any<br>problems with medication changes or<br>implementation  | Type and no. of<br>drugs,<br>appropriateness of<br>prescribing<br>according to<br>OBRA guidelines,<br>use of primary and<br>secondary care<br>resources, no. of<br>accidents and<br>deaths | 8 months  | None   |
|                               | Roberts <i>et al.</i><br>(Australia, 2001)<br>[28] | Cluster RCT, 2261<br>NHR; 52 NHs (1<br>intervention : 3<br>control)                | Mode=<br>80–89 | Inclusion: at least 20<br>residents, within 3 h<br>drive from study<br>centre, supply of drugs<br>under government<br>medication subsidy<br>scheme, and centralised<br>hospitalisations, ADE<br>and deaths records | Contact with GPs indirect<br>Problem-based education sessions to nurses<br>(6–9 sessions): basic geriatric<br>pharmacology and common problems in<br>long-term care e.g. depression<br>Supported by wall charts, telephone<br>consultations, clinical pharmacist visits:<br>approximately 26 h contact per home<br>Drug regimen review by clinical pharmacist<br>for patients selected by NH staff | Mortality rate, no. of<br>hospitalisations,<br>ADE, drug use in<br>terms of total<br>number of drugs<br>and their<br>categories,<br>prescription claims                                    | 1 year    | None   |

*Continued*

Table 2. Continued

| Intervention | Author (country, year)                    | Design and setting                              | Age        | Inclusion and exclusion criteria  | Description of intervention   | Outcomes  | Follow-up | Statistically significant findings <sup>a</sup>   |
|--------------|---|---|------------|---|---|---|-----------|---|
| MDT meetings | Schmidt <i>et al.</i> (Sweden, 1998) [29] | Cluster RCT, 1854 NHR; 33 NHs                   | Mean =83.5 | Inclusion: 2 homes chosen in each area in Sweden with similar NHR and staff characteristics, homes typical for that region, homes supervised by different physicians and separated geographically, physicians who are not geriatricians | Pharmacists arranged monthly MDT meetings, focused on communication skills, drug use in elderly, networking and problem solving and support<br>Attended by nurses, physicians, pharmacists, nursing assistants<br>Discussed drug use for individual patients  | Proportion of residents with any psychotropic drug, proportion of residents with 2 or more drug classes, proportion of residents with 2 or more drugs within the same class, proportion of residents with non-recommended and acceptable hypnotic use by 6% ( $P < 0.001$ )<br>proportion of residents with non-recommended and acceptable antipsychotic prescribing by 19% ( $P = 0.007$ ), decrease in non-recommended hypnotics by 37% ( $P = 0.001$ )<br>Increase in acceptable hypnotic use by 6% ( $P < 0.001$ )<br>Decrease in non-recommended antidepressants (TCAs) and increase in acceptable antidepressants (SSRIs) | 12 months | Increase in 'acceptable' anxiolytics from 13.9% to 20.8% ( $P = 0.02$ )<br>Decrease in antipsychotic prescribing by 19% ( $P = 0.007$ ), decrease in non-recommended hypnotics by 37% ( $P = 0.001$ )<br>Increase in acceptable hypnotic use by 6% ( $P < 0.001$ )<br>Decrease in non-recommended antidepressants (TCAs) and increase in acceptable antidepressants (SSRIs) |
|              | King, (Australia, 2001) [17]              | Controlled before-and-after study, 245 NHR;3 NH | Mean =79.8 | GP selected NHR to review<br>31% of baseline residents reviewed   | Weekly MDT meetings attended by GP, GP project officer, pharmacist, senior nursing staff, and other health care professionals<br>GP presented patient details, followed by a 30 min discussion and then formulated a management plan<br>Questionnaire to GP post-case conference to assess changes and usefulness of review | No. of recommendations and whether beneficial to (i) NHR (ii) carers, changes in number of medications prescribed and administered, medication cost, mortality  | 9 months  | None  |



|       |   |  |             |   |  |   |  |  |
|-------|---|--|-------------|---|--|---|--|--|
|       | Crotty <i>et al.</i> (Australia, 2004) [30]       | Cluster RCT, 154 residents; 10 residential aged-care facilities                                  | Mean = 84.5 | Inclusion: patients prescribed >5 medicines, those dependent for ADLs, those with challenging behaviour and about whom staff want more information and advice | 2 MDT case conferences 6–12 weeks apart<br>Attended by GP, geriatrician, pharmacist, residential care staff and representative from Alzheimer's Association of South Australia<br><br>Independent pharmacist reviewed medication chart pre- and post-intervention using MAI  | Change in MAI, change in NHBPS, changes in monthly drug costs   | 3 months   | Change in MAI score improved in intervention : MAI mean change 4.1 (95% CI 2.1–6.1) versus control: MAI mean change 0.4 (95% CI –0.4 to 1.2, <i>P</i> = 0.001) |
| CDSSs | Field <i>et al.</i> (Canada, 2009) [31]           | Cluster RCT, 833 residents; one long-term care facility with randomisation of 22 long-stay units | Mean = 86.3 | Inclusion: patients with renal insufficiency and all units with computerised physician order entry (CPOE)   | 62 alerts for maximum recommended daily dose/frequency of administration, medication to be avoided, and missing serum creatinine test results or weight  | Proportion of alerts that led to an appropriate final drug order, overall rate of prescribing of 'drugs that should be avoided' | 12 months  | Higher proportion of final drug orders that were appropriate in the intervention units: relative risk 1.2 (95% CI 1.0–1.4)                                     |
|       | Gurwitz <i>et al.</i> (USA and Canada, 2008) [32] | Cluster RCT, 1118 residents; 2 large long-term care facilities                                   | Mean = 87.2 | Inclusion: facilities with existing computerised physician order entry systems without CDSSs<br>Exclusion: patients on short term care                        | Programmed to identify more than 600 potentially serious drug-drug interactions and to display alerts<br>ADEs identified, determined if they were preventable, i.e. if they were errors due to drug–drug interactions etc. and then assessed whether any of the alerts included in the CDSSs could have prevented the prescribing of these drugs | Number of ADEs that could have been prevented by CDSSs, number of ADEs preventable by any means, and severity of the events     | 1 year in one facility and 6 months in the other | None   |

AD, academic detailing; ADE, adverse drug events; ADLs, activities of daily living; ADR, adverse drug reaction; AF, atrial fibrillation; CDSSs, computerised clinical decision support systems; CI, confidence interval; Cr, creatinine clearance; GP, general practitioner; HTN, hypertension; MAI, Mean Appropriateness Index; MDT, multi-disciplinary team; NHBPS, Nursing Home Behaviour Problem Scale; NHR, nursing home residents; NHs, nursing homes; NSAIDs, non-steroidal anti-inflammatory drugs; OBRA, Omnibus Reconciliation Act; OT, occupational therapist; RCT, randomised controlled trials; SMPA, Swedish Medical Product Agency; SSRI, selective serotonin re-uptake inhibitors; TCA, tricyclic antidepressants.

<sup>a</sup>Only significant improvement in prescribing described.

### Computerised clinical decision support systems

There is considerable literature on the value of CDSSs. Evidence from US hospital settings suggests that drug safety can be improved by computerised physician order entry (CPOE) with CDSS [36]. One of the two studies that examined the effect of CDSS showed a positive effect, although the extent of the intervention might have been underestimated as study physicians cared for both control and intervention patients. The Gurwitz study [32] showed no significant difference in the rate of adverse drug events with CDSS; however, adverse drug events are rarer than inappropriate orders and as such differences are likely to be more difficult to detect. The CPOE system was also reported as not able to calculate total daily dose [32] and hence the high number of false alerts in the CPOE system may have led to 'alert fatigue', where the prescriber starts to ignore the alerts [37].

### Multi-disciplinary team meetings

MDT meetings are commonly used to improve communication among healthcare professionals, and to optimise patient care. Of the three studies, those by Crotty *et al.* [30] and Schmidt *et al.* [29] found statistically significant changes in medication-related outcomes. Selection bias could have possibly been introduced in King *et al.*'s [17] study, where patients were selected for MDT discussion by their primary care physician. Staff involved in the MDT meetings also cared for control patients, possibly affecting their care. Moreover, with one month follow-up, this gives no indication of the long-term impact of the intervention.

### Pharmacist medication reviews

The UK's National Service Framework for Older People recommends that patients taking four or more drugs be reviewed six-monthly, with the remainder, annually [38]. The value of a pharmacist in conducting regular medication reviews to reduce IP in hospitals is well established [39–41] and similar results were anticipated in care homes. However, only one of three studies demonstrated a significant effect of pharmacists' interventions on prescribing. This may partly be due to the inappropriate choice of outcome measures. Roberts *et al.* and Furniss *et al.*, for example, used the change in the number of medications as a primary outcome measure. Although with increased number of medications, there is greater likelihood of adverse drug reactions, polypharmacy does not always reflect appropriateness of prescribing, as the initiation of some medications may be clinically indicated [42].

### Choice of outcome measures

Outcome measures varied considerably with a number of authors interpreting a reduction in the total number of medication as an improvement in prescribing, which may not always be true. One of the UK-based studies used the

US OBRA guidelines to assess appropriateness of prescribing. Others have used national or good practice guidelines. One used MAI but interestingly, none used Beer's criteria [43], a USA-based tool commonly used to assess IP in nursing homes.

### Limitations of review

Categorisation of articles was not always straightforward. For instance, academic detailing by pharmacists who reviewed case notes and identified points for discussion as part of an outreach programme was categorised as staff education and not pharmacist medication review [18, 22, 24]. Rovner's study could potentially be classified as management by a specialist combined with MDT meetings [25], but was classified as an educational intervention. In addition, with a limited number of articles, some of which targeted psychosocial interventions more than pharmacotherapy (e.g. behavioural management more than improving prescribing), it is challenging to synthesise the evidence for improved prescribing in care homes [19, 21, 25].

The limited search terms and limit to the English language mean that this systematic review has its limitations. For instance, unless a quality improvement effort was indexed as an intervention, it would have been missed. The types of studies that we had aimed to retrieve have also been subjected to publication bias.

Some studies may be considered 'old', because prescribing guidelines and doctors' training have evolved; however, we believe their strategies are still relevant.

Lastly, we acknowledge the difficulty in generalising findings from one country to another, due to differences in definitions, nature of personnel training and supervision of drug therapy.

### Implications for policy and practice

For educational interventions to be effective, tailored programmes that employ several complementary techniques may be needed; academic detailing with educational reinforcement and follow-up should be directed at all healthcare professionals and possibly family members. Educational interventions can be easy and effective to implement as the knowledge gained is not patient-specific. Sustainability is supported if 'in-house training' is an option, as this will enable GPs to be regularly updated. Conversely, CPOE-CDSS is resource-intensive which may restrict its applicability in care homes.

Monthly pharmacist medication review is mandatory in the USA to improve prescribing in care homes; this has also been proposed for the UK [4]. In our review, MDT meetings [29, 30] as well as staff education [22, 24] involving pharmacists proved successful despite insufficient evidence for pharmacist-led reviews alone. Beneficial effects have been documented in hospitals and may be transferable to care homes, given sufficient pharmacist resource.

With those aged 65 and over predicted to account for 22% of the population by 2033, there needs to be clear guidelines for prescribing. The OBRA 1987 created a set of USA national minimum standards of care and rights for people living in certified nursing facilities [44]. We propose that UK policy be directed to improve the quality of prescribing in care homes based on results of controlled trials. Standardised measurements for measuring IP are also needed to enable effective benchmarking. Finally, we recommend that a combination of two or more interventional strategies is explored to improve prescribing in this population.

## Conclusion

Improving prescribing in care homes is complex and there is limited evidence for effective interventions. This review demonstrated mixed results with substantial evidence and promising options for some of the interventions. Education including academic detailing seems to show most promise. Combinations of intervention strategies are likely to be required.

## Key points

- There is limited evidence for most interventions but education including academic detailing seems to show most promise.
- Combinations of intervention strategies are likely to be required.
- Standardised measures for IP are needed to facilitate comparison across studies.

## Conflicts of interest

Azeem Majeed is a GP Principal in a general practice that provides NHS services to residents of two care homes.

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## Supplementary data

Supplementary data mentioned in the text is available to subscribers in *Age and Ageing* online.

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The long list of references supporting this review has meant that only the most important are listed here and are represented by bold text throughout the paper. The full list of references is available at *Age and Ageing* online.

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**10.5.10 Appendice E10 : Article n° 10 – Improving the quality of pharmacotherapy in elderly primary care patients through medication reviews : a Randomised Controlled Trials**

|               |   |
|---------------|---|
| Article n° 10 | <b>Improving the Quality of Pharmacotherapy in Elderly Primary Care Patients Through Medication Reviews: A Randomised Controlled Study</b>  |
| Auteurs       | Milos, V., Rekman, E., Bondesson, Å., Eriksson, T., Jakobsson, U., Westerlund, T., & Midlöv, P. (2013).   |
| Titre         | Le titre précise clairement les concepts clé (pharmacothérapie, revue de la médication) et la population concernée (personnes âgées en home).   |
| Résumé        | <p>Un résumé est présent, contenant :</p> <ul style="list-style-type: none"> <li>• <b>Background :</b> la polymédication chez la population âgée suédoise est une priorité de recherche, avec un focus sur la réduction des médicaments potentiellement inappropriés.</li> <li>• <b>Objectif :</b> Evaluer un modèle structuré pour une revue de la médication dirigée par un pharmacien et mesurer ses effets sur un nombre de patients avec une médication potentiellement inappropriée (<math>\geq 10</math> médicaments et <math>\geq 3</math> psychotropes).</li> <li>• <b>Méthode :</b> Essai clinique contrôlé randomisé sur un groupe de patients âgé <math>\geq 75</math> ans et vivant dans des homes. La revue de la médication a été effectuée par des pharmaciens cliniciens formés sur la base de l'évaluation infirmière des symptômes en partenariat ou sur feed-back du médecin.</li> <li>• <b>Résultats :</b> 369 patients ont été inclus (182 dans le groupe « intervention » et 187 dans le groupe « contrôle »). Un tiers des patients dans les deux groupes a au moins une prescription potentiellement inappropriée à la base. 2 mois après la revue de la médication, le nombre de patients du groupe « intervention » ayant 10 ou plus de médicament ou au moins 1 prescription inappropriée a diminué. Pas de changement dans le nombre de médicaments psychotropes (dosage diminué par contre). Un problème lié à la médication a été identifié chez 93% des 182 patients du groupe « intervention ».</li> </ul> |

|                               |  |
|-------------------------------|--|
|                               | <ul style="list-style-type: none"> <li>• <b>Conclusions :</b> La revue de la médication impliquant un pharmacien est une méthode faisable pour réduire le nombre de patients avec une médication potentiellement inappropriée.</li> </ul>  |
| <b>INTRODUCTION</b>           |  |
| Problème de la recherche      | <p>Le problème à l'étude n'est pas clairement défini, toutefois les auteurs définissent l'état des lieux : la thérapie médicamenteuse est un défi chez les personnes âgées.</p> <p>En l'état actuel des connaissances, évaluer les revues de la médication par un pharmacien est tout à fait pertinent (les auteurs citent plusieurs recherches pour appuyer leurs dires).</p>   |
| Recension des écrits          | <p>Une recension des écrits n'est pas présentée comme telle. Toutefois, les auteurs s'appuient sur différentes études afin d'étoffer les différents concepts mis en avant dans leur recherche (défi de la thérapie médicamenteuse chez la personne âgée, médication potentiellement inappropriée, revue de la médication, semainier, la revue de la médication dans les soins primaire en Suède) et établir un état des connaissances actuelles pertinents.</p>  |
| Cadre de recherche            | <p>Les différents concepts relatifs à l'étude sont définis :</p> <ul style="list-style-type: none"> <li>• <b>Problème lié à un médicament :</b> expérience indésirable qui implique une thérapie médicamenteuse et qui interfère avec les résultats souhaités du patient.</li> <li>• <b>Revue de la médication :</b> Pas de définition univoque.<br/>Définition mise en avant dans la présente recherche : Evaluation des médicaments du patient avec pour but la gestion des risques et l'optimisation des résultats de la thérapie médicamenteuse en détectant, résolvant et prévenant les problèmes liés aux médicaments.</li> </ul> <p>Les concepts sont à mettre en lien avec l'approche intégrée mise en place en Suède (the Lund Integrated Medicines Management model) dont l'utilisation a démontré une réduction des médicaments potentiellement inappropriés et des hospitalisations liées aux médicaments.</p> |
| Buts et question de recherche | <p>Les buts de l'étude sont de :</p> <ul style="list-style-type: none"> <li>• Evaluer un modèle structuré de soins en étudiant l'impact d'une revue de médication sous la conduite d'un pharmacien sur le nombre de patients utilisant une médication potentiellement inappropriée.</li> </ul>   |

|                                      |   |
|--------------------------------------|---|
|                                      | <ul style="list-style-type: none"> <li>• Evaluer si ce modèle d'intervention conduit à une diminution du nombre de patients utilisant <math>\geq 10</math> médicaments et <math>\geq 3</math> psychotropes.</li> <li>• Essayer de classifier et décrire les types de problèmes liés aux médicaments identifiés durant la période d'intervention et l'impact de la revue de la médication sur la thérapie médicamenteuse des patients.</li> </ul>  |
| <b>METHODE</b>                       |   |
| <b>Population et échantillon</b>     | <p>La population étudiée est clairement décrite :</p> <ul style="list-style-type: none"> <li>• Utilisateur d'un semainier âgé de plus de 75 ans, vivant en home ou bénéficiant de soins à domicile.</li> <li>• Les patients ont été inclus dans l'étude uniquement après avoir donné leur consentement ou celui de l'entourage en cas de troubles cognitifs sévères.</li> </ul> <p>Les auteurs ont invité tous les centres de soins publics à participer à l'étude pour des raisons pratiques (diminuer le nombre de différentes archives électroniques médicales).</p> <p>4 pharmaciens avec au moins 4 ans d'expérience dans la revue de médication ont été sélectionnés afin d'effectuer les revues de médications de la population étudiée.</p> |
| <b>Considérations éthiques</b>       | <p>Cette étude a reçu une approbation éthique du Regional Ethical Review Board de Lund (no : 2011/245).</p>   |
| <b>Devis de recherche</b>            | <p>Le devis de recherche a permis d'atteindre les objectifs fixés au début de l'article.</p> <p>Le choix du devis (essai contrôlé randomisé) respecte les différents critères scientifiques, notamment celui de la neutralité (randomisation).</p> <p>La méthode de recherche proposée est adéquate puisqu'elle cherche à mesurer l'efficacité d'une intervention en comparant deux groupes (l'un subissant l'intervention, l'autre non).</p>   |
| <b>Modes de collectes de données</b> | <p>Les outils de mesure de l'étude ne sont pas décrits.</p> <p>Les observations sont clairement ciblées et reprises dans la partie « Data Collection and Statistical Analysis » de l'article.</p> <p>Les auteurs indiquent clairement les outils qu'ils ont utilisés. Aucun outil n'a été créé pour cette étude.</p>  |

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|                               | La procédure utilisée est cohérente avec les données recherchées et mesurées.  |
| Conduite de la recherche      | Le processus de collecte de données est expliqué sous forme de texte et résumé grâce à deux organigrammes (p. 238 et 239 de l'article).  |
| Analyse des données           | <p>Les méthodes de collecte de données et d'analyse sont décrites. Elles s'appuient sur des outils (catégories utilisées par d'autres auteurs, test t de Student, test de McNemar pour rassembler par paires les observations utilisant IBM SPSS version 20.0 UK).</p> <p>Deux auteurs ont participé aux rencontres à propos de la recherche actuelle afin de s'assurer de la qualité des données récoltées.</p>   |
| <b>RESULTATS</b>              |  |
| Présentation des résultats    | <p>Les résultats sont présentés sous forme de tableaux et résumé par un texte narratif. Ils sont analysés en regard des médicaments potentiellement inappropriés et des problèmes liés aux médicaments.</p> <ul style="list-style-type: none"> <li>• La proportion de patient avec au moins un médicament potentiellement inapproprié a diminué de 6% (<math>p = 0.007</math>) dans le groupe « intervention ». Aucune différence de mortalité n'est constatée dans les deux groupes. Le nombre total de médicaments a significativement diminué dans le groupe « intervention ».</li> <li>• Les deux recommandations principales par le pharmacien pour le médecin ont été l'arrêt du médicament (30%) et une réduction du dosage (28%).</li> </ul> |
| <b>DISCUSSION</b>             |  |
| Interprétations des résultats | <p>Les auteurs déclarent que les revues de la médication impliquant un pharmacien réduisent le nombre de patient avec des médicaments potentiellement inappropriés.</p> <p>Les résultats de l'évaluation de ce modèle de soin ont conduit à une réduction du nombre de patients prenant des médicaments potentiellement inappropriés, à une réduction chez ces mêmes patients du nombre de médicaments consommés et à une identification des problèmes communs liés aux médicaments (sur-prescription, raison d'utilisation du médicament peu claire).</p> <p>Les résultats sont interprétés en regard d'autres études et présentent des résultats similaires.</p>   |



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|  | <p>Aucune différence du taux de mortalité n'est constatée entre les deux groupes (intervention et contrôle). Toutefois, la courte période de suivi doit être prise en considération.</p> <p>L'impact d'une approche multidisciplinaire sur des effets cliniques (morbidity) et l'utilisation des institutions de soins n'a pu être clairement démontré. Les auteurs ont toutefois exclu les interventions combinées de professionnels de la santé (médecin et infirmiers par exemple) où le pharmacien n'était que partiellement impliqué.</p> <p>Les problèmes liés aux médicaments ont été identifiés par une évaluation des symptômes, effectuée par un infirmier travaillant en étroite collaboration avec le patient.</p> <p>Les limites de l'étude sont décrites :</p> <ul style="list-style-type: none"><li>• Les pharmaciens n'ont pas eu de contact direct avec les patients évalués. De ce fait, les problèmes liés aux médicaments ne sont que potentiels.</li><li>• La période de suivi (2 mois) est trop courte pour mesurer les effets d'un arrêt des médicaments psychotropes (ils nécessitent une réduction lente du dosage avant l'arrêt).</li><li>• La revue de la médication par un pharmacien est un processus complexe qui débute avec les observations cliniques infirmières et se termine avec la décision finale du médecin.</li><li>• L'influence sur l'amélioration de la qualité de vie ou sur le taux d'hospitalisation d'une revue de la médication n'a pas été prise en compte dans cette étude.</li></ul> <p>Les auteurs recommandent des recherches approfondies dans plusieurs domaines :</p> <ul style="list-style-type: none"><li>• Explorer une possible association entre les patients âgés qui consomment plusieurs médicaments affectant le système nerveux et les pathologies psychiatriques.</li><li>• Prendre en considération la qualité de vie et le taux d'hospitalisation afin de démontrer l'efficacité de ce type d'intervention (revue des médicaments par un pharmacien).</li></ul> |
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| <p>Conséquences et recommandations</p> | <p>Cette étude a démontré que les prescriptions inappropriées sont un problème de santé et reflètent les études internationales sur le même sujet.</p> <p>Les auteurs concluent leur recherche de littérature en présentant la revue de la médication par un pharmacien comme une méthode envisageable afin de réduire le nombre de patients avec des médicaments potentiellement inappropriés et par là, améliorer la qualité de la pharmacothérapie chez les personnes âgées.</p> |
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# Improving the Quality of Pharmacotherapy in Elderly Primary Care Patients Through Medication Reviews: A Randomised Controlled Study

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## Abstract

**Background** Polypharmacy in the Swedish elderly population is currently a prioritised area of research with a focus on reducing the use of potentially inappropriate medications (PIMs). Multi-professional interventions have previously been tested for their ability to improve drug therapy in frail elderly patients.

**Objective** This study aimed to assess a structured model for pharmacist-led medication reviews in primary health care in southern Sweden and to measure its effects on numbers of patients with PIMs (using the definition of the Swedish National Board of Health and Welfare) using  $\geq 10$  drugs and using  $\geq 3$  psychotropics.

**Methods** This study was a randomised controlled clinical trial performed in a group of patients aged  $\geq 75$  years and living in nursing homes or the community and receiving

municipal health care. Medication reviews were performed by trained clinical pharmacists based on nurse-initiated symptom assessments with team-based or distance feedback to the physician. Data were collected from the patients' electronic medication lists and medical records at baseline and 2 months after the medication review.

**Results** A total of 369 patients were included: 182 in the intervention group and 187 in the control group. One-third of the patients in both groups had at least one PIM at baseline. Two months after the medication reviews, the number of intervention group patients with at least one PIM and the number of intervention group patients using ten or more drugs had decreased ( $p = 0.007$  and  $p = 0.001$ , respectively), while there were no statistically significant changes in the control patients. No changes were seen in the number of patients using three or more

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psychotropic drugs, although the dosages of these drugs tended to decrease. Drug-related problems (DRPs) were identified in 93 % of the 182 patients in the intervention group. In total, there were 431 DRPs in the intervention group (a mean of 2.5 DRPs per patient, range 0–9, SD 1.5 at 95 % CI) and 16 % of the DRPs were related to PIMs. *Conclusions* Medication reviews involving pharmacists in primary health care appear to be a feasible method to reduce the number of patients with PIMs, thus improving the quality of pharmacotherapy in elderly patients.

## 1 Background

### 1.1 The Challenge of Drug Therapy in the Elderly

The elderly population is increasing worldwide, and statistical demographic data estimate that 20 % of the global population will be older than 65 by 2025 [1]. According to the Swedish Central Bureau of Statistics, the proportion of the population aged 65 years or older was 18.8 % in Sweden in 2011. Aging is known to be associated with an increased prevalence of multiple chronic diseases and therefore the use of complex therapeutic regimes. Age-related changes in pharmacokinetics and pharmacodynamics [2], together with co-morbidity and polypharmacy, make the elderly a special group of patients who need to be treated with increased attention [1].

Polypharmacy is a controversial issue and has been found to be related to an increased risk of drug–drug interactions, higher morbidity in the older population, higher numbers of hospital admissions, lower compliance and increased institutionalisation [3]. A comprehensive literature review on the topic shows that polypharmacy is increasing in the elderly and is a major cause of morbidity and mortality in the elderly population worldwide [4]. Lack of continuity in physician contacts, lack of a consistent drug list, and inadequate prescribing and monitoring of drug therapy are some of the reasons for drug-related problems and the need for emergency hospital contacts [4]. A drug-related problem (DRP) has previously been described as “an undesirable patient experience that involves drug therapy and that actually or potentially interferes with a desired patient outcome” [5].

### 1.2 Potentially Inappropriate Medication

Well-defined criteria (Beers’ criteria) for potentially inappropriate medications (PIMs) in the elderly that use toxicological aspects and risk of adverse drug reactions have been described and were updated in 2012 [6]. The lack of good nationally adapted alternatives has led to the wide use in studies of the internationally accepted definition criteria

in order to create tools for identifying PIMs. About half of the drugs listed as PIMs in the Beers criteria are, however, unavailable in Europe. Therefore, criteria corresponding to European drug formularies have been developed, such as the Swedish quality indicators developed by the Swedish National Board of Health and Welfare [7]. They can work as a support for the prescriber in choosing appropriate medications but can even be used by drug and therapeutics committees to follow up doctors’ prescribing habits or to assess the quality of prescribing at the local or national level.

A nationwide register-based study in Sweden showed a strong correlation between the number of prescribed drugs and the number of PIMs, such as anticholinergic drugs, long-acting benzodiazepines, and three or more psychotropic drugs [8]. Use of multiple psychoactive drugs has been identified as particularly problematic in nursing home patients [9].

### 1.3 Medication Review

Optimisation of drug therapy in the elderly can be challenging, and different tools have been tested, such as educational outreach visits [10], medication reports at hospital discharge [11] and pharmaceutical care programmes using community pharmacists and medication reviews [12].

Currently, there is no well-established definition of the term “medication review” but Pharmaceutical Care Network Europe has suggested the following definition: “Medication review is an evaluation of patients’ medicines with the aim of managing the risk and optimising the outcome of medicine therapy by detecting, solving and preventing drug-related problems” [13].

Collaboration between physicians and pharmacists to identify drug-related problems has proven to be useful and led to better patient safety, as well as cost savings [14, 15]. Multi-disciplinary approaches have proved to be very satisfactory in the elderly patient, being appreciated by physicians and nurses, and had long-term effects on the patient’s drug therapy [16].

### 1.4 Multi-dose Drug Dispensing

Community-dwelling elderly individuals and nursing home residents in Sweden use on average eight to ten different drugs [7]. A large proportion of them use multi-dose drug dispensing (MDD). The goal of MDD is to create safer drug therapy, improve the patients’ drug management and adherence, get a complete picture of the patient’s drug prescriptions from different health-care providers as well as to improve communication between hospitals, primary care and communities. However, this service is used

primarily in Sweden and there are no studies to support evidence for such positive effects compared to traditional prescribing. According to data from 2005, 19 % of women and 13 % of men aged  $\geq 75$  years use MDD [8] and a majority of them live in nursing homes. The same study showed that 40 % of these patients were treated with at least one PIM. However, MDD led to fewer dangerous drug–drug interactions and may thus have advantages if used optimally. Disadvantages, including managing difficulties and uncritical renewal of prescriptions, have been mentioned [17]. A majority of the nursing home patients and community-dwelling patients with municipally provided home care in Sweden receive MDD because of high age, co-morbidity, cognitive impairment, polypharmacy and therefore increased care need. The medication is dispensed to the patient by the nurse and the intake is documented, leading to a high level of compliance.

### 1.5 The Medication Review in Primary Care in Southern Sweden

An integrated approach in which pharmacists help in the clinical routine has been developed in hospital care in Skåne County in southern Sweden (the Lund Integrated Medicines Management [LIMM] model) [18] and has been shown to reduce PIMs and drug-related hospital admissions [11]. This model of medication reviews for elderly patients with multiple illnesses originates from an early Swedish study in nursing homes, where medication reviews including the pharmacist in the multidisciplinary team produced a significant reduction in the number of psychotropic drugs [19]. In primary health care in Skåne County, medication reviews have been conducted during the past 10 years in different projects, both in nursing homes and community-dwelling elderly patients with multiple illnesses, and several models and approaches have been tried. The goal of medication reviews has been improved patient safety and quality of medication use, according to the Swedish National Board of Health and Welfare's indicators for good drug therapy in the elderly [7]. The instruments used in the LIMM model have been adapted to work in primary care. The main aim of adapting the instruments for primary care was to implement a new model of care with medication reviews before the patient's annual visit in order to improve the quality of elderly patients' pharmacotherapy in both community-dwelling and nursing home patients.

## 2 Objectives

The primary objective was to assess a structured model of care by studying the impact of pharmacist-led medication

reviews on the number of the patients using PIMs. Secondary objectives were to assess if this intervention model led to a decreased number of patients using  $\geq 10$  drugs and  $\geq 3$  psychotropics. The study also intended to classify and describe the types of DRPs identified during the intervention period and the medication reviews' impact on the patients' medication therapy.

## 3 Methods

The study received ethical approval from the Regional Ethical Review Board in Lund (no: 2011/245).

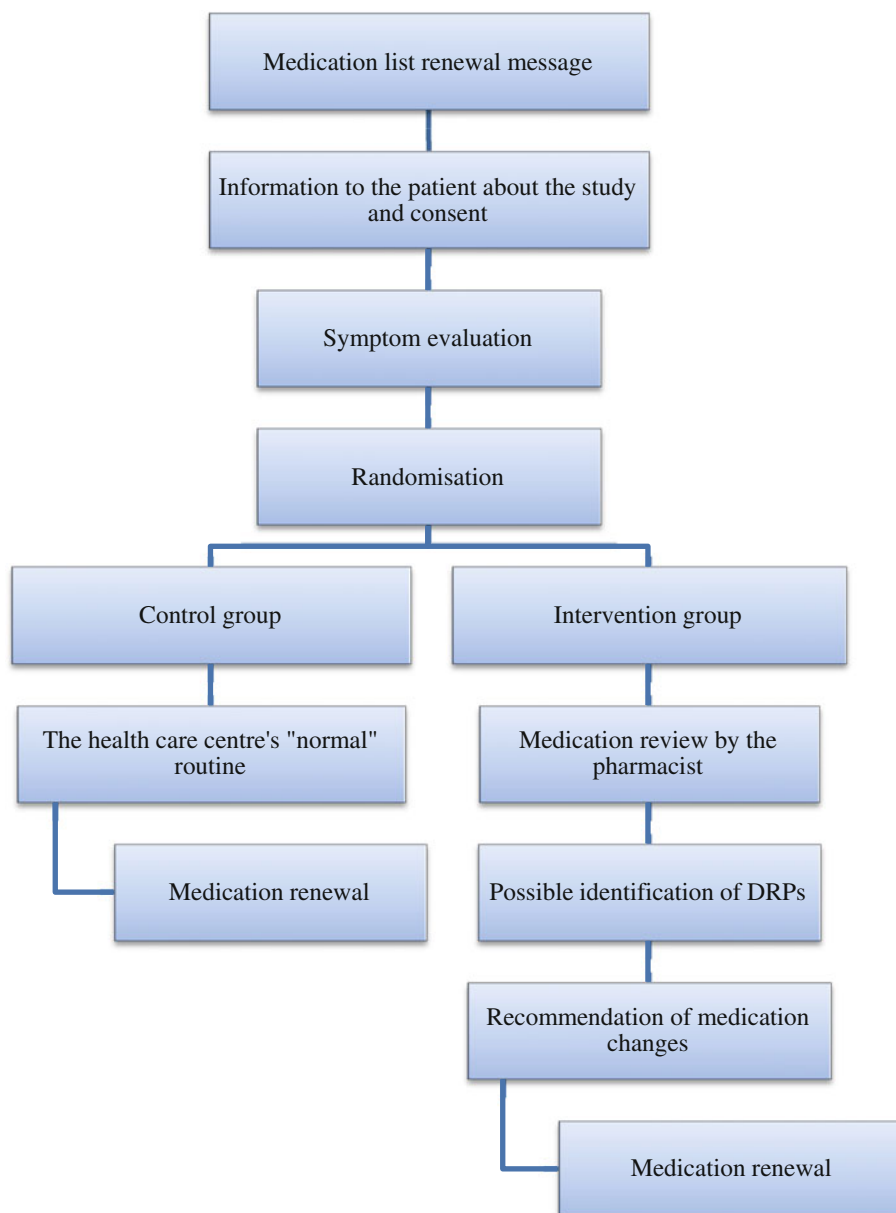
### 3.1 Study Setting and Design

Skåne County is situated in the southern part of Sweden and has approximately 1,150,000 inhabitants. Primary care is provided by public or private primary health care centres (PHCCs). There are 90 public and approximately 40 private PHCCs in Skåne. Due to practical reasons, such as to minimise the number of different electronic medical records (EMRs) we invited all public PHCCs to participate in this study. Four pharmacists were selected and were assigned to one area each. The pharmacists had at least 4 years' experience of performing medication reviews. Patients eligible for inclusion were users of the multi-dose drug dispensing system aged 75 years or older, living in nursing homes or their own homes with municipally provided home care. Patients were included in the study after they provided written consent (directly or through relatives in cases of severe cognitive impairment). The patients were included between 1 September and 16 December 2011 with follow-up data collection continued until 16 February 2012. An overview of the actions in the study is presented in Fig. 1.

### 3.2 Implementation

Prior to the patient's annual visit and medication renewal by the GP, nurses collected the patient's written consent for participation in the study and conducted a specific symptom evaluation and health status check including blood pressure, pulse, weight, tendency to fall and confusion, using a validated symptom assessment form (Phase-20) [20]. After inclusion, the pharmacist used closed, non-transparent envelopes to randomise the patient to one of two groups: control or intervention (Fig. 2). The randomisation was performed using a random number generator and stratified only for geographic area. Medication lists (MDD cards) were printed by the pharmacists who had received permission to access patients' EMR as well as the electronic MDD record.

**Fig. 1** Overview of the study.  
DRPs drug-related problems



### 3.3 Intervention

For patients in the intervention group the pharmacists performed a systematic medication review without personal patient contact. The medication review included assessment of relevant parts of the EMR and collection of data on the patient's blood sample results for creatinine, estimated glomerular filtration rate (eGFR), cystatin C, haemoglobin, sodium and potassium plasma levels.

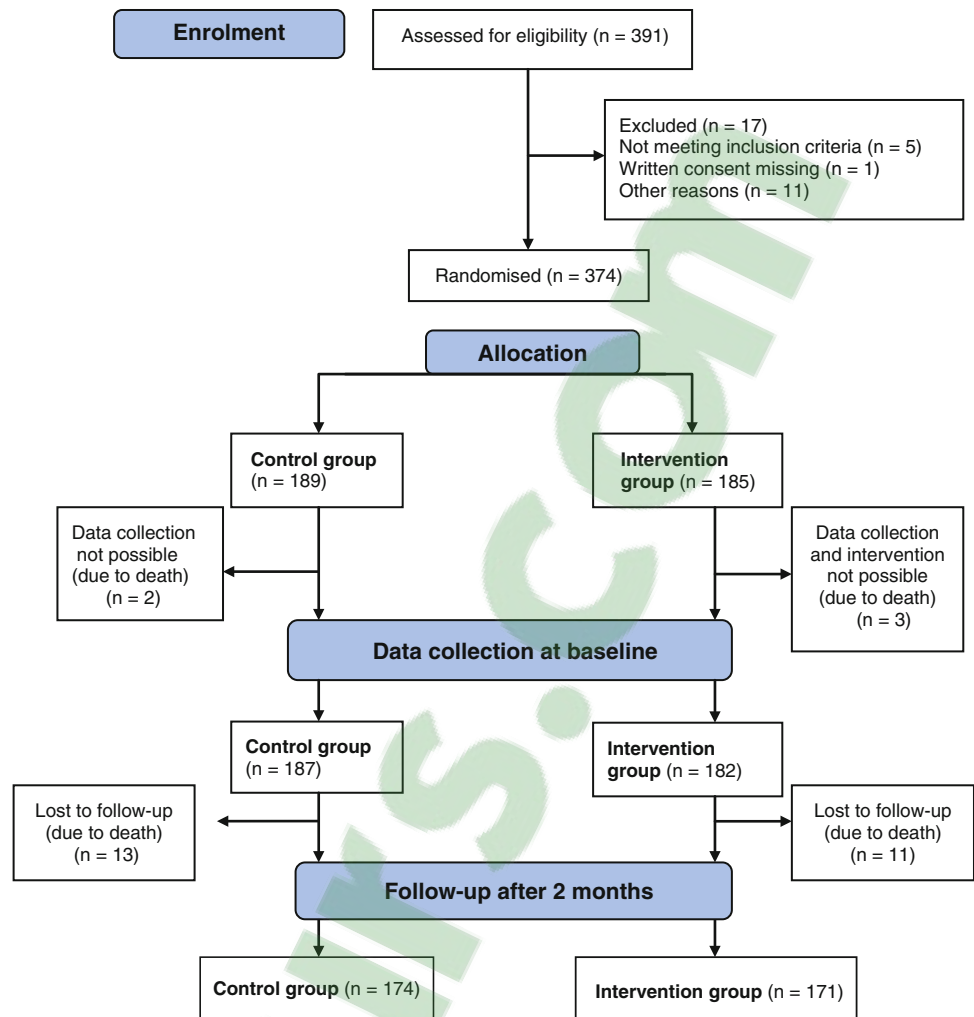
To identify DRPs the clinical pharmacist initiated medication reviews based on the background information (symptom assessment form and the MDD cards). The

working process was carried out in a structured way with formularies compiled from the LImm model [18].

The following predetermined risk categories for identifying DRPs were taken into account by the pharmacist and documented by the student:

- Drugs that required therapeutic monitoring
- Inappropriate drugs for elderly according to The National Board of Health and Welfare (PIMs)
- Drugs that are not recommended according to the regional drug and therapeutics committee
- Problems with administration/handling of the drugs (crush, cut, inhalation technique)
- C/D drug–drug interactions (C interactions are those involving a drug combination that could require dose

**Fig. 2** CONSORT study flow chart of the inclusion and assessment process



adjustment; D interactions are those involving a drug combination that ought to be avoided)

- Drug type or drug dosage not adjusted for the patient (renal function, liver function)
- Unclear indication for drug treatment
- Suboptimal treatment
- Drugs causing potential adverse drug reaction.

The check list including the nine risk categories was an instrument to facilitate the medication review.

PIMs were identified according to the national guidelines of the Swedish National Board of Health and Welfare regarding drug therapy in the elderly [7].

The pharmacists' recommendations were documented in patients' EMRs. The feedback to the physician varied depending on the PHCC's routines and organisation and consisted of team rounds, written contact, personal contact and telephone contact.

To ensure that the pharmacists worked similarly, they were formally instructed in one tutorial by the head pharmacist (E.R.) about the method of medication review, had

monthly meetings with the data collector (S.W.) and had one meeting with the head researcher (V.M.). In addition, the head pharmacist was available for consultation throughout the entire study.

### 3.4 Data Collection and Statistical Analysis

The required sample size was estimated to be at least 160 patients ( $n = 80$  per group) by power calculation analysis ( $p = 0.05$ ; power: 0.80) based on the assumption that 40 % of respondents would have at least one inappropriate drug. The intervention was expected to reduce this proportion to 20 %. The calculation was based on previous studies on drug consumption in the elderly [8].

For the intervention patients, S.W. and V.M. compiled drugs associated with the DRPs and assigned categories of risk and type of suggested change in collaboration with the consulting research pharmacist (Å.B.). Medication lists were not assessed for DRPs for the control patients for ethical reasons.

During the data collection, medication lists and patients' EMRs were reviewed at baseline and after 2 months. Drugs were classified according to the Anatomical Therapeutic Chemical (ATC) classification system [21].

The documented DRPs were further classified by S.W and V.M into the seven categories used by Cipolle, Strand and Morley [22]: need for additional therapy, unnecessary drug therapy, wrong drug, dosage too low, adverse drug reaction, dosage too high and compliance problems.

Both S.W. and V.M. participated in the ongoing review meetings of the research team, where the input method was discussed continuously, in order to assure the quality of the collected data.

If a drug prescription was for both continuous use and as needed, it was counted as one drug. Drugs for topical use such as eye drops, moisturisers and topical steroids were included; short-term antibiotic prescriptions were not.

The primary outcome measure was change in the proportion of patients taking PIMs [7] including one or more of the following drugs: intermediate- or long-acting benzodiazepines (ATC group N05BA01, N05CD02 and N05CD03), antipsychotics [N05A, excluding lithium (N05AN)], tramadol (N02AX), propiomazine (N05CM) and drugs with anticholinergic effects (R06, G04 and N05BB). Secondary outcome measures were percentage of patients taking ten or more medications (regularly or as needed) and percentage of patients taking three or more psychotropic drugs (from one or more of the following ATC groups: N05A, N05B, N05C and N06A) regularly or as needed before and after the intervention. The secondary outcome measures are based on the definition of "polypharmacy" as described by the Swedish National Board of Health and Welfare.

Intermediate- and long-acting benzodiazepines prescribed in Sweden are nitrazepam, flunitrazepam and diazepam.

The average age and sex distribution of the patients were determined, as were the average number of drugs per patient and the proportion of patients using drugs in the different ATC subgroups. Data on DRPs, if recommended changes were performed or not and actions taken were also collected. Identification of DRPs was a part of the intervention and thus not made in the control group. The DRPs were identified based on the symptom assessment performed by the nurse at baseline. This was not repeated after the intervention. Focus was on the medication changes in the medication lists with data collection before and after the medication reviews.

Data were analysed according to the "intention-to-treat" principle with the last value carried forward using a single imputation method [23]. A significance level of  $\alpha = 0.05$  was used. Statistical tests were performed for both intention-to-treat and per-protocol analyses using Student's

*t* test and McNemar's test for pairwise observations using IBM SPSS version 20.0 UK.

## 4 Results

A flow chart of the inclusion and assessment steps is presented in Fig. 2. Baseline characteristics are presented in Table 1. In the intervention group the pharmacist had a face-to-face encounter with the physician during team sessions in 20 % of cases. Distance medication reviews were performed in 80 % of the cases. The control and intervention groups were similar, and a majority of patients were females and lived in nursing homes.

### 4.1 PIMs

A total of 391 patients were assessed, and 369 were included in the intention-to-treat analysis. The proportion of patients with at least one PIM decreased in the intervention group (by 6 %;  $p = 0.007$ ) but not in the control group ( $p = 1.0$ ) (Table 2). Similarly, the number of patients taking ten or more drugs decreased in the intervention group but not in the control group (Table 2). No differences in mortality between the groups were seen after the medication reviews: 6.8 % of patients in the control group and 5.9 % of patients in the intervention group died during follow-up (Fig. 2). Nearly one-third of the patients in both the control and intervention groups had at least one PIM for elderly patients at baseline (Table 2). The total number of drugs and number of continuous drugs decreased significantly between baseline and follow-up in the intervention group (Table 3). No significant decreases after the medication reviews were noted in the medication subgroups (antipsychotics, benzodiazepines, etc.). Similar results were found in both intention-to-treat and per-protocol analyses.

### 4.2 DRPs

DRPs were identified in 93 % of the 182 patients in the intervention group. The total number of DRPs in this group was 431 with a mean of 2.5 DRPs per patient [range 0–9 (SD = 1.5)]. No difference between the number of DRPs in community-dwelling patients [mean 2.55 (SD = 1.29)] and nursing home patients [mean 2.53 (SD = 1.33)] was seen ( $p = 0.767$ ).

Drugs acting on the nervous system (26 %), cardiovascular system (25 %) and blood and blood-forming organs (15 %) were the most common ATC classes involved in DRPs.

The distribution of the seven main categories of DRPs identified when data were collected is shown in Fig. 3. Of



**Table 1** Baseline characteristics of intervention and control group patients

| Characteristic   | Control group | Intervention group | <i>p</i> value     |
|--|---------------|--------------------|--------------------|
| Female, <i>n</i> (%)   | 142 (75.9)    | 138 (75.8)         | 0.980 <sup>a</sup> |
| Age, mean (SD)   | 87.7 (5.5)    | 87.0 (5.8)         | 0.662 <sup>b</sup> |
| Place of residence, <i>n</i> (%)                               |               |                    |                    |
| Community  | 47 (25.1)     | 43 (23.6)          | 0.736 <sup>a</sup> |
| Nursing home   | 140 (74.9)    | 139 (76.4)         |                    |
| No. of drugs, mean (SD)  | 12.1 (4.7)    | 11.4 (4.2)         | 0.903 <sup>b</sup> |
| No. of continuous drugs, mean (SD)                             | 9.7 (3.9)     | 9.3 (3.7)          | 0.528 <sup>b</sup> |
| No. of drugs as needed, mean (SD)                              | 2.2 (1.8)     | 2.1 (1.7)          | 0.399 <sup>b</sup> |
| No. of antipsychotics, mean (SD)                               | 0.11 (0.36)   | 0.14 (0.35)        | 0.137 <sup>b</sup> |
| No. of intermediate- or long-acting benzodiazepines, mean (SD) | 0.06 (0.25)   | 0.10 (0.29)        | 0.070 <sup>b</sup> |
| No. of anticholinergics, mean (SD)                             | 0.12 (0.34)   | 0.08 (0.26)        | 0.040 <sup>b</sup> |
| No. of propiomazine, mean (SD)                                 | 0.04 (0.19)   | 0.04 (0.19)        | 0.918 <sup>b</sup> |
| No. of tramadol, mean (SD)                                     | 0.06 (0.24)   | 0.07 (0.27)        | 0.873 <sup>b</sup> |
| No. of psychotropics, mean (SD)                                | 1.93 (1.37)   | 1.71 (1.37)        | 0.750 <sup>b</sup> |

SD standard deviation

<sup>a</sup> Chi-square test

<sup>b</sup> Student's *t* test

the identified DRPs, 67 (16 %) were related to PIMs, as follows: antipsychotics (27), intermediate- or long-acting benzodiazepines (15), tramadol (11), anticholinergics (9) and propiomazine (5).

The two most common intervention recommendations the pharmacist presented to the physician were withdrawal of drug therapy (30 %) and reduced dosage (28 %) (Fig. 4).

Fifty-six percent (241) of the presented DRPs (Fig. 4) resulted in actions taken by the physician such as changes in medication, with a minimum of one and maximum of seven changes for the same patient [mean 1.44 (SD = 1.33)] with no difference between the community-dwelling and the nursing home patients ( $p = 0.946$ ) or between the group receiving team-based medication reviews compared to the distance medication reviews ( $p = 0.363$ ).

The changes in the actions taken by the physician regarding PIMs were significant ( $p = 0.003$ ) for “lowered dosage” (Table 4) and there was a clear tendency to withdraw the PIMs, although it was not significant. There were no significant differences in actions taken on PIMs

between the group receiving team-based medication reviews and the group receiving distance medication reviews.

## 5 Discussion

Our study showed that medication reviews involving pharmacists in primary health care reduced the number of patients with PIMs.

The majority of the patients in the present study were women, were living in nursing homes, were old and were using a large number of drugs, characteristics similar to those in other studies [24–26]. The results demonstrate that the assessed care model led to a reduction in the number of intervention group patients taking PIMs and the total number of drugs these patients were taking and identified common DRPs [27–29], such as overprescribing or unclear reasons for medication use.

Similar to another study using a multidisciplinary approach [30], the present study did not show a decrease in

**Table 2** Changes in number of patients with PIMs, patients with  $\geq 10$  drugs or  $\geq 3$  psychotropic drugs

| Variable                                    | Group              | Frequency at randomisation (%) | Frequency at follow-up (%) | <i>p</i> value <sup>a</sup> |
|---|--------------------|--------------------------------|----------------------------|-----------------------------|
| No. of patients with $\geq 10$ drugs        | Control group      | 123 (65.7)                     | 120 (64.1)                 | 0.549                       |
|   | Intervention group | 120 (65.9)                     | 107 (58.7)                 | <b>0.001</b>                |
| No. of patients with $\geq 3$ psychotropics | Control group      | 60 (32.0)                      | 64 (34.2)                  | 0.219                       |
|   | Intervention group | 47 (25.8)                      | 49 (26.9)                  | 0.754                       |
| No. of patients with PIMs                   | Control group      | 58 (31.1)                      | 57 (30.5)                  | 1.000                       |
|   | Intervention group | 60 (33.0)                      | 49 (27.0)                  | <b>0.007</b>                |

PIM potentially inappropriate medication

<sup>a</sup> McNemar's test

Clicours.COM

**Table 3** Changes in medication in the control and intervention groups at follow-up

|   | Group        | Mean number of drugs (range) at baseline | Mean number of drugs (range) at follow-up | <i>p</i> value <sup>a</sup> |
|---|--------------|--|---|-----------------------------|
| No. of drugs  | Control      | 12.1 (3–28)                              | 12.1 (3–29)                               | 0.782                       |
|   | Intervention | 11.4 (2–21)                              | 10.8 (0–22)                               | <b>&lt;0.001</b>            |
| No. of continuous drugs   | Control      | 9.7 (1–27)                               | 9.6 (1–25)                                | 0.327                       |
|   | Intervention | 9.3 (1–20)                               | 8.8 (1–18)                                | <b>&lt;0.001</b>            |
| No. of drugs as needed  | Control      | 2.2 (0–12)                               | 2.5 (0–12)                                | 0.061                       |
|   | Intervention | 2.1 (0–10)                               | 2.0 (0–8)                                 | 0.171                       |
| No. of antipsychotics <sup>b</sup>                              | Control      | 0.11 (0–3)                               | 0.11 (0–3)                                | 1.000                       |
|   | Intervention | 0.14 (0–1)                               | 0.13 (0–1)                                | 0.158                       |
| No. of intermediate- or long-acting benzodiazepine <sup>c</sup> | Control      | 0.06 (0–2)                               | 0.06 (0–2)                                | 1.000                       |
|   | Intervention | 0.10 (0–1)                               | 0.10 (0–1)                                | 0.556                       |
| No. of anticholinergics <sup>d</sup>                            | Control      | 0.12 (0–2)                               | 0.10 (0–3)                                | 0.319                       |
|   | Intervention | 0.08 (0–1)                               | 0.08 (0–1)                                | 1.000                       |
| No. of propiomazine <sup>e</sup>                                | Control      | 0.04 (0–1)                               | 0.04 (0–1)                                | 1.000                       |
|   | Intervention | 0.04 (0–1)                               | 0.03 (0–1)                                | 0.416                       |
| No. of tramadol <sup>f</sup>                                    | Control      | 0.06 (0–2)                               | 0.07 (0–1)                                | 0.416                       |
|   | Intervention | 0.07 (0–2)                               | 0.04 (0–1)                                | 0.103                       |
| No. of psychotropics <sup>g</sup>                               | Control      | 1.93 (0–6)                               | 1.96 (0–6)                                | 0.224                       |
|   | Intervention | 1.71 (0–6)                               | 1.69 (0–6)                                | 0.082                       |

Anatomical Therapeutic Chemical (ATC) classification system codes for medications are provided in footnotes b–g

<sup>a</sup> Student's *t* test

<sup>b</sup> N05A excluding lithium (ATC code N05AN)

<sup>c</sup> N05BA01, N05CD02 and N05CD03

<sup>d</sup> R06, G04 and N05BB

<sup>e</sup> N05CM

<sup>f</sup> N02AX

<sup>g</sup> N05A, N05B, N05C and N06A

the number of patients taking three or more psychotropics, possibly because of multiple illnesses and the remaining need for psychotropics due to cognitive or other psychiatric impairments in this group of patients. This conclusion is, however, only speculative and future research is required to explore a possible association between elderly patients' multiple use of drugs affecting the nervous system and psychiatric morbidity.

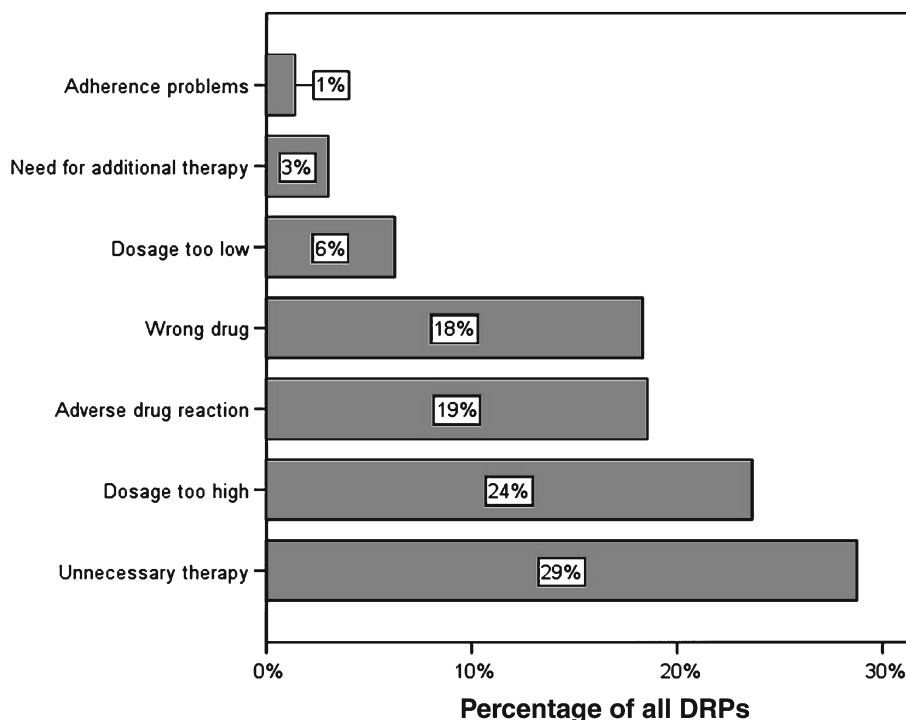
There was no difference in mortality after the performed medication reviews between the intervention and control groups, but the short follow-up period and multiple illnesses in this frail group of elderly patients should be taken into consideration.

Assessing the effect of optimisation strategies on the appropriateness of prescribing in elderly patients is currently a priority for both clinical and interventional health care research [31]. Multi-disciplinary approaches have been highlighted [32], although according to a meta-analysis of randomised controlled trials of pharmacist-led medication reviews, the evidence of an impact on clinical outcomes (e.g. morbidity) and health-care use was inconclusive [33].

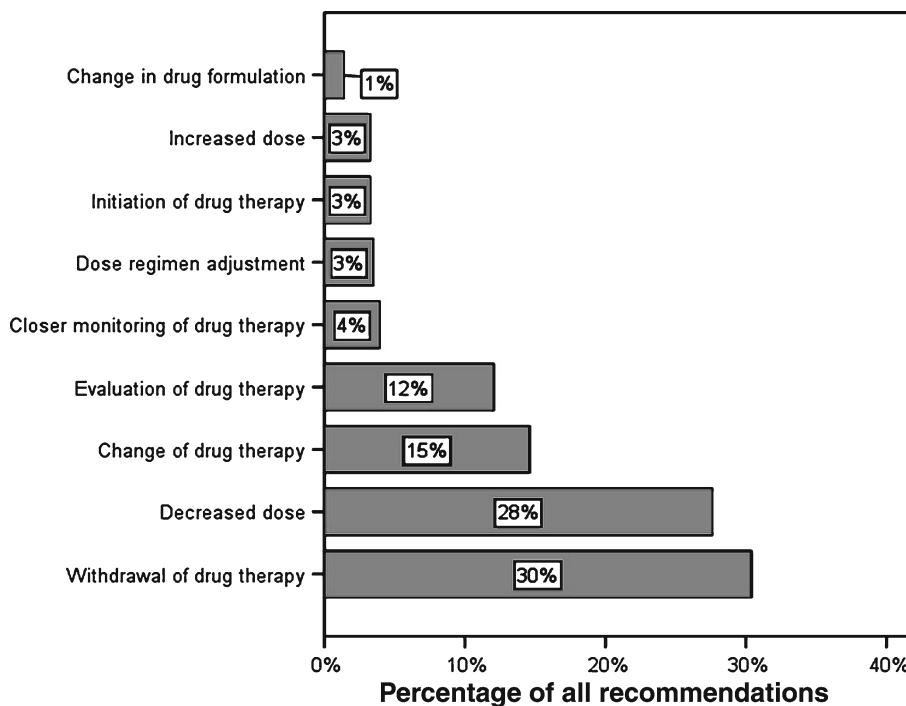
The analysis excluded, however, interventions delivered by combinations of health professionals (e.g. physician and nurses) where the pharmacist was only partly involved. This accentuates the difficulties in measuring the effects of such interventions. Although there is broad knowledge of medication use in older people and tools exist to improve adherence to treatment guidelines, the prevalence of inappropriate prescribing remains high and further studies are needed to identify effective interventions [34].

A strength of our study is that the pharmacists were blinded to patient allocation but not blinded performing the medication reviews. The DRPs were identified by symptom assessment by a nurse working closely with the patient. This information was included by the pharmacist in the written feedback to the physician that was recorded in the patient's EMR and also faxed to the physician as a reminder regardless of medication review form. The MDD cards and EMRs were the central instruments for the assessment of drug therapy, giving current information to the pharmacist and responsible physician and therefore increasing the ability of pharmacists to make an accurate

**Fig. 3** Distribution of drug-related problems in the intervention group by category (N = 431)



**Fig. 4** Distribution of recommended changes in drug therapy in the intervention group (N = 431)



decision in recommending changes in medication. No other medication prescribing interventions were conducted in the districts at the time of the study that impacted on the results. Physicians' decision-making in medication changes was not influenced by patients' living form, implying that the present model of medication review could be applicable

in both community-dwelling and nursing home patients with similar results.

The results from this study have to be interpreted with acknowledgement of its limitations. The pharmacists did not have any direct contact with the assessed patients. Therefore, the identified DRPs are only potential DRPs.

**Table 4** Frequency of changes in PIMs in the control group versus the intervention group

| Action taken by the physician on drug therapy | No. of cases (percent) |              | <i>p</i> value <sup>a</sup> |
|---|------------------------|--------------|-----------------------------|
|   | Control                | Intervention |                             |
| Dose not changed                              | 56 (76.8)              | 45 (64.8)    | 0.349                       |
| PIM out                                       | 8 (11.5)               | 13 (17.5)    | 0.238                       |
| New PIM in                                    | 7 (10.1)               | 2 (2.7)      | 0.098                       |
| Lowered dose                                  | 0 (0.0)                | 10 (13.5)    | <b>0.003</b>                |
| Increased dose                                | 1 (1.4)                | 1 (1.3)      | 0.995                       |

*PIM* potentially inappropriate medication

<sup>a</sup> Student's *t* test

Feedback between the pharmacists and the physicians varied from team discussions to distance reviews, which may partly explain the low rate of physician response in performing medication changes. Fifty-six percent of the presented suggestions led to medication changes. These figures are low compared to those for team-based interventions including a responsible physician in secondary care (65–90 %) [35, 36]. In a British study of elderly nursing home patients, 75 % of the pharmacist's proposals were accepted and of these 76 % were implemented [37]. The present study assessed the implemented medication changes, with results similar to those from other studies performed in primary care [38, 39]. The medical literature supports the theory that valid clinical care recommendations do not always have the desired impact on physicians' behaviour due to cultural barriers [40, 41] or contextual factors (e.g. staffing and resources) [42]. Our study shows that the physicians responded in similar ways after the distance medication reviews compared to the team-based medication reviews.

Inter-professional medication reviews with pharmacists are often studied when performed in face-to-face team discussions [16, 27]. Despite this, distance reviews can have benefits such as accessibility despite large geographical patient distributions and have been performed in southern Sweden as an alternative to team-based medication reviews with positive results concerning quality and quantity of medication and drug costs [43]. Comparison with a model using team-based reviews in another Swedish region showed similar results and the possibility to implement the method should be taken into account in order to improve physicians' adherence to drug therapy guidelines and the inter-professional collaboration.

Medication reviews as interventions performed by pharmacists not primarily responsible for the prescribing decision have previously been criticised for not delivering clear positive outcomes or even potentially worsening health outcomes [44]. Despite this, the present study shows

an effect on the primary outcome measure (number of patients with PIMs).

We estimated that physicians might be most prone to take action within 2 months after the medication review. A longer period to follow-up might also risk a larger dropout because of death in this group of frail patients.

However, the 2-month follow-up period after the intervention may have been too short to measure withdrawal of psychotropic drugs that need a slow reduction in dosage. The analysis of the actions taken by physicians showed a significantly higher frequency of PIM dosage reduction in the intervention group compared to the control group. Dosage reduction is a preferable and recommended step when withdrawal of psychotropics such as long-acting benzodiazepines or antipsychotics is planned.

It is important to mention that the pharmacist's role in reviewing the medication list must be weighed against the clinical reasoning in the final patient assessment and that the path from medication review to the actual implementation of the proposed changes is a complex process. This process starts with the nurses' observation and ends up with the physician's decision.

The assessed method addressed the complexity of prescribing in the elderly, where the professionals were able to collaborate and where use of information technology tools improved drug therapy.

Health outcomes such as improvement in quality of life or effect on hospital admissions were not investigated in this study but should be considered in future studies in order to demonstrate the effectiveness of this kind of intervention.

## 6 Conclusions

This study verifies that inappropriate prescribing is a problem in Swedish elderly patients living in the community or nursing homes, mirroring the results of international studies [26]. Medication reviews involving pharmacists in primary health care appear to be a feasible method to reduce the number of patients with PIMs, thus improving the quality of pharmacotherapy in elderly patients.

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**Conflict of interest** None declared

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## 10.6 Appendice F : Tableau récapitulatif des principaux thèmes des articles 1 à 10

| Articles / thèmes  | Thème 1 : polymédication (introduction)  | Thème 2 : population (population)  | Thème 3 : interventions (intervention)  |
|--|--|--|---|
| <p style="text-align: center;"><b>Article 1 :</b></p> <p style="text-align: center;"><b>Stratégies to reduce medication errors with reference to older adults.</b></p> <p style="text-align: center;">Hodgkinson, B., Koch, S., Nay, R., &amp; Nichols, K. (2006).</p> | <p>Les auteurs disent qu'en Australie 2-4% des hospitalisations sont dues aux médicaments. Les problèmes de santé chez la personne âgée augmentent car elle est polymédiquée. Plus précisément les problèmes en lien avec cette polymédication sont directement liés à : une prescription de médicaments inappropriés, des erreurs dans les prescriptions (dosage, indications) et des erreurs liées à l'administration (horaire) de ces traitements. Une des raisons citée en tant que cause est une mauvaise communication entre le patient et les professionnels de la santé.</p> | <p>Les personnes âgées de plus de 65 ans, ont souvent plusieurs médicaments prescrits par plusieurs médecins et ces traitements sont souvent obtenus des pharmacies différentes ce qui soulève un problème de communication cité préalablement. Les auteurs soulignent un constat fait par le pharmacien lors des visites à domicile que nombreux sont les clients qui gardent des traitements périmés, soit qu'ils les gardent même quand leur traitement est fini.</p> | <p>Les moyens permettant de prévenir la polymédication dans cette étude n'ont pas toutes été efficaces soit par manque de preuve, soit car l'intervention ne montre pas une amélioration significative. Les auteurs nous informent que plus de recherches sont nécessaires pour déterminer l'efficacité des méthodes étudiées. Néanmoins les auteurs proposent les actions suivantes : un système informatisé qui favoriserait des transmissions des ordres médicaux du médecin aux autres professionnels de la santé. Cet outil pourrait réduire les erreurs liées à la rédaction des prescriptions ; un stockage nominatif des médicaments permettrait de réduire les erreurs souvent constatées avec la méthode de stockage générale utilisée dans les hôpitaux ; de plus l'intervention d'un pharmacien qui vérifierait les commandes de médicaments et</p> |



| Articles / thèmes  | Thème 1 : polymédication (introduction)   | Thème 2 : population (population)   | Thème 3 : interventions (intervention)  |
|--|---|---|---|
|  |   |   | pourrait aussi être sollicité en cas de besoin par l'équipe, en tant que conseiller ; la nécessité de contrôler et de vérifier les ordres médicaux avant leur administration par deux infirmiers diminue les erreurs.           |
| <p align="center"><b>Article 2 :</b></p> <p><b>Registered nurses' medication management of the elderly in aged care facilities.</b></p> <p>Lim, L. M., Chiu, L. H., Dohrmann, J., &amp; Tan, K.-L. (2010).</p> | <p>Cet article tente de cibler les connaissances des infirmiers Australiens, dans la gestion des médicaments chez les personnes âgées. Les infirmiers questionnés dans l'article sont soit de niveau un (spécialisés avec des compétences pour travailler dans de nombreux secteurs) soit de niveau deux (ceux qui travaillent sous la direction des niveaux un). Des connaissances pharmacologiques sont nécessaires car les effets indésirables de la polymédication chez les personnes âgées sont en augmentation à cause du risque des interactions médicamenteuses qui y sont associés. Un questionnaire a été créé afin d'évaluer les connaissances des infirmiers avant et après un programme d'éducation pharmacologique.</p> | <p>Les personnes âgées décrites ici sont des résidents de home. Leur âge, selon l'article étudié par les auteurs, est de plus de 60ans ou 65ans. Etant donné l'âge avancé induit une métabolisation moins efficace des médicaments il est important que les infirmiers aient des connaissances approfondies en pharmacologie s'ils veulent évaluer et prévenir les risques potentiels liés aux médicaments inappropriés et mal absorbés. L'article nous informe que dans le cas où une personne âgée prend plus de 8 médicaments, le risque des effets indésirables est à 100%.</p> | <p>Malgré certaines limites dans cette étude les auteurs proposent une formation pour les infirmiers afin d'améliorer leur niveau de connaissance dans la gestion des médicaments et leurs effets chez les personnes âgées.</p> |

| Articles / thèmes  | Thème 1 : polymédication (introduction)  | Thème 2 : population (population)   | Thème 3 : interventions (intervention)  |
|--|--|---|---|
| <p align="center"><b>Article 3 :</b></p> <p align="center"><b>Polypharmacy : Misleading, but manageable</b></p> <p>Bushardt, R. L., Massey, E. B., Simpson, T. W., Ariail, J. C., &amp; Simpson, K. N. (2008).</p> | <p>Les auteurs ont une approche polysémique de la polymédication. Soit ils considèrent la polymédication à partir d'un seul médicament inapproprié ou alors à partir de 6 médicaments lors d'une même prise. Les définitions de la polymédication que l'on retrouve dans la littérature sont perçues comme imprécises. D'autre part et selon le contexte clinique de prescription, ce phénomène est avancé dans la littérature soit de façon positive ou négative. Les auteurs sont d'accord avec la notion d'hyperpharmacothérapie que l'on retrouve dans certaines études qui signifie un usage excessif de drogue dans le traitement d'une maladie.</p> | <p>Le phénomène de polymédication est investigué chez les personnes âgées (&gt; 65 ans) car cette population est à risque de maladie chronique en lien avec l'espérance de vie et par conséquent l'usage de médicaments multiples et de leurs effets secondaires et d'éventuelles interactions.</p>   | <p>Les auteurs pensent que les professionnels de la sante en soins primaires, ont l'opportunité d'évaluer et contrôler le risque de polymédication chez les personnes âgées à travers des entretiens médicaux et notamment avec l'emploi de l'outil HAT (Hyperpharmacothérapie Assessment Tool, adapté du « Médication Management Outcome » de Bergman-Evans).</p>          |
| <p align="center"><b>Article 4 :</b></p> <p align="center"><b>Polypharmacy in the Elderly : A Literature Review.</b></p> <p>Fulton, M. M., &amp; Allen, E. R. (2005).</p>  | <p>Les auteurs ont tenté de définir la polymédication, existe-t-il des méthodes pour l'évaluer et quelles interventions pour la contrer. Selon les articles étudiés ils constatent qu'il existe des définitions de la polymédication qui la font varier par une prise de 2 à 4, ou 5 comprimés. En Europe le consensus se fait à partir du nombre de comprimés pris tandis</p>   | <p>Dans cette recherche la tranche d'âge ciblée sont les adultes de plus de 60 ans. Il a été démontré que ces derniers sont plus à risque lors de l'emploi de certaines molécules comme la prescription de benzodiazépine. De plus le vieillissement altère la pharmacodynamique et la pharmacocinétique de cette molécule augmentant ainsi</p> | <p>L'article mentionne le Beers Criteria, cet outil sous forme de liste, nomme les médicaments qui sont potentiellement inappropriés pour les personnes âgées. Les outils mnémotechniques comme SAIL (Simple Adverse effects List) et TIDE (Time Individualize Drug Interactions Education) peuvent être utilisés pour réduire le risque de polymédication. Les auteurs</p> |

| Articles / thèmes   | Thème 1 : polymédication (introduction)  | Thème 2 : population (population)  | Thème 3 : interventions (intervention)  |
|---|--|--|---|
|   | <p>qu'aux Etats Unis s'il n'y a pas de raison clinique probante à l'introduction d'un médicament, nous parlerons de polymédication. Les auteurs recommandent de poursuivre la recherche d'une définition adaptée à la polymédication, mais s'accordent pour dire que la polymédication est une utilisation de médicament non indiqué cliniquement. Selon eux, une définition basée sur la quantité de médicament semble inappropriée parce que certaines maladies nécessitent plusieurs traitements.</p> | <p>l'impact de ses effets secondaires comme la chute.</p>  | <p>estiment qu'il faut développer la recherche afin de mieux définir la polymédication et trouver les moyens de la contrôler et/ou diminuer les médicaments qui ne sont pas cliniquement indiqués.</p>  |
| <p><b>Article 5 :</b><br/><b>Polypharmacy in Elderly Patients.</b><br/>Hajjar, E. R., Cafiero, A. C., &amp; Hanlon, J. T. (2007).</p> | <p>Polymédication est déterminée entre 2 et 9 médicaments prescrits. Polymédication augmente le risque des prescriptions inappropriées.</p>  | <p>La personne âgée (&gt; 65ans) est plus touchée par ce phénomène du fait de leurs multiples pathologies qui requièrent plusieurs traitements médicamenteux à la fois faisant apparaître des effets secondaires délétères. Les auteurs définissent le syndrome gériatrique par la polymédication et le risque de chute que ce dernier entraîne.</p> | <p>Les auteurs ont démontré que les prescriptions inappropriées peuvent être réduites si les professionnels de la santé évaluent méticuleusement les traitements des patients. Ils recommandent que dans certains cas une thérapie non pharmacologique pourrait être envisagée. L'importance d'une éducation thérapeutique auprès des patients et/ou leurs familles est aussi conseillée.</p> |
| <p><b>Article 6 :</b></p>   | <p>Polymédication est définie comme plus de 4 traitements médicamenteux. Les auteurs</p>   | <p>Les personnes âgées (&gt; 65ans) sont plus sujettes aux risques liés aux interactions médicamenteuses</p>   | <p>Les médecins, pharmaciens et infirmiers vont passer en revue les médicaments qui sont prescrits aux</p>  |

| Articles / thèmes   | Thème 1 : polymédication (introduction)   | Thème 2 : population (population)  | Thème 3 : interventions (intervention)   |
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| <p><b>Interventions to improve the appropriate use of polypharmacy for older people (Review).</b></p> <p>Patterson, S. M., Hughes, C., Kerse, N., Cardwell, C. R., &amp; Bradley, M. C. (2012).</p> | <p>soulignent le fait que ce mot a pourtant plusieurs définitions y compris « l'administration de plus de médicaments qui est nécessaire cliniquement ».</p>  | <p>et leurs effets indésirables. Ce dernier phénomène s'inscrit dans ce que nomment les auteurs « le syndrome gériatrique » et auquel s'ajoute l'incontinence urinaire, insuffisance cognitive et des problèmes d'équilibre qui favorisent des chutes.</p>   | <p>patients dans les homes et tenter d'en diminuer le nombre. Les professionnels de la santé utilisent le Beers criteria, STOPP/START et MAI (index des médicaments inappropriés) qui sont des outils indispensables pour détecter les prescriptions inappropriées et encouragent ainsi une meilleure utilisation des médicaments. Ce sont surtout les pharmaciens qui utilisent ce type d'outils. Les auteurs suggèrent au personnel de suivre des formations adaptées à l'utilisation de ces outils afin d'améliorer leur utilisation.</p> |
| <p><b>Article 7 :</b></p> <p><b>Health Outcomes and Polypharmacy in Elderly Individuals. An Integrated Literature Review</b></p> <p>Frazier, S. C. (2005).</p>                                      | <p>Les auteurs ont trouvé que dans 16 études, 7 ont donné une définition de la polymédication avec une prise de plus de 5 médicaments. La polymédication amène un risque important de problèmes en lien avec les interactions médicamenteuses et les effets indésirables des médicaments. Une étude citée voit la polymédication comme une médication inappropriée et précise qu'il n'existe toujours pas de définition universelle. Cet article montre qu'en général la polymédication est</p> | <p>Dans cette étude la population avait en moyenne 65 ans ou plus. La polymédication est un facteur dans le placement d'une personne âgée dans un home. Les comorbidités induisent une prescription multiple et on parle alors de polymédication. A cet âge le processus de métabolisation est ralenti et lors d'une polymédication ce même processus est d'autant plus perturbé. De plus, cette population souffre souvent de problème cognitif et/ou visuel et le risque de subir les effets</p> | <p>L'infirmier joue un rôle clé dans la diminution des effets indésirables de la polymédication. Plus de recherche pourraient aider l'infirmier à mieux intervenir et prévenir sur ce sujet. Etant donné que plusieurs traitements médicamenteux sont parfois nécessaires, l'utilisation des logiciels qui alertent les professionnels de la santé sur les interactions médicamenteuses et leur bénéfice/risque est indispensable. D'autre part une approche multidisciplinaire est tout</p>   |

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|  | associée avec des risques de chutes, d'hospitalisation et que le risque des effets indésirables augmente avec le nombre et la durée des traitements.   | indésirables de la polymédication est prépondérant.   | aussi importante car par exemple le pharmacien peut alerter le soignant lors d'une prescription à risque.  |
| <p align="center"><b>Article 8 :</b></p> <p align="center"><b>Interventions to optimise prescribing for older people in care homes (Review).</b></p> <p align="center">Alldred, D. P., Raynor, D. K., Hughes, C., Barber, N., Chen, T. F., &amp; Spoor, P. (2013).</p> | <p>Polymédication est définie par une consommation de plus de 4 médicaments. Ce phénomène est en augmentation chez les personnes âgées du fait de plusieurs facteurs comme par exemple de problème cognitif ne permettant pas au patient d'exprimer les problèmes vécus en lien avec la prise d'un traitement. Lorsque plusieurs médecins sont en charge d'un patient (généraliste, spécialistes) chacun prescrira un traitement adapté. Les auteurs soulignent le fait que dans des essais cliniques il y a un manque de preuve car cette population est souvent absente.</p> | <p>Cette étude cible les personnes âgées résidant dans des homes (cette définition regroupe plusieurs noms pour les homes selon le pays). La personne âgée est définie comme ayant plus de 65ans. Cette population est plus vulnérable car elle est sujette aux comorbidités et le fait que le vieillissement apporte des changements pharmacocinétiques et pharmacodynamiques dans le métabolisme des médicaments.</p> | <p>Cet article s'intéresse aux interventions qui visent l'optimisation globale des prescriptions médicales. Cette optimisation est globale car elle ne cible pas qu'une seule drogue ni une seule classe de médicament. Les auteurs ont proposé aux professionnels prescripteurs une formation sur les risques en lien avec la polymédication et insistent sur l'importance de la communication interdisciplinaire. Malgré un manque de preuve suffisant sur l'effet de cette formation sur les professionnels prescripteurs, les auteurs ont néanmoins trouvé des témoignages scientifiques qui montrent une amélioration dans l'identification et résolution des problèmes associés aux médicaments. L'association de l'utilisation d'une revue médicamenteuse et une bonne communication interdisciplinaire</p> |

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|  |  |  | <p>joue un rôle important dans l'optimisation des prescriptions dans les homes même si les auteurs prétendent que l'efficacité de cette prise en charge n'a pas été démontrée. Davantage d'essais sont nécessaires afin de déterminer l'efficacité de cette prise en charge et notamment au moyen des essais contrôlés randomisés.</p>   |
| <p><b>Article 9 :</b></p> <p><b>Interventions to optimise prescribing in care homes : systematic review.</b></p> <p>Loganathan, M., Singh, S., Franklin, B. D., Bottle, A., &amp; Majeed, A. (2011).</p> | <p>Cet article ne donne pas de définition claire de la polymédication, même si un exemple des homes au Royaume-Uni donne des statistiques qui définissent la polymédication à partir de 6 médicaments et plus que 20% de la population des homes en prend plus de 10. Par contre les auteurs attirent l'attention sur le fait de « prescrire de façon inappropriée » une notion déjà rencontrée dans d'autres articles. Ce problème est en recrudescence et pose le risque des effets indésirables plus spécifiquement chez les personnes âgées dans les homes, étant donné que cette population fragile est moins en mesure de détecter et ou</p> | <p>Une recherche dont l'âge moyen des résidents est de 65ans a montré qu'à partir de 60 ans le nombre de traitements augmente et cela en comparaison avec une population jeune qui en général reçoit moins de 10 médicaments prescrits par an, ce chiffre grimpe jusqu'à plus de 40 chez les personnes âgées dans les homes.</p> | <p>Pour éviter les problèmes en lien avec la polymédication, 4 méthodes de résolution de ces problèmes sont avancées dans cet article : favoriser l'éducation du personnel (les prescripteurs, le personnel soignant des homes) ; favoriser les réunions multidisciplinaires ; la consultation de revues de médicaments rédigées par des pharmaciens et pour finir l'utilisation des systèmes de soutien clinique sur ordinateur. L'éducation du personnel (médecins/infirmiers) a montré une amélioration dans les prescriptions. Les réunions multidisciplinaires, n'ont pas prouvé leur efficacité sur la problématique de la</p> |

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|   | <p>d'exprimer des symptômes indésirables vécus et qui sont en lien avec les nombreux médicaments souvent prescrits par plusieurs médecins à la fois.</p>   |   | <p>polymédication. En ce qui concerne l'intervention des pharmaciens les auteurs n'ont trouvé qu'une étude sur trois, qui a pu montrer un effet positif sur les prescriptions. Il existe beaucoup de littérature sur l'effet positif de l'emploi des systèmes de soutien informatisé mais plusieurs points faibles ont été notés comme une incapacité de calculer les dosages journaliers et un taux élevé de fausses alertes. Les auteurs supposent que l'association de ces 4 méthodes, avec pour priorité l'éducation, semble être le moyen optimal d'améliorer les prescriptions dans les homes.</p> |
| <p><b>Article 10 :</b><br/><b>Improving the quality of pharmacotherapy in elderly primary care patients through medication reviews : a Randomised Controlled Trials</b><br/>Milos, V., Rekman, E., Bondesson, Å., Eriksson, T., Jakobsson, U., Westerlund, T., &amp; Midlöv, P. (2013).</p> | <p>Avec la polymédication le risque d'interactions entre les médicaments est accru chez les personnes âgées et entraîne directement une morbidité et une mortalité chez ces dernières. Les auteurs utilisent le terme « médicaments potentiellement inappropriés » qui vient du « Beers Criteria » qui cible les traitements médicamenteux qui posent un risque élevés d'effets indésirables chez les personnes âgées.</p> | <p>La population mondiale des personnes âgées est en augmentation. Au vieillissement est associée une prévalence de plusieurs pathologies qui nécessitent de multiples traitements médicamenteux. Dans cette étude il a été montré que les personnes âgées résidant dans les homes ou à domicile sont polymédiquées ce qui augmente entre autres, le risque des</p> | <p>Une revue des médicaments, menée par des pharmaciens, est proposée afin d'évaluer les traitements médicamenteux des patients âgés dans le but de minimiser les risques associés à la polymédication. La collaboration des médecins dans une approche multidisciplinaire est utile permettant ainsi de détecter des problèmes en lien avec la polymédication et est appréciée par les infirmiers. 93% des</p>  |

| Articles / thèmes | Thème 1 : polymédication<br>(introduction) | Thème 2 : population<br>(population)                        | Thème 3 : interventions<br>(intervention)   |
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|                   |  | interactions entre médicaments et les séjours hospitaliers. | personnes âgées du groupe d'étude ont au moins 2,5 problèmes en lien avec les médicaments prescrits. Dans 30% des cas les pharmaciens ont recommandé aux médecins de prescrire les traitements en discontinue et dans 28% de réduire le dosage. Cette étude a démontré que ce type de revue est efficace permettant la diminution de médicaments potentiellement inappropriés chez ces personnes. L'article souligne que l'infirmier est souvent l'ultime contrôle qui permettra d'identifier les symptômes liés aux effets indésirables des médicaments. |