L'Unité de coordination clinique des services préhospitaliers d'urgence A clinical telemedicine platform that improves prehospital and community health care for rural citizens

Title

L'Unité de coordination clinique des services préhospitaliers d'urgence: a clinical telemedicine platform that improves prehospital and community health care for rural citizens

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2.1 Résumé

L'accès aux soins de santé dans les régions rurales canadiennes est un défi. L'Unité de Coordination Clinique des Services Préhospitaliers d'urgence (UCCSPU) est un programme de télémédecine qui a été implanté au Centre de santé et de services sociaux (CSSS) Alphonse-Desjardins afin d'améliorer les soins de santé dans les régions de Chaudière-Appalaches et de Québec. Les soins de santé sont administrés à distance par des infirmières et un médecin afin d'améliorer, dans un premier temps, l'accès aux soins de santé de cette population majoritairement rurale. Dans ce but, les techniciens ambulanciers paramédics (TAP) en soins primaires et les infirmières de l'UCCSPU reçoivent une formation complémentaire en dehors de leurs champs de compétences habituels. Les ECG administrés à partir de l'ambulance permettent de diagnostiquer les IAMEST à distance sans passer par le centre hospitalier le plus proche. Les ambulanciers bénéficient du soutien médical afin de surveiller la situation clinique de ces patients lors du transport vers le centre tertiaire de cardiologie. De plus, les TAP en soins primaires peuvent également recevoir l'autorisation d'administrer un analgésique opioïde aux patients souffrants grâce à des prescriptions à distance. L'UCCSPU offre également à des infirmières de CLSC ne bénéficiant pas de la présence d'un médecin 24/7 un soutien médical par système audiovisuel. Dans un deuxième temps, l'UCCSPU permet d'optimiser les ressources médicales. À cet effet, des constats de décès à distance ont été implantés afin d'éviter le transport ambulancier de personnes décédées vers les départements d'urgence. Cette intervention permet de réduire les visites à l'urgence et d'augmenter la disponibilité des ambulances et des TAP pour d'autres interventions. Cet article dresse un portrait du programme de télémédecine de l'UCCSPU et présente des résultats clinico-administratifs préliminaires.

2.2 Summary

Access to health care in Canada's rural areas is a challenge. The *Unité de Coordination Clinique des Services Préhospitaliers d'urgence* is a telemedicine program designed to improve health care in the Chaudiere-Appalaches and Quebec City regions. Remote medical services are provided by nurses and by an emergency physician based in a clinical unit at the Alphonse-Desjardins Community Health and Social Services Center. The interventions were developed to meet two primary objectives. The first objective is to enhance access to quality health care. To this end, Basic Life Support paramedics and nurses were taught interventions outside of their usual field of expertise. Prehospital electrocardiograms were used to remotely diagnose ST segment elevation myocardial infarction and to monitor patients who were *en route* by ambulance to the nearest catheterization facility or emergency department. Basic Life Support paramedics received extended medical authorization that allowed them to provide opioid analgesia via telemedicine physician orders. Nurses from community health centers without physician coverage were able to request medical assistance via a video telemedicine system. The second objective is to optimize medical resources. To this end, remote death certifications were implemented to avoid unnecessary transport of deceased persons to emergency departments. This intervention decreased overall emergency department visits and permitted better use of ambulances and paramedics for emergencies. This paper describes the telemedicine program and presents preliminary clinical and administrative results.

Keywords

Prehospital, emergency medical services, electrocardiogram, rural, telehealth, nurse, Basic
Life Support paramedics, STEMI, UCCSPU, percutaneous coronary intervention, pain management, opioid; fentanyl, community health centers, remote death certification, remote assistance.

2.3 Introduction

Approximately 20% of the Canadian population lives in rural areas. Members of the rural population are older and in poorer health than are urban citizens[1], but the former have reduced access to specialized care, advanced imaging, intensive care units (ICUs), and trauma centers [2]. Many community health centers do not have local 24/7 access to a physician, and are operated solely by nurses during some shifts. Further, the rural population relies on Emergency Medical Services (EMS), which are limited by long travel distances and few vehicles in service[3, 4]. Such reduced hospital and prehospital services pose a threat to rural health care.

The Chaudiere-Appalaches region of Quebec is primarily rural. The population of 418,704 is sparsely distributed across a vast area of 15,073 km^2. A telemedicine program was implemented at the Alphonse-Desjardins Community Health and Social Services Center (a university-affiliated hospital) to improve emergency health care for Chaudiere-Appalaches citizens. The *Unité de Coordination Clinique des Services Préhospitaliers d'Urgence* (UCCSPU) [Emergency Prehospital Services Clinical Coordination Unit] provides online medical support to emergency medical technicians (EMTs) and nurses in the Chaudiere-Appalaches and Quebec City regions (See Figure 1). A nurse and an emergency physician are available 24/7. The specially trained nurses work in a designated telehealth room. The unit improves access to quality health care and optimizes resources in two ways. First, EMTs and nurses from community health centers learn interventions that are typically beyond their expertise. Second, the use of the UCCSPU decreases the use of health care resources. The following sections describe the UCCSPU program.

2.4 Description of UCCSPU program and preliminary analyses

In the province of Quebec, EMS are primarily provided by Basic Life Support (BLS) paramedics. BLS paramedics are authorized to perform cardiopulmonary resuscitation, bag-valve-mask ventilation, semiautomatic defibrillation, and tracheal intubation, and to administer five medications: aspirin, nitroglycerin, salbutamol, epinephrine, and glucagon. They are not authorized to use venous access. With the help of UCCSPU, BLS from the Chaudiere-Appalaches and Quebec City regions were authorized to extend beyond their usual protocols and administer additional doses of the medications listed above. They received advice and guidance from UCCSPU nurses as needed. Four remote interventions were developed between 2006 and 2011, with the objective of supporting BLS paramedics and providing online support to rural nurses. These health care practitioners received theoretical and practical training (three days for paramedics and two weeks for nurses) to perform the interventions that were beyond their scope of professional training. For each episode of care provided with the help of UCCSPU, a nurse collected the data on selected variables relevant to each of the four remote services

and stored them in a database. The preliminary analyses presented in this paper were performed on data extracted from this database. The four UCCSPU interventions were implemented one after another once their clinical validity was confirmed. Therefore, they were not planned *a priori*, but rather developed as the unexpected possibilities were discovered over time.

Prehospital STEMI diagnosis

The prehospital diagnosis of ST segment elevation myocardial infarctions (STEMIs) patients was the main creative idea and clinical justification behind the UCCSPU implementation and was thus the first intervention to be fully operated. The first objective of this clinical platform was to improve access to percutaneous coronary intervention (PCI) in a rural population sparsely distributed across a vast area. UCCSPU staff members have been using prehospital ECGs to remotely diagnose STEMIs since July 2006. The procedure is as follows: the UCCSPU nurse activates the catheterization laboratory, and the ambulance bypasses the nearest ED if the primary percutaneous coronary intervention (PCI) can be performed within 90 minutes from first medical contact (American Heart Association/American College of Cardiology- AHA/ACA)[5]. If PCI cannot be performed within 90 minutes, or if the patient is terminally ill, the ambulance heads to the nearest ED. The AHA/ACA recommendation of 90 minutes cannot be applied everywhere in the sizeable Chaudiere-Appalaches region. Prehospital ECGs were therefore implemented to reduce the interval between EMS arrival and reperfusion by eliminating the stop at a non-PCI hospital. We published a more detailed description of the prehospital STEMI diagnosis procedure elsewhere[6].

EMTs conduct a 12-lead ECG with the Mobimed telemetry Ortivus system[7] when one or more of the following criteria are met: chest pain, dyspnea, palpitations, diaphoresis, electrization, syncope, major bleeding, stroke, hypotension, weakness, and trauma in an individual over 65 years old. A new ECG is transmitted by modem every two minutes to the UCCSPU at Alphonse-Desjardins (an academic hospital). The receiving nurse interprets the ECG; if an ST segment elevation is suspected, the nurse calls the emergency physician for validation of the diagnosis. If STEMI is confirmed, the nurse calls the cardiologist on duty at one of the three catheterization laboratories: Institut Universitaire de Cardiologie et de Pneumologie de Quebec (IUCPQ), the Quebec City Hôtel-Dieu Hospital (HDQ) or the Sherbrooke University Hospital Center (CHUS) (See Figure 2). Choice of PCI center is designed to allow the ambulance to reach the hospital within 60 minutes of STEMI diagnosis; average time from PCI center arrival to reperfusion is 32 minutes[8]. The first medical contact (defined as the first positive ECG) to balloon recommendation of ≤ 90 minutes is therefore respected. EMTs are advised to bypass the nearest ED and head directly to the designated PCI center.

Of the 53,000 ECGs transmitted by EMTs between August 2006 and May 2014, 1,009 STEMIs were diagnosed. 75% (757 STEMIs) were directly transferred to a cardiac catheterization laboratory. The remaining 25% (252 STEMIs) were transported to the nearest ED because they did not meet the criteria for PCI, i.e., first medical contact to balloon time greater than 90 minutes, contraindication to PCI, instability, or terminal illness. As shown in Figure 3, 99% of patients transported to a PCI center arrived in under 60 minutes after STEMI diagnosis. These results were confirmed in a 208 patients sample study that assessed if the UCCSPU STEMI system could achieve the recommended 90-min interval benchmark for PCI[6].

Pain management with opioids

The purpose of this intervention was to provide analgesia during long ambulance transportations. This idea came along during the early stages of the UCCSPU implementation and was thus initially planned for STEMI patients. A pilot project initiated in July 2010 allows EMTs to administer opioid analgesia for pain during ambulance transport. Health Canada agreed to allow BLS paramedics to request and administer doses of subcutaneous fentanyl with a physician's prescription.

UCCSPU physicians remotely prescribe fentanyl if the following criteria are met: age ≥ 14 and severe pain defined as ≥ 7/10 on the 11-point verbal numeric rating scale (VNRS)[9]. The exclusion criteria are bradycardia (<50 beats per minute), hypotension (systolic blood pressure < 100 mm Hg), slow respiratory rate (<12/minute), fentanyl allergy and P or U score on the AVPU scale. EMTs administer patients subcutaneous doses packaged at 50 µg/ml for an overall concentration of 1.5 ug/kg. There is a two-dose maximum and 50 ug limit for patients over 70 years old. VNRS are recorded at baseline, prior to each dose of analgesia, and at destination. Repeat doses are available. Clinically significant pain relief is defined as a minimum reduction of three points on the VNRS. Fentanyl doses are kept in a security safe in the ambulance. This protocol was adopted by the Quebec Ministry of Health and Social Services and by the Quebec College of Physicians.

From July 2010 to May 2014, EMTs made 2,135 requests to the UCCSPU for fentanyl doses. UCCSPU physicians approved 1,940 (91%) of the requested doses. Pain reduction was calculated from a sample of 298 care reports. Degree of relief from pain was associated with transport duration: 30% (82/273) of patients transported in 15 minutes, 40% (57/141) of patients transported in 30 minutes, and 46% (24/52) of patients who were still in transport after 45 minutes reported clinically significant pain relief[10]. No adverse events (systolic

blood pressure < 90 mmHg, O_2 saturation < 90%, allergic reaction, or Ramsay scale ≥ 4) were recorded. This intervention has only been implemented in the Chaudiere-Appalaches region to date.

Remote assistance to community health centers

Community health centers that do not offer 24/7 access to a physician made a request to UCCSPU to receive remote assistance if needed when no doctor is on duty. The UCCSPU has been providing online assistance to nurses from three rural community health centers since the end of the year 2010. The local community health centers (CLSC) are located 93 kilometers (St-Jean-Port-Joli), 141 kilometers (St-Pamphile) and 68 kilometers (Île-aux-grues, accessible by ferry) from the UCCSPU (See Figure 2). Nurses who need to stabilize a patient can request medical assistance from a UCCSPU physician over a two-way audio/video system. Nurses completed additional training to be able to administer thrombolysis and perform cardioversion. As soon as patients' symptoms are stabilized, they are transferred by ambulance to the nearest ED.

From December 2010 to May 2014, 86 calls were received from rural community service centers. The cases included thoracic pain (44), palpitations (8), dyspnea (7), abdominal pain (6), various traumas (3), two STEMI patients and one received fibrinolysis prescribed by the emergency physician and 16 cases of other minor complaints.

Remote death certification

The remote death certification service was strongly suggested by the provincial direction of pre-hospital emergency services. The aim behind the implementation of this intervention was to save EMTs travel time and ED resources by avoiding the transportation of deceased persons to hospital. The EMT on the scene attests that the patient is in cardiac arrest without possible intervention, and communicates the data to the UCCSPU nurse. The physician on duty prepares a death certificate if the following inclusion criteria are met: a) death due to a natural case (likely cause of death is known), and b) funeral home previously designated by the family. The nurse calls the funeral home and the home takes over responsibility for the deceased. When there is doubt concerning cause of death, or suspected violent or obscure cause, the coroner on duty is contacted and subsequently takes responsibility for the corpse. In the case of road fatalities, remote death certificates may be suitable in isolated and low traffic areas, or if the road is closed for an extended period. This protocol was

approved by the Quebec Ministry of Health and Social Services, the Coroner's Office, and the Quebec College of Physicians.

From April 11, 2011 to May 2014, the UCCSPU accepted 1440 (80%) of 1799 EMT requests for remote death certifications. Of the 1440 deaths, 944 were from natural causes and the corpse was transported to a funeral home; 496 were investigated by a coroner. The remaining 359 requested death certificates were rejected either because the inclusion criteria were not met or because the UCCSPU medical team was overloaded. The corpses that were not approved for remote certification were transported to hospital for on-site certification.

The remote death certification program saves EMTs money and operation time. EMTs now spend an estimated 50 minutes completing the death certification protocol (average time calculated from a sample of 185 death certificates); prior to the remote death certification program, time of call to return to service point took EMTs an average of 121 minutes. That is, the use of remote death certifications saves an average of 71 minutes in the sample used, and the difference between the two groups was statistically significant (t-test; $p<0.0001$). Further analyses will allow to determine the EMTs travel time saved for all death certifications.

2.5 Discussion

The UCCSPU provides online medical support to EMTs and nurses in the Chaudiere-Appalaches and Quebec City regions. Although telemedicine units are being implemented worldwide, UCCSPU is the first to offer a combination of services that includes STEMI diagnosis, death certifications, fentanyl prescription, and nurse assistance.

Improved access to quality health care

When the UCCSPU was created in 2006, STEMI patients were identified as a vulnerable population most likely to benefit from a rapid prehospital telemedicine system. Prehospital ECGs are now used to evaluate patients with suspected acute coronary syndrome[11-13]. ECG results are then transmitted for interpretation to either a call cardiologist[14], a telecardiology "hub"[15], or an ED physician[16, 17]. Remote STEMI diagnoses, and activation of the catheterization laboratory while patients are *en route* to hospital reduces treatment delays and improves clinical outcomes[18]. Despite the significant size of the Chaudiere-Appalaches territory, remote diagnosis allows medical personnel to respect the first medical contact to balloon recommendation time for 99% of patients.

A novel protocol developed by the UCCSPU authorizes BLS paramedics from the Chaudiere-Appalaches region to safely relieve patients' pain with subcutaneous fentanyl doses; this is the first time such authorization was given in Quebec. Prehospital pain management with opioids is now common[19]. While morphine is the best choice when long-lasting pain relief is desired, fentanyl's quick onset and relatively brief effect is appropriate for emergency care[20]. In this study, a greater proportion of patients (46%) with long transportation times (45 minutes) than patients with short (15 minutes) transportation times (30%) reported pain reduction ≥ 3 points. Pain reduction can make a significant difference in a rural context where transportation can take up to 60 minutes. Average prehospital pain reduction with fentanyl reported in the literature is 2.5 to 4.8[21-26]; our results are at the lower end of this average. To our knowledge, this is the first study to report subcutaneous fentanyl administration in a prehospital setting; the most commonly used form is intranasal[27]. Further investigations are needed to determine whether or not mode of administration has an impact on the analgesic effect. In the future, the UCCSPU plans to extend authorization for fentanyl administration to the pediatric population and to optimize the protocol for the geriatric population.

A second telemedicine solution developed to improve health care for rural citizens involved online assistance for nurses at community service centers. This telemedicine application was demonstrated to greatly benefit communities with no 24/7 physician coverage. Telehealth systems developed to support rural nurses have been successfully implemented in several areas[28-30].

Saved medical resources

To our knowledge, the UCCSPU is the first telemedicine system to report remote death certifications. The objective behind this creative idea was to save healthcare resources. A preliminary study has already demonstrated that this intervention saves over 60 minutes per patient for EMTs; paramedics are therefore more immediately available for other calls, and fewer ED resources are used. Maximizing time and use of ED resources are key issues in a rural context where the limited ambulance fleet travel significant distances. Remote death certification avoids unnecessary transportation of deceased persons to the ED, which in turn reduces overall ED visits, burden on staff and maximizes the use of ambulances and paramedics for emergencies. Further studies will determine the extent of savings in terms of time and money.

Lessons learned

In order to succeed into the development of telemedicine interventions such as UCCSPU services, several key elements should be considered. The only clinical activities that are worth using telemedicine service are those

with an added value for the patient, i.e. the right treatment for the right patient at the right time. A strong medical leadership with volunteer physicians interested by remote medical interventions is another important element. All the involved healthcare practitioners should be informed of the changes made to the regular operations. It is also important to obtain endorsement of health decision-makers on local, regional and national levels for management and funding. In the case of UCCSPU, co-management involving medical and nurse staff was a successful model and should be considered in the implementation of a similar clinical telemedicine platform.

Limitations

This paper describes the telemedicine program and presents preliminary analyses of four remote interventions added one after another. Because the data were collected for clinical administrative purposes, results are at risk of non-differential information bias. Selection bias could also have been introduced in the results due to the small sample sizes used. Due to the preliminary nature of the analyses, it has not been possible to measure the impact of this program yet. More detailed data and analysis will be presented in future publications.

2.6 Conclusion

The UCCSPU is a telemedicine program that improves health care in the Chaudiere-Appalaches and Quebec City regions. Remote health applications were implemented with special staff training, and with significant benefit to a primarily rural population. The UCCSPU is planning to expand its services to the entire province of Quebec, with the exception of the city of Montreal, where EMS are regulated by an independent corporation (Urgences-Santé).

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Conflicts of interest

We declare no conflicts of interest.

2.7 References

1. Canadian Institute for Health Information. https://secure.cihi.ca/free_products/rural_canadians_2006_report_e.pdf. Date accessed:

2. Hameed S, Schuurman N, Razek T, et al. Access to trauma systems in Canada. *J Trauma*. 2010; 69: 1350-61.

3. Gonzalez RP, Cummings G, Mulekar M and Rodning CB. Increased mortality in rural vehicular trauma: identifying contributing factors through data linkage. *J Trauma*. 2006; 61: 404-9.

4. Grossman DC, Kim A, Macdonald SC, Klein P, Copass MK and Maier RV. Urban-rural differences in prehospital care of major trauma. *J Trauma*. 1997; 42: 723-9.

5. O'Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013; 127: 529-55.

6. Tanguay A, Dallaire R, Hebert D, Begin F and Fleet R. Rural Patient Access to Primary Percutaneous Coronary Intervention Centers is Improved by a Novel Integrated Telemedicine Prehospital System. *The Journal of emergency medicine*. 2015.

7. Ortivus Mobimed Smart. http://www.ortivus.com/en/solutions/mobimed-smart/. Date accessed: October 12, 2015.

8. Plourde G, Abdelaal E, Bataille Y, et al. Effect on door-to-balloon time of immediate transradial percutaneous coronary intervention on culprit lesion in ST-elevation myocardial infarction compared to diagnostic angiography followed by primary percutaneous coronary intervention. *The American journal of cardiology*. 2013; 111: 836-40.

9. Williamson A and Hoggart B. Pain: a review of three commonly used pain rating scales. *Journal of clinical nursing*. 2005; 14: 798-804.

10. Fournier F, Bégin F, Tanguay A, Hébert D, Foldes-Busque G and Fleet R. Subcutaneous fentanyl administration: a safe and novel approach to pain relief by BLS-EMT *Prehospital emergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors*. 2015; 19: 140–77.

11. O'Connor RE, Brady W, Brooks SC, et al. Part 10: acute coronary syndromes: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2010; 122: S787-817.

12. Ting HH, Krumholz HM, Bradley EH, et al. Implementation and integration of prehospital ECGs into systems of care for acute coronary syndrome: a scientific statement from the American Heart Association Interdisciplinary Council on Quality of Care and Outcomes Research, Emergency Cardiovascular Care

Committee, Council on Cardiovascular Nursing, and Council on Clinical Cardiology. *Circulation*. 2008; 118: 1066-79.

13. Welsh RC, Travers A, Huynh T, Cantor WJ and Canadian Cardiovascular Society Working G. Canadian Cardiovascular Society Working Group: Providing a perspective on the 2007 focused update of the American College of Cardiology and American Heart Association 2004 guidelines for the management of ST elevation myocardial infarction. *The Canadian journal of cardiology*. 2009; 25: 25-32.

14. Sanchez-Ross M, Oghlakian G, Maher J, et al. The STAT-MI (ST-Segment Analysis Using Wireless Technology in Acute Myocardial Infarction) trial improves outcomes. *JACC Cardiovascular interventions*. 2011; 4: 222-7.

15. Brunetti ND, De Gennaro L, Dellegrottaglie G, Amoruso D, Antonelli G and Di Biase M. A regional prehospital electrocardiogram network with a single telecardiology "hub" for public emergency medical service: technical requirements, logistics, manpower, and preliminary results. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association*. 2011; 17: 727-33.

16. Farshid A, Allada C, Chandrasekhar J, et al. Shorter Ischaemic Time and Improved Survival with Pre-hospital STEMI Diagnosis and Direct Transfer for Primary PCI. *Heart, lung & circulation*. 2014.

17. Rao A, Kardouh Y, Darda S, et al. Impact of the prehospital ECG on door-to-balloon time in ST elevation myocardial infarction. *Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions*. 2010; 75: 174-8.

18. Le May MR, Dionne R, Maloney J and Poirier P. The role of paramedics in a primary PCI program for ST-elevation myocardial infarction. *Progress in cardiovascular diseases*. 2010; 53: 183-7.

19. Dijkstra BM, Berben SA, van Dongen RT and Schoonhoven L. Review on pharmacological pain management in trauma patients in (pre-hospital) emergency medicine in the Netherlands. *European journal of pain*. 2014; 18: 3-19.

20. Braude D and Richards M. Appeal for fentanyl prehospital use. *Prehospital emergency care : official journal of the National Association of EMS Physicians and the National Association of State EMS Directors*. 2004; 8: 441-2.

21. Johnston S, Wilkes GJ, Thompson JA, Ziman M and Brightwell R. Inhaled methoxyflurane and intranasal fentanyl for prehospital management of visceral pain in an Australian ambulance service. *Emergency medicine journal : EMJ*. 2011; 28: 57-63.

22. Karlsen AP, Pedersen DM, Trautner S, Dahl JB and Hansen MS. Safety of intranasal fentanyl in the out-of-hospital setting: a prospective observational study. *Annals of emergency medicine*. 2014; 63: 699-703.

23. Middleton PM, Simpson PM, Sinclair G, Dobbins TA, Math B and Bendall JC. Effectiveness of morphine, fentanyl, and methoxyflurane in the prehospital setting. *Prehospital emergency care : official journal*

of the National Association of EMS Physicians and the National Association of State EMS Directors. 2010; 14: 439-47.

24. Rickard C, O'Meara P, McGrail M, Garner D, McLean A and Le Lievre P. A randomized controlled trial of intranasal fentanyl vs intravenous morphine for analgesia in the prehospital setting. *The American journal of emergency medicine*. 2007; 25: 911-7.

25. Smith MD, Wang Y, Cudnik M, Smith DA, Pakiela J and Emerman CL. The effectiveness and adverse events of morphine versus fentanyl on a physician-staffed helicopter. *The Journal of emergency medicine*. 2012; 43: 69-75.

26. Wedmore IS, Kotwal RS, McManus JG, et al. Safety and efficacy of oral transmucosal fentanyl citrate for prehospital pain control on the battlefield. *The journal of trauma and acute care surgery*. 2012; 73: S490-5.

27. Hansen MS and Dahl JB. Limited evidence for intranasal fentanyl in the emergency department and the prehospital setting--a systematic review. *Danish medical journal*. 2013; 60: A4563.

28. Clegg A, Brown T, Engels D, Griffin P and Simonds D. Telemedicine in a rural community hospital for remote wound care consultations. *Journal of wound, ostomy, and continence nursing : official publication of The Wound, Ostomy and Continence Nurses Society / WOCN*. 2011; 38: 301-4.

29. Henderson K. TelEmergency: distance emergency care in rural emergency departments using nurse practitioners. *Journal of emergency nursing: JEN : official publication of the Emergency Department Nurses Association*. 2006; 32: 388-93.

30. Young TL and Ireson C. Effectiveness of school-based telehealth care in urban and rural elementary schools. *Pediatrics*. 2003; 112: 1088-94.

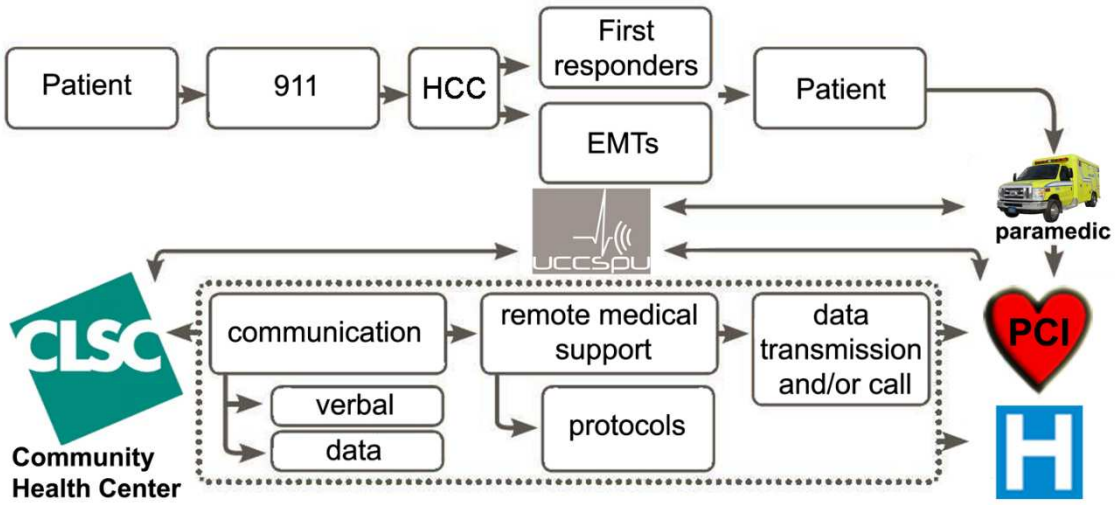

Figure 1. The UCCSPU provide online medical support to community health centers and emergency medical technicians. HCC: Health Communication Center; PCI: percutaneous coronary intervention.

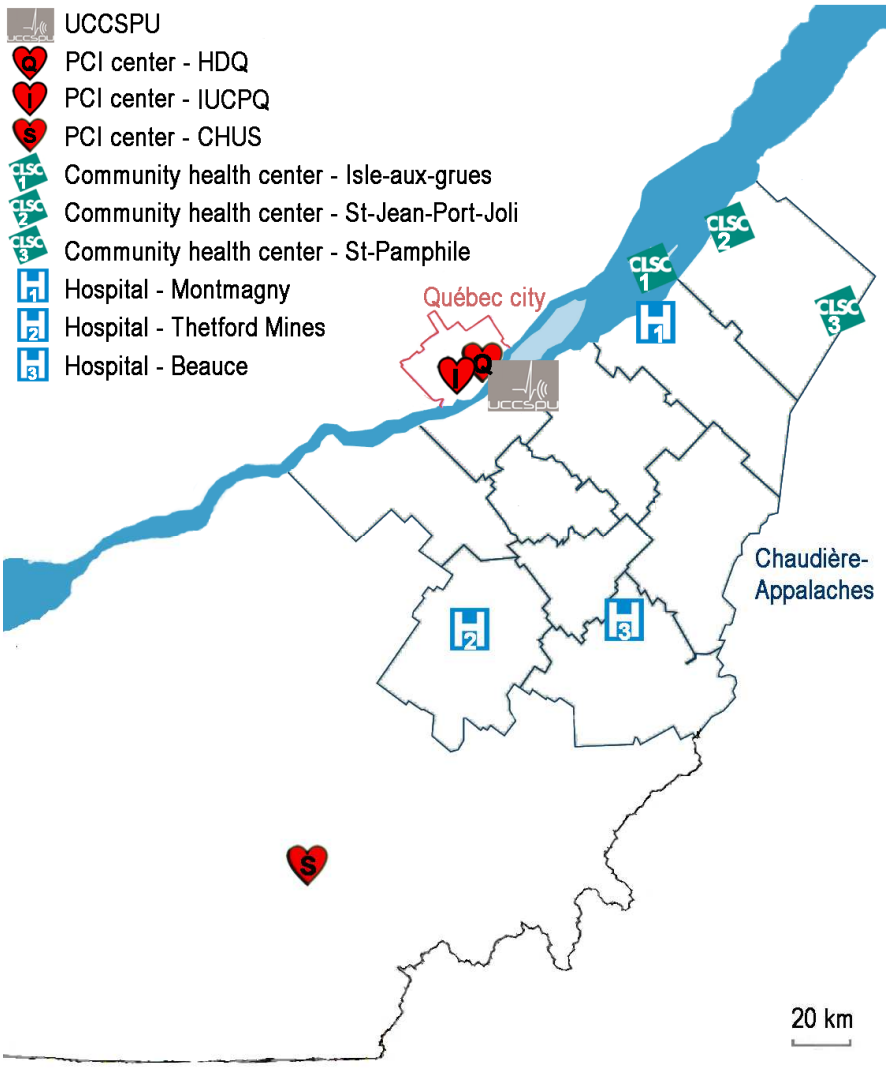

Figure 2. The Chaudiere-Appalaches region covered by the UCCSPU telemedicine program. The remote STEMI diagnosis was extended to the Quebec city area.

UCCSPU: *Unité de Coordination Clinique des Services Préhospitaliers d'Urgence;* PCI: percutaneous coronary intervention; HDQ: Quebec City Hôtel-Dieu Hospital; IUCPQ: Institut Universitaire de Cardiologie et de Pneumologie de Quebec; CHUS: Sherbrooke University Hospital Center; *CLSC : Centres locaux de services communautaires*.

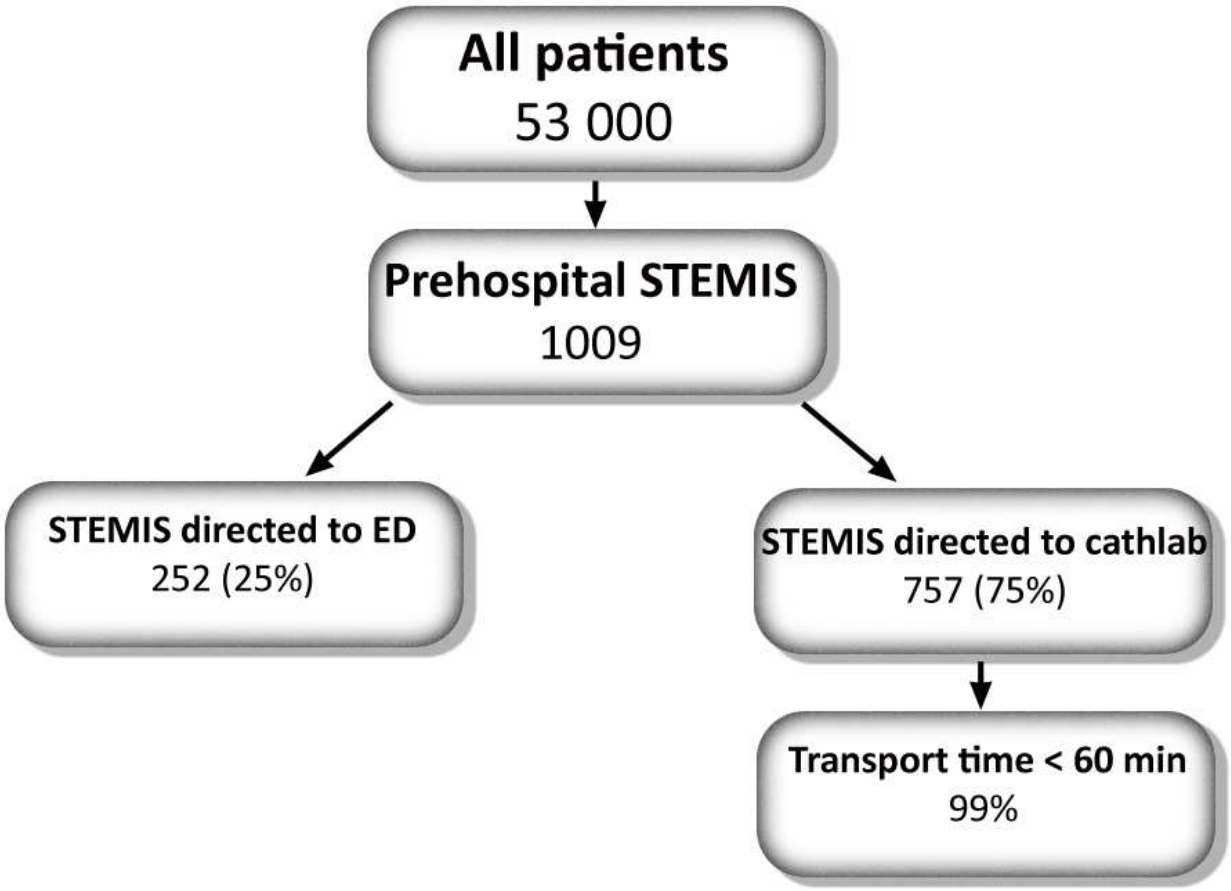

Figure 3. STEMIS diagnosed from the prehospital ECGs transmitted by EMTs between August 2006 and May 2014. STEMIS: ST segment elevation myocardial infarctions; ED: Emergency Department.

3. Objectifs

3.1 Objectif 1 : Le premier objectif est d'établir une classification des événements indésirables survenant lors du transport ambulancier des patients avec IAMEST selon un niveau de gravité mineur et majeur en se basant sur une recherche de la littérature scientifique ainsi qu'un consensus d'experts.

3.2 Objectif 2 : Le deuxième objectif est d'utiliser la classification établie à l'objectif 1 pour déterminer la fréquence des événements indésirables survenant lors du transport de patients avec IAMEST dans les régions de Chaudière-Appalaches et de Québec.

3.3 Objectif 3 : Le troisième et dernier objectif est de déterminer si le temps de transport a un impact sur la fréquence des événements indésirables.

Ces trois objectifs font l'objet d'une publication présentée à la section 4. Les résultats permettront de déterminer si le transport de patients avec IAMEST vers un centre d'hémodynamie par des TAP en soins primaires est sécuritaire.

4. Méthodologie

4.1 Classification des événements indésirables

Tel que mentionné à la section 1.4, une revue de littérature a été effectuée dans le but de classifier les événements indésirables survenant en milieu préhospitalier en niveaux « important » et « mineur » (voir Annexe A de la section 5 pour la stratégie de recherche). À l'intérieur d'une rencontre, en se basant sur les études identifiées à l'aide de cette recherche documentaire, les experts de notre groupe de recherche ont établi par consensus des définitions opérationnelles d'événements indésirables à partir de la tension artérielle (TA), la fréquence cardiaque (FC), l'état de conscience et les arythmies. Pour chaque patient ayant subi un événement, les ECG ont été révisés par un résident en médecine d'urgence, Pierre-Alexandre Leblanc, afin de déterminer l'arythmie spécifique. Les experts ont convenu que deux événements cliniques mineurs ou plus devraient être considérés comme un événement clinique majeur.

4.2 Devis de l'étude et population

Cette étude observationnelle est basée sur une cohorte rétrospective utilisant des données clinico-administratives. Les patients éligibles sont tous les patients transportés en ambulance dans les régions de Chaudière-Appalaches et de Québec qui ont bénéficié d'un épisode de soins pour IAMEST dans le cadre d'un transport direct ou d'une déviation vers l'Institut Universitaire de Cardiologie et de Pneumologie de Québec - Université Laval (IUCPQ-UL). Les patients avec démence, sous dialyse ou instables avec nécessité d'intervention médicale immédiate ont été exclus de la cohorte. Ce projet multicentrique a été approuvé par les comités d'éthique de la recherche du Centre intégré de santé et de services sociaux (CISSS) Chaudière-Appalaches et de l'IUCPQ-UL.

4.3 Collecte de données et variables

Les TAP administrent un ECG au patient si au moins un de ces critères d'inclusion est répondu : douleur thoracique, dyspnée, palpitations cardiaques, diaphorèse, électrocution, syncope, saignements majeurs, accident vasculaire cérébral, hypotension, faiblesse ou patient de 65 ans et plus victime d'un traumatisme. Dans la région de Chaudière-Appalaches, les ECG sont enregistrés de façon automatique à toutes les deux minutes à l'aide du système Ortivus (Danderyd, Suède), et reçoivent un soutien médical à distance durant le transport vers le centre de cardiologie lorsqu'un IAMEST est confirmé. Dans la région de Québec, les TAP doivent

transmettre l'ECG à l'UCCSPU avant le départ de l'ambulance avec le système médical Zoll (Chelmsford, MA) et ne bénéficient pas du soutien médical.

Lorsque le patient avec IAMEST est diagnostiqué à distance grâce à l'UCCSPU, un épisode de soins est ouvert dans un logiciel qui permet d'y entrer les données cliniques du patient. Les ECG sont transférés au logiciel depuis l'ambulance grâce à un système de télémétrie et les données cliniques sont communiquées à l'infirmière de garde à l'aide d'un téléphone cellulaire. L'infirmière fait une première interprétation de chaque ECG. Si un IAMEST est suspecté, elle consulte le médecin d'urgence sur place. Si l'infarctus est confirmé, l'UCCSPU indique aux TAP de transférer le patient directement vers le centre d'hémodynamie le plus proche : l'IUCPQ-UL ou le Centre hospitalier Universitaire de Sherbrooke (CHUS) (voir la figure 2 de la section 1.3.1), si l'intervalle entre le premier ECG positif et l'arrivée au centre d'ICP est ≤ 60 minutes. Cette règle a été établie afin de respecter les recommandations de l'AHA/ACC d'administrer l'ICP à l'intérieur de 90 minutes [26, 27], considérant que le temps moyen entre l'arrivée au centre d'ICP et l'inflation du ballonnet d'angioplastie est de 30 minutes [47].

Les données cliniques sont dénominalisées dans la base. Les variables enregistrées incluent : sexe, âge, territoire de l'infarctus, centre hospitalier receveur initial, centre hospitalier de la réorientation (s'il y a lieu), score de douleur, site de douleurs et symptômes, fréquence respiratoire, saturation en oxygène, pouls, tension artérielle, état de conscience (AVPU), événements indésirables et distance à parcourir pour se rendre au centre hospitalier. Le temps de transport a été calculé à partir du départ de l'ambulance du site de l'intervention jusqu'à l'arrivée à l'IUCPQ-UL. Durant la période de l'étude, un total de 52 infirmières ont entré des données cliniques dans la base après chaque épisode de soin.

Lors de l'analyse préliminaire des données enregistrées dans la base de données cliniques de l'UCCSPU, il a été constaté que plusieurs données étaient manquantes dans un certain nombre de dossiers de patients. Ainsi, afin de compléter les données manquantes et d'améliorer la validité des données existantes, les rapports d'intervention préhospitalière (AS-803) et ont été consultés à partir du logiciel CrystalNet à l'IUCPQ-UL. Étant donné que ce logiciel ne permet pas d'exporter un ensemble de données cliniques sur demande, chaque rapport a dû être consulté et extrait manuellement à l'aide d'une feuille d'extraction que j'ai développée avec la collaboration du Dr François Bégin, médecin d'urgence à l'HDL.

4.4 Analyses statistiques

L'association entre la durée du transport ambulancier des patients avec IAMEST et les événements indésirables a été étudiée à l'aide d'un modèle de régression logistique multivarié ordinal. La variable indépendante, soit le temps de transport, a été classée en trois niveaux: 0-14, 15-29 and >30 min. Ces durées de transport représentent des transports courts, moyens et longs dans les régions de Chaudière-Appalaches et de Québec. La variable dépendante a également été classée en trois niveaux, soit aucun événement, un événement mineur et un ou plusieurs événements majeurs. Le groupe d'expert a déterminé que deux événements mineurs distincts devaient être considérés comme un événement majeur selon cette classification. Les rapports de cote (RC) ont été ajustés pour le sexe et l'âge, et ont également été présentés sous une forme non ajustée. L'âge a été classifié selon les espaces interquartiles.