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The Role of EMS in Regionalized Systems of Care

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ABSTRACT

The parallel advancement of prehospital and in-hospital patient care has provided impetus for the development and implementation of regionalized systems of health care for patients suffering from acute, life-threatening injury and illness. Regardless of the patient's clinical condition, regionalized systems of care revolve around the premise of providing the right care to the right patient at the right time. Current regionalization strategies have shown improvements in the time to patient treatment and in patient outcome, with the incorporation of emergency medical services (EMS) bypass as a key component of the system of care. This article discusses the emerging role of EMS as a critical component of regionalized systems essential to ensure effective and efficient use of resources to improve patient outcome. We also examine some of the benefits and barriers to implementation of regionalized systems of care and avenues for future research.

RÉSUMÉ

L'évolution en parallèle des soins préhospitaliers et hospitaliers a donné une impulsion à l'élaboration et à la mise en place de systèmes régionalisés de soins de santé pour les patients souffrant de blessures ou de maladies aiguës potentiellement mortelles. Peu importe l'état clinique du patient, les systèmes régionalisés de soins de santé ont pour prémisse la prestation de soins appropriés au bon patient, au bon moment. Les stratégies actuelles de régionalisation ont déjà permis d'améliorer les délais de traitement et les résultats cliniques, grâce à l'incorporation du programme auxiliaire des services médicaux d'urgence (SMU) en tant que l'un des principaux constituants du système de soins. Il sera question dans l'article du nouveau rôle des SMU en tant qu'élément crucial des systèmes régionaux et maillon essentiel à l'utilisation efficace et efficiente des ressources en vue de l'amélioration des résultats cliniques. Les auteurs examineront également certains avantages de la mise en place des systèmes régionalisés de soins de santé, ainsi que certains obstacles, et proposeront de nouvelles voies de recherche à explorer dans l'avenir.

Keywords: EMS, Paramedic, Systems of Care

EDITORIAL

Patients suffering from life-threatening illness and trauma require specialized, time-sensitive interventions to ensure the best possible outcome and return to a high quality of life. This concept is well established throughout medicine, perhaps most notably with regards to trauma, the "golden hour." Although there is nothing magical about the one-hour mark in trauma, it does represent an important concept; rapid, specialized treatment results in improved clinical outcomes.[1] This time-sensitive concept is applied to a number of high-intensity, critical conditions, including ST-elevation myocardial infarction (STEMI)[2], cerebrovascular accident (CVA)[3], out-of-hospital cardiac arrest (OHCA)[4], and sepsis.[5,6]

Since the era of bed rest for the treatment of STEMI in the 1960s[7], the treatment of this and many other life-threatening conditions has undergone profound changes, leading to the development of "regionalized systems of care" using hospital-based "centres of excellence," which provide advanced diagnostics, interventions, and expertise not routinely available in typical referral hospitals. Only recently has the importance of emergency medical services (EMS) been recognized as a key component.

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Historically, despite regionalized systems of care, patients were transported by EMS to the closest emergency department (ED) regardless of their clinical condition. It was thought, due to the potential risk of deterioration during longer transports, and a lack of evidence that paramedics could safely identify and treat these patients, that initial stabilization at the local ED was necessary prior to transfer to a higher level of medical care. This often resulted in significant delays to definitive care.[8-10] It may have inadvertently also resulted in some patients never being transferred to a known centre of excellence.

EMS providers combine increased skill in patient assessment and diagnostics with life-saving interventions to provide high-quality prehospital emergency care. Paramedics are now able to appropriately manage a wide variety of critically ill patients whom they previously would not have had the equipment, training, or expertise to handle.[11] Furthermore, recent research examining the effect of EMS transport interval on patient outcome suggests that longer transport times (up to 35 minutes) are not associated with adverse patient outcomes for both severe trauma and OHCA.[12-14] This new appreciation for advancements in EMS care has provided the impetus to expand the reach of centres of excellence into the prehospital setting. The parallel advancement of in-hospital and prehospital patient care has provided the opportunity to integrate prehospital bypass programs into regionalized systems of care, resulting in a systems-based approach that we see in many areas of health care today.

Components of regionalized systems of care

There is a mounting body of evidence that shows improvements in patient morbidity and mortality with regionalized systems of care.[15-17] The importance of developing regionalized systems is further supported by a number of national organizations in Canada and the United States.[18-21] Historically, the drivers of regionalized systems of care have been trauma and STEMI; however, other systems include stroke, traumatic brain injury (TBI)[22], OHCA[4,23], and burns[24] (Table 1). Regardless of the specific illness or injury, regional strategies designed around systems of care require the integration of a number of common key components in order to be successfully implemented, provide optimal patient care, and maximize health care efficiency. There are a number of priority stakeholders impacted by regionalized systems of care that must all be involved in the planning and implementation to ensure success. A priori agreements must be arranged between EMS services, referral hospitals, and receiving facilities, to allow for seamless transitions in patient care, and to ensure that the patient is cared for at the most appropriate destination.

Table 1. Typical and potential regionalized systems of care.

Trauma
ST-Elevation Myocardial Infarction (STEMI)
Cerebrovascular Accident
Out-of-Hospital Cardiac Arrest
Burns
Traumatic Brain Injury
Organ and Tissue Donation[25,26]

Some of the common elements of an effective regionalized system of care include:

(i) **The Public**, who must recognize a life-threatening condition and appropriately activate the 911 response, as opposed to going on their own to an ED of their choice.

(ii) **EMS Agencies and EMS Medical Direction**, including expertly trained paramedics, EMS personnel, and medical dispatchers, as well as medical oversight by medical committees and EMS physicians.

(iii) **EMS Bypass Criteria/Protocols,** specific for each illness/injury, to aid in patient identification, bypass of closest EDs, and advance notification of centres of excellence by EMS.

(iv) **Interfacility Transfer Protocols,** between EMS and referral hospitals, to ensure rapid transfer by appropriately trained personnel to the centre of excellence.

(v) **Regional Centres of Excellence,** equipped with facilities, staff, and resources to provide optimal and definitive care 24/7 for critically injured or ill patients.

(vi) **Rehabilitation Systems,** which must be in place to ensure appropriate care during the recovery process.

(vii) **Quality Assurance Programs**, to monitor and continually assess/improve/ report system of care performance.

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Emergency medical services impact on patient care

There are a number of personnel and health care practitioners involved in the different components required for an effective EMS system of care. This commentary focuses on the impact of advancements made with frontline paramedics that have allowed bypass programs to develop and integrate into our health care system. EMS providers can have a significant impact on patient outcomes. Perhaps the most important responsibility of EMS providers is determining the "right place" for patient care. Rapid and accurate triage by paramedics to appropriate destinations can have a significant impact on patient outcome, more so than intravenous therapy, endotracheal intubation, and most other interventions applied in the field.[27] Prehospital bypass has been shown to significantly reduce the time to arrival at a trauma centre, which in turn is directly related to improved patient outcome.[28,29] A recent study by Gomez et al concluded that prehospital bypass was associated with a 3.5 hour (IQR 1.7 to 4.5 hours) reduction in time to arrival at a trauma centre, compared to transport and subsequent transfer from a non-trauma centre;[30] this reduction in time is important, considering that the majority of deaths from trauma occur within the first 24 hours after injury.[31] Similarly, prehospital stroke bypass has improved patient access to thrombolytics,[32] and STEMI bypass programs have significantly reduced the time from initial medical contact to percutaneous coronary intervention (PCI), compared to initial transportation to the nearest ED[9,33]. These cardiac programs have been shown to be associated with a decrease in short-term mortality.[34]

Identification of patients who would benefit from prehospital bypass protocols should be a major focus for EMS systems, and should be based upon a number of important endpoints, such as death, disease (morbidity), disability, discomfort, dissatisfaction, and destitution (cost).[35] In order to be effective, paramedics and other EMS providers must be provided with and trained in validated, evidence-based tools to assess the need for centre of excellence care, whether based on signs and symptoms of a stroke,[36-38] a 12-lead electrocardiogram (ECG) for identification of STEMI,[33] or criteria to indicate severe trauma[39]. With training and quality improvement programs in place, and using these validated tools, it has been shown that EMS recognition of life-threatening conditions can be extremely accurate, mimicking ED physicians.[2,40-42]

Ideal bypass protocols should use validated, objective criteria to help minimize both over- and under-triage. Ineffective bypass systems can lead to increased costs, inefficient use of both hospital-based and EMS resources, and over-crowding of regional-based centres.[32] Prehospital bypass activates a significant number of resources dedicated to the care of individual patients, decreasing the resources available to care for other patients. Each disease-specific system is unique, and it is therefore difficult to quantify a universal number of false-positives that would be deemed "acceptable." It is important for each system to decide what is acceptable for their specific situation. For example, there are substantial in-hospital costs associated with PCI.[43] Activation during "off hours" can result in a number of members of the PCI team being called in from home, placing considerable stress on these individuals. In general, criteria for EMS bypass protocols should aim for high specificity (i.e., not bypassing patients that do not require specialized care). However, as EMS systems aim to limit false-positive activations and achieve a high specificity, there will inevitably be a larger number of patients requiring specialized care that will not undergo bypass and will instead be transported to the closest ED. Validated, easy to apply protocols would allow for accurate, rapid, and safe application by paramedics in high-intensity, chaotic emergency situations.

The development of prehospital bypass programs can have a significant impact on EMS service delivery. EMS systems must invest substantial time dedicated to training and continued quality assurance of program performance. This can be a significant barrier to implementation. Furthermore, regional strategies require ambulances to transport patients to centres of excellence, often bypassing the closest hospital and transporting to hospitals outside their region of coverage. This could result in extended periods of time where ambulances are not available for other 911 responses, and ultimately may result in a larger number of ambulances required to maintain consistent levels of local emergency coverage. There is currently a lack of research examining the impact that bypass programs and ambulance diversion have on ambulance resource utilization, and this is an area that requires further investigation.

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Emergency department and in-hospital impact

Implementation of regional patient care strategies can have a major impact on ED and in-hospital care. Redistribution of patients across hospitals means that centres of excellence must maintain sufficient bed capacity to care for patients that are transported from within their catchment area. The centre must be capable of offering specialized care at all times, above and beyond the care patients would receive in community hospitals. There is strong evidence that the number of cases treated at a particular institution, or by a particular practitioner, is directly correlated with patient outcome, providing further evidence in support of centres of excellence.[4,44-47]

There are a number of reasons why patients requiring specialized care may not be bypassed to a centre of excellence, including: a) a substantial proportion of patients do not live within the catchment area and are not eligible for prehospital bypass programs;[48,49] b) a significant number of patients do not call 911 and instead seek medical attention on their own; and c) a paramedic may not identify a patient who qualifies for prehospital bypass, or the condition of interest may not develop until after the patient has arrived at the general ED.

Since many patients are initially assessed and treated at non-specialized centres, referral hospitals are essential in optimizing efficiency in a regionalized system. Interfacility transfer agreements must be developed to ensure that there is comprehensive region-wide access to a centre of excellence. EMS agencies must be able to quickly respond to requests from referral hospitals for patient transfers, sending appropriately trained paramedics to manage the patient's condition. To ensure efficient use of health care resources, interfacility agreements must consider repatriation of patients back to their community hospital, either because they were ineligible to receive specialized treatment, or once stable post-procedure, to continue in their recovery process. Repatriation will help to ensure that health care resource consumption is redistributed back to referral hospitals and that centres of excellence do not become over-burdened.

Barriers to implementation

Despite the success of regionalized systems of care, there are a number of barriers to implementation of these systems across Canada.

All systems of care require lay bystanders to rapidly recognize a potential life-threatening emergency and to activate the 911 system. Delays in activation of 911 often account for the largest delay from symptom onset to definitive care.[50] Average delays to hospital arrival for STEMI patients have been shown to be between 1.5 and six hours from symptom onset.[51] Furthermore, once a patient decides to seek medical care, a substantial number of patients with concerning symptoms do not utilize 911. Improvements in public awareness and educational campaigns regarding signs and symptoms and the benefits of 911-based care may help to improve this vital link.

Geographic barriers can limit the effectiveness of regionalized systems of care. As Canada is a large and mostly rural country, a significant proportion of the population lives outside of the catchment area of centres of excellence, and is unable to be transported by EMS within a reasonable timeframe. In Canada, it is estimated that 23% of the population (> seven million people) live beyond a one-hour drive from a level I or level II trauma centre,[48] and since current bypass protocols in some provinces limit ambulance bypass travel time to just 30 minutes, this percentage becomes even greater. Similarly, only 85% of patients having an ischemic stroke live within 100 km of a centre capable of treating with thrombolytics.[16]

There are also many unknowns regarding the indirect consequences of establishing regionalized systems of care and EMS bypass protocols. For instance, it is not known how implementation of EMS bypass protocols affects the length of time EMS are tied up on a call, the availability of ambulances for future 911 calls, and the impact that extended transport times have on the overall delivery of 911 services. It is critical that further research is done to evaluate the impact that regionalized care may have on the entire 911 system, beyond individual patient outcomes.

Finally, although bypass programs may be implemented into EMS practice, not all patients will be bypassed to a specialized care facility. A recent study of one Canadian EMS agency showed that, despite meeting all inclusion criteria for bypass to a trauma centre, and a median time of transport to the regional trauma centre of 10 minutes, only 53% of eligible patients were transported directly to the trauma centre.[8] Furthermore, it was noted that the relationship was dependent upon the differential distance between closest ED and trauma centre.[8]

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Research, or lack thereof, continues to be a major barrier to successful systems of care. Life-threatening conditions are relatively infrequent, and due to the emergent nature, the unpredictable prehospital environment, and the resources required to follow patients over a continuum of care, there are many ethical and logistic challenges to conducting high-quality clinical research in the prehospital setting. As a result, the science behind the who, what, where, when, and why of regionalized systems of care may rely on expert consensus opinion and lower-quality evidence. This means that science may not always be able to drive systems of care.

Future of regionalized emergency care

One can imagine a number of other low-frequency, resource-intensive clinical conditions readily identifiable by paramedics where patients might benefit from direct transport to a centre of excellence. As a result of the success of current regionalized systems, other models of care are being investigated as potential regionalization strategies for OHCA,[1,4,45] sepsis,[52] and isolated TBI. These strategies, yet to be inducted into widespread clinical practice, have shown promise in improving care and patient outcome. Burns, toxicologic emergencies, amputations, and procurement of donor tissue and organs are other potential indications for care at specialized centres that deserve future consideration.

CONCLUSION

As our health care system continues to evolve we will continue to explore avenues to better treat patients while ensuring efficient and effective use of health care resources. Regionalization of health care has shown promise in a number of time-sensitive critical conditions by improving patient outcomes and optimizing resource utilization. As we continue to make progress in this area of research, it is important to continually monitor and reassess these systems of care, while incorporating input from all stakeholders involved. Strategies incorporating EMS into regionalized systems of care have the potential to make a significant impact on the outcomes of the most critically ill patients.

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