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Medical Appropriate Use of Helicopters

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Medically Appropriate Use of Helicopter EMS: The Mission Acceptance/Triage Process

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Abstract

Introduction: Appropriate use of helicopter emergency medical services (HEMS) ensures the maximum impact of a limited resource on improved health outcomes. Overtriage increases real and opportunity costs and may unjustifiably expose the program to small but inherent safety risks. The purpose of this study is to describe the mission acceptance process for an integrated, provincially based HEMS program and determine its utilization patterns.

Methods: This is a retrospective review of patient care and administrative databases. All missions were reviewed to determine whether they were medically appropriate. "Appropriateness" was defined a priori as requiring admission to a critical care unit, death during transportation or in first 24 hours, or in the case of trauma, an injury severity scale (ISS) score ≥ 12. Overtriage was defined as not meeting these a priori definitions.

Results: Five hundred eighty-four missions were reviewed from March 31, 2003 through December 31, 2004. Our mission acceptance process consists of three distinct but complementary phases: ongoing outreach education, scanning by dispatchers in an integrated dispatch center, and a clinician to online physician discussion about each case. The overall overtriage rate was 13.1%.

Conclusion: The rate of medically appropriate missions in this system is relatively high. Prospective research is required to improve HEMS triage systems.

Introduction

Helicopter emergency medical services (HEMS) is a limited resource in most jurisdictions. Although still somewhat controversial, the balance of the outcomes literature shows a mortality benefit to HEMS over ground transport.[1-3] Medically appropriate use of HEMS seeks to maximize utilization of a scarce resource to improve health outcomes. Inappropriate use (overtriage) of HEMS may expose a system to increased real costs and increased opportunity costs. In many systems the potential for missing a call in which there is a high likelihood of benefit because the helicopter is on another mission is significant.[4] Finally, inappropriate use may expose the program to unjustifiable safety risks.[5-7]

In a trauma outcomes study by Braithwaite et al[8] comparing air transport to ground transport, a mortality benefit was seen in those with an Injury Severity Score (ISS) between 15 and 60. No benefit was seen in the patient group with an ISS ≤ 15 (not seriously injured) or with an ISS ≥ 60 (catastrophically injured). Intriguingly, 55% of the 15,938 patient cohort in this study had an ISS ≤ 15. Another trauma study comparing field paramedics with emergency physicians in the emergency department (ED) showed that their performance was equal when it came to activating HEMS "appropriately." Still, they both activated HEMS when the ISS turned out to be 15 or less approximately 60% of the time.[9] In another air medical study including trauma and nontrauma patients using APACHE II scores to quantify severity of illness, 52% of 13,808 patients had an APACHE II score < 10, which is generally considered a score to mark critical illness where there is an expected 10% mortality rate.[10] These papers illustrate a significant problem with the appropriate triage of HEMS resources, demonstrating a consistently concerning false-positive rate.

Although the rational use of HEMS depends on improving the mission acceptance/triage process, little has been written specifically addressing this issue.[11] An ideal HEMS triage system would correctly identify patients with a high likelihood of benefiting from this level of care (limit overtriage) without missing any (limit undertriage). No triage system will be perfect, however. The American College of Surgeons (ACS) have suggested in their trauma trip destination guidelines[12] that an overtriage rate of 50% must be expected to reduce the undertriage rate to 10%. We must be clear, however, that trip destination guidelines for trauma patients and HEMS appropriateness are two separate (but related) issues. Little has been published to achieve a consensus benchmark for accept-

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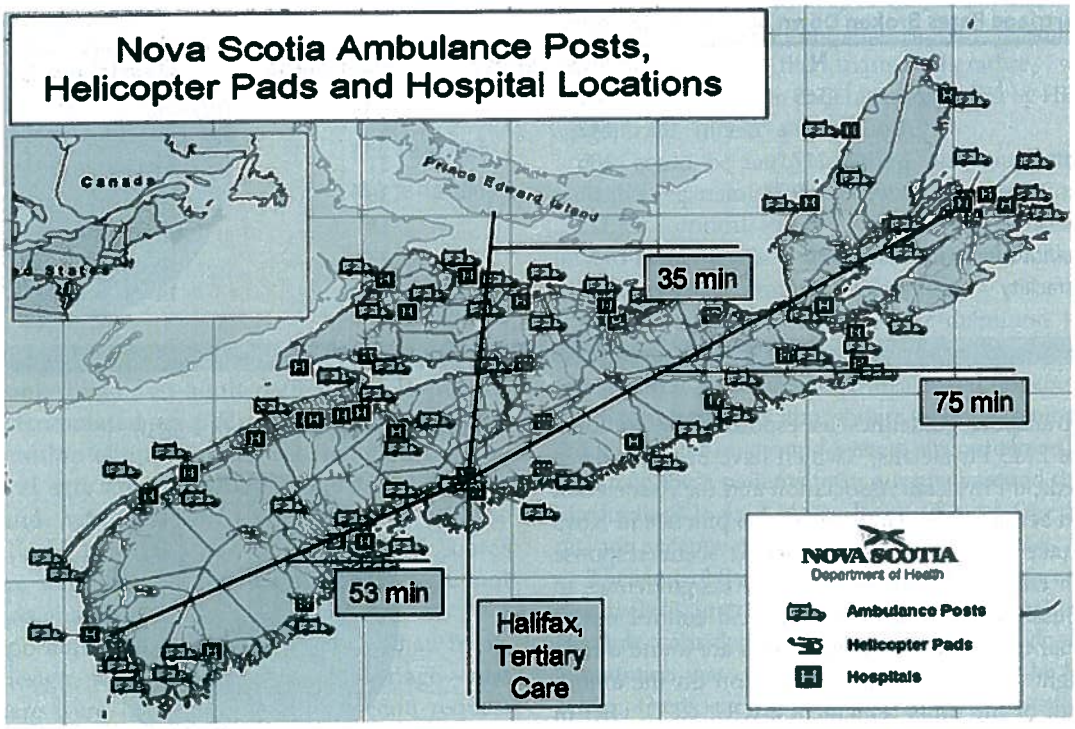
Figure. 1. Time indicators represent flying time in S-76 to Halifax, Tertiary Care.



able overtriage in HEMS. Furthermore, a comprehensive critical care transport system also must consider the appropriateness of HEMS utilization in nontrauma patients.

Clearly, "the goal is to facilitate air medical care when needed, and avoid over utilization when not needed."[13] To that end, future research efforts should focus on the refinement of triage in air medical transport.[7]

The purpose of this paper is to first describe a unique mission acceptance/triage process in a single, provincially based, HEMS system; second, to measure the ability of this triage process to identify patients considered medically appropriate for air medical transport.

Methods

This is a retrospective review of administrative and patient care databases (including the provincial trauma registry). If appropriateness could not be determined by initial database queries, a limited chart review was undertaken. All adult (≥ 16 years old) missions were reviewed between March 2003 and December 2004. This project received full ethics approval from the local ethics review board.

For the purposes of this evaluation, "appropriateness" was defined as:

- Admission to critical care unit [intensive care unit (ICU), critical care unit (CCU), operating room (OR), step down, burn unit)
- Death during transport or in first 24 hours
- ISS ≥ 12 (if trauma)

Overtriage was defined as not meeting these criteria.

Appropriateness and overtriage rates were calculated and reported overall and by "trauma," "cardiac," and "other-medical" categories. Trauma appropriateness rates are reported overall and by scene, interfacilty, and scene/interfacility mission categorization. Scene/interfacility trauma is defined as a mission that initially launched as a scene mission but the patient was extricated and transported to a nearby ED before arrival of the helicopter.

Results

Description of mission acceptance/triage process

Emergency Health Services Nova Scotia (EHSNS) LifeFlight operates within an integrated, provincially based EMS system.[14-17] A single central dispatch center coordinates all ground and air responses. A single tertiary care center is also the only level I trauma center (Figure 1). LifeFlight serves approximately 1 million people in Nova Scotia and an additional 150,000 in the neighboring province of PEI. A single Sikorsky S-76 does the vast majority of EHS LifeFlight missions; however, there is access to a fixed-wing backup on a periodic contract basis.

The single ground provider is also integrated with the provincial trauma system. Approximately 90% of the first-on-scene ambulances are capable of advanced life support. Target response intervals for urban (9 minutes), suburban (15 minutes), and rural (30 minutes) are made well over 90% of the time. Almost half of our 9-1-1 calls come from rural areas of the province, which underscores the importance of an effective and efficient air medical transport system.

The mission acceptance/triage process involves three separate but related aspects. First, the program educates sending facilities and ground medics within the system with regard to

Table 1. Overtriage Rates Broken Down by Clinical Category

	N	Appropriate	Overtriage	Overtriage %
Overall	563	489	74	13.1
Cardiology	147	142	5	3.4
Other medical	217	186	31	14.3
Trauma all	199	161	38	19.1
Trauma scene	49	32	17	34.7
Trauma scene/interfacility	50	43	7	14
Trauma interfacility	100	86	14	14

air medical transport guidelines as espoused by National Association of EMS Physicians,[18] which have been endorsed by the Air Medical Physician Association and the Association of Air Medical Services. All paramedics who practice in Nova Scotia must take the air medical transport scene response course, which emphasizes the use of the ACS guidelines to trigger a discussion with the online medical control physician. The actual criteria for these guidelines are found online at the LifeFlight website and in card version on the ambulances..All staff of the units (emergency, ICU, CCU, OR) in every hospital in Nova Scotia are also educated through our outreach program and site visits with regard to indications for helicopter transport.

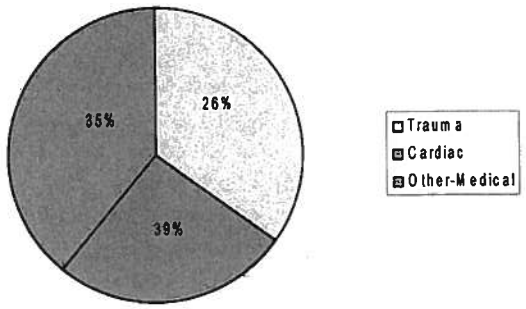
Second, the single dispatch setting allows dedicated air medical dispatchers to scan for potential missions or "hotspots" in the ground system before a specific request is even initiated.

Third, there is a "medical doctor to medical doctor" (or "paramedic to doctor" for scene mission requests) conversation between the sending physician (or paramedic) and the online air medical control physician (MCP). This conversation serves three purposes: it confirms or rejects acceptance of the mission and launches the flight, it provides medical advice re stabilization and transport, and it may facilitate preparation and treatment at the receiving hospital (eg, direct to the operating room with a leaking aortic aneurysm).

All missions are reviewed by our continuous quality improvement process, which identifies potential undertriage or overtriage criteria cases and brings them to the attention of the medical director for review. If necessary, individual feedback is then brought to the specific online MCP involved. Cases with educational value to the group are presented at the monthly morbidity and mortality rounds.

Autolaunch (the simultaneous dispatch of air and ground resources to a 9-1-1 request for EMS based on predesignated criteria[19]) is a topical issue in trauma response by HEMS. Although there are theoretic benefits to this approach, whether patient outcomes are improved by this approach remains to be seen. Our mission acceptance/triage process is not inconsistent with the autolaunch principles. In some circumstances based on geography, mechanism of injury, description by 9-1-1 caller, and location of closest ground unit (all known by the air medical dispatcher), the helicopter will be launched and the online MCP will be notified. In this situation the physician will be patched through to the first paramedic to arrive on scene, and they will decide whether to continue to the scene or to abort the mission.

Figure 2. Clinical category (n = 563).



Measuring appropriateness of mission acceptance/triage

Five hundred seventy-eight adult cases for potential inclusion were identified through the LifeFlight mission database between March 2003 and December 2004. During this time 162 pediatric, 180 neonatal, and 126 obstetric LifeFlight missions were completed but not included in our analysis.

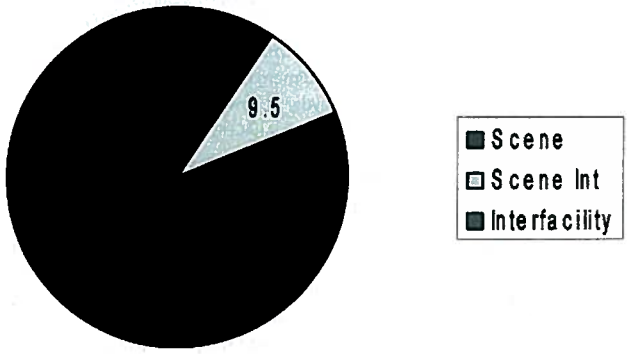
Of the 578 cases identified, 15 (2.6%) were excluded from analysis because of inadequate data, leaving 563 in the final cohort. Clinical category distribution can be seen in Figure 2; mission type distribution can be seen in Figure 3.

Overall, 489 of 563 (86.9%) missions were deemed to be medically appropriate by our a priori definition, an overtriage of rate of 13.1%. Further appropriateness and overtriage rates can be seen in Table 1.

Limitations

This study was retrospective in nature, so we relied on administrative data entered originally into large databases. We believe, however, that our a priori definition of appropriateness was explicit, simple, objective, and easily determined through our data analysis with a low likelihood of subjective misinterpretation. A small number of cases had missing or inadequate data.

Figure. 3. Mission type (n = 563).



Our study only looked at adult patients, so its results may not be extrapolated to pediatric or neonatal missions. Our definition of appropriateness included "admission to a critical care area," which is a surrogate marker of severity and was left to the discretion of the treating/admitting physician. Use of APACHE II scores would be more explicit and reproducible but were not available for this analysis.

Another important limitation of the study is that, by its retrospective design, it cannot measure undertriage—that is, whether there were instances when a mission request was refused by an online MCP when there was a reasonably good chance that HEMS may have positively affected outcome. Another type of undertriage that is even harder to measure would be a situation in which the sending clinician does not call at all when there is a reasonably good chance that HEMS may positively affect outcome.

Discussion

The rational and appropriate use of HEMS is absolutely vital to ensure maximum benefits to patients while minimizing potential costs and exposure to safety concerns. The mission acceptance/triage process then becomes extremely important to any air medical transport program. Because of overtriage in past studies,[8-10,20] several authors have called for improved triage guidelines. However, before new or different HEMS triage criteria can be evaluated prospectively, an accepted consensus is needed on what type of mission is considered medically appropriate and then what would be an acceptable overtriage rate. Only then will we be able to compare systems through benchmarking to each other and to a clinically justifiable target.

Defining "medically appropriate"

Our definition is reasonably considered but admittedly not validated or based on an industry consensus. It is partly evidence based and partly pragmatic. Based on earlier studies in trauma that failed to show an outcome benefit in minimally injured trauma patients,[8,20-22] we used an ISS cutoff. Twelve was chosen instead of 15 for two reasons: to err on the side that HEMS may be of some benefit in this group (ie, between 12 and 15), and because an ISS of 12 is also used by the Canadian National Trauma Registry (NTR) as defining major trauma (Canadian Institute for Health Information, National Trauma Registry, Major Injury in Canada, 2004 Report). In nontrauma patients, we used surrogate markers of severity such as "admission to critical care area" and "peri-transport death" to define appropriateness. Our reasoning here was extrapolated from the trauma literature, which shows improved outcomes in patients transported by HEMS if there is a significant "illness" severity score.

We could be fairly criticized that our definition is too inclusive (eg, using ISS $\geq$ 12 rather than $\geq$ 15 or defining the CCU as a critical care area). This would bias our findings toward higher levels of appropriateness and make our mission acceptance/triage process "look better."

Others may fairly criticize our definition for being too exclusive [did not count hyperbaric chamber (2 patients transported) as a critical care area or did not count logistically justified missions as appropriate, such as remote location/no ground access or ground system overwhelmed]. We did not eliminate these patients from our analysis and this would bias our findings toward higher levels of overtriage and make our mission acceptance/triage process "look worse."

The issue of defining appropriateness prospectively or retrospectively is interesting and warrants further discussion. For example, consider a patient who hits his head while skiing on a mountain that is 3 hours by ground from the level 1 trauma center. There is a transient loss of consciousness, followed by improvement, a decreasing level of consciousness, and increasing headache. If this is an epidural, a time-dependent procedure (craniotomy with clot evacuation) is needed, and increasing time to procedure will significantly impact outcome; there is a concomitant risk of herniation and airway compromise during transport. Prospectively, therefore, this seems to be an appropriate HEMS transport.

However, if the patient arrives by air, has a negative computed tomography (CT) scan, and then is admitted to a non–critical care area for observation, he will be considered an inappropriate HEMS transport by our retrospective definition. Similar situations will be encountered in nontrauma patients. Consider the 65-year-old man who presents to a rural hospital with syncope, low blood pressure, mid-back pain, and a wide mediastinum on chest radiograph. This could be anything from an aortic dissection requiring urgent workup and possibly surgery to a urinary tract infection requiring intravenous (IV) fluids, antibiotics, and supportive care. The retrospectively applied definition used in this study would classify HEMS use in this patient as inappropriate, when, prospectively, it might be quite reasonable.

One potential improvement to our proposed appropriateness definition might be "requires urgent imaging or test to rule out a time-dependent pathologic condition." This would incorporate prospectively applied considerations; however, the data could be practically gathered retrospectively for continuous quality improvement and benchmarking.

Establishing a benchmark for overtriage

Regardless of the refinement in HEMS triage criteria, they will never be perfect, given the complex nature of medical management in a continuously evolving system. Overtriage will always hinge on the definition of appropriateness, so

establishing some consensus on this concept is essential. Some degree of overtriage is necessary to reduce what may be more dangerous to the patient—undertriage.[12] As with any test, the cost of improved specificity will be a reduction in sensitivity. Where do we draw the line that balances the risks and benefits of overtriage and undertriage?

Overtriage in the trauma situation (especially scene trauma) likely will be higher than in other diagnostic areas. The early, undifferentiated trauma has little definitive information to make difficult decisions on potentially life-threatening and time-dependent issues. Most clinicians will err on the side of the patient. Maybe the 50/10 rule, as per the American College of Surgeons, is the best we can do here. However, we can no longer emphasize exclusively our noble advocacy for the individual patient without recognizing the reality that we must advocate for the system (and future individual patients) at the same time. This may seem like an esoteric ethical dilemma, but it has pragmatic ramifications. As experts in the field of critical care and transport medicine, we must be involved in establishing a balanced approach through research.

Furthermore, we must differentiate our approach to trip destination decisions from transport mode decisions. In other words, there may be evidence that a specific type of trauma patient should bypass closer, smaller hospitals to go directly to a trauma center[23-25] to improve outcomes. This may not necessarily justify the use of HEMS. These two issues may be clarified through research.

Similar principles established in trauma care can be extrapolated to the nontrauma patient, but this expectation should be validated through research. For example, the increasing evidence for early goal-directed care in sepsis[26] and the push for a regional approach to ST elevation myocardial infarction[27-31] illustrate how important the issue of HEMS triage is and will become.

Conclusion

A unique mission acceptance/triage process in an integrated, centrally dispatched, provincially based HEMS system is described. The rate of medically appropriate missions in this system is relatively high. Consensus is needed to define the concept of medically appropriate. Future research is needed to improve HEMS triage systems.

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