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Original Research

Helicopter Emergency Medical Services Utilization

Timothy J. Lenz, MD, MPH, EMT-P, FACEP *, Elena A. Kossyreva, MD, M. Riccardo Colella, DO, MPH, FACEP

Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI

A B S T R A C T

Background: The decision to utilize HEMS is a complex process that involves many considerations. Professional associations and agencies have published guidelines to assist providers with decision making for the utilization of helicopter transport.
Study Objective: Determine if requests for HEMS align with recently published utilization guidelines.
Study Design: A retrospective chart review was performed during a six-month period. Reviewers versed in Wisconsin HEMS Utilization, NAEMSP, and CAMTS guidelines determined if transport criteria were met. Charts were categorized according to whether or not criteria for each set of recommendations were followed.
Results: 514 charts were reviewed; 439 consisted of completed patient transports. CAMTS, NAEMSP, and WI HEMS guidelines satisfied 85.4%, 83.4%, and 53.1% of requests, respectively. Statistically significant differences existed when comparing rates meeting criteria between WI HEMS and CAMTS and between WI HEMS and NAEMSP guidelines (p-value <0.0001). This was true in all subgroups except STEMI, which did not show significant difference. No difference existed between rates for CAMTS and NAEMSP guidelines in any group.
Conclusion: Significant difference between Wisconsin HEMS utilization versus NAEMSP guidelines, and between Wisconsin HEMS utilization and CAMTS guidelines in all subgroups except STEMI patients exist. No statistically significant difference existed between NAEMSP and CAMTS guidelines.

Ongoing discussions exist on the benefit of helicopter emergency medical services (HEMS) in various settings, with safety, cost, and outcome implications often cited in these debates. Helicopters may provide a faster mode of transport than ground ambulances, especially in remote areas where a specialty care center is hundreds of miles away. HEMS can also provide an increased level of care with advanced care professionals staffing the transports. HEMS may be able to provide timely clinical resources to patients needing care when they would otherwise be unable to obtain such services by ground emergency medical services (GEMS) while preventing the loss to the local community of a GEMS unit. However, many argue that although HEMS is faster than GEMS, limited evidence exists showing improvement in patient outcomes.

The number of air medical transports doubled between 2000 and 2010.[1] However, with this came a doubling of the number of crashes related to air medical transports.[1] According to the Federal Aviation Administration, in February 2014, there were 75 air ambulance companies in the United States operating 1,515 helicopters, which is an increase from 74 air ambulance companies operating 850 helicopters in October 2010.[2] As of June 1, 2015, there were 172 Commission on Accreditation of Medical Transport Systems (CAMTS)–accredited services throughout the world, with 164 of these services in the United States.[3] Frequently, these numbers are cited when discussing the safety of HEMS. In 2011, the Federal Interagency Committee on EMS sponsored the first nationwide assessment on emergency medical services (EMS) in the United States. The survey found there are more than 21,000 licensed EMS agencies in the United States, with each state having 7 to 1,555 agencies, for an average of 249 EMS agencies per state and 7 EMS agencies per county.[4] Although there is a significantly larger number of GEMS services compared with HEMS services, the federal government does not require a centralized reporting system for GEMS crashes, so it is impossible to know the actual number of GEMS crashes compared with HEMS crashes for the same time period. Without a centralized reporting system, it is inappropriate to refer to GEMS as a safer mode of transport when compared with HEMS.

Transport by helicopter EMS is a complex decision-making process that takes many factors into consideration. Not only does patient

* Address for correspondence: Timothy Lenz, MD, MPH, EMT-P, FACEP, Department of Emergency Medicine, Medical College of Wisconsin, 8701 Watertown Plank Road, HUB 3rd Floor, Milwaukee, WI 53226.
E-mail address: tilenz@mcw.edu (T.J. Lenz).

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Table 1
An Abbreviated Summary of the Guidelines on Helicopter Emergency Medical Services (HEMS) Use Proposed by the Wisconsin Helicopter Emergency Medical Services (WI HEMS), the National Association of EMS Physicians (NAEMSP), and the Commission on Accreditation of Medical Transport (CAMTS)

WI HEMS Guidelines	NAEMSP Guidelines	CAMTS Guidelines
1. Acute life-threatening event that requires a time-sensitive intervention IF the patient can be delivered during an interventional window AND GEMS are not able to deliver the patient within that window 2. Trauma patients meeting WI Field Trauma Triage Guidelines category 2 or 3 that are > 30 minutes ground travel to the closest level 1 or 2 trauma center 3. HEMS may provide critical care services not available by GEMS 4. Transport may be considered for geographically isolated, remote patients independent of medical emergency 5. HEMS as a resource to local GEMS during disasters and times of low community resources	1. General guidelines Patients in need of critical interventions Patients with unstable vital signs, critical injuries, or critical illness Patients in need of intra-transport critical care services Patients in topographically hard-to-reach areas Transport distance is "sufficiently long" Disaster/mass casualty events 2. Trauma guidelines Trauma score < 12, unstable vital signs, significant trauma, multisystem injuries, ejection from vehicle, pedestrian or cyclist struck by vehicle, death in the same passenger compartment, GEMS perception of significant damage to compartment Other considerations, including neurologic, thoracic, abdomen/pelvis, ortho/extremity, and burn specific Patients with near drowning injuries 3. Interfacility transfers Patients have diagnostic and/or therapeutic needs that cannot be met at the referring hospital AND factors such as time, distance, and/or advanced care requirements are not met by GEMS crew's abilities 4. Other Patient needs transport for organ salvage Search and rescue In rare cases, if an arrest does not meet criteria for cessation of resuscitative efforts OR in areas where EMS cannot cease such efforts	1. HEMS transport is encouraged if Specialized personnel and/or equipment is available through HEMS but otherwise unavailable 2. HEMS transport will be reviewed if Nonemergent request with other, more economic transport options are available Unsafe conditions Patient was discharged home directly from the ED Transported from scene with trauma score of 15+ OR failed to meet triage criteria for a critically injured trauma patient Other considerations

ED = emergency department; EMS = emergency medical services; GEMS = ground emergency medical services.

condition play into the decision to transport by air, research has shown that regions may benefit from a detailed assessment of their specific geographic and logistical situation when deciding to transport by HEMS versus GEMS.[5] Wisconsin's Southeast Regional Trauma Advisory Council promotes optimal trauma care across local, regional, and state boundaries and adopted the Wisconsin Helicopter Emergency Medical Services Utilization Guidelines to aid in the complex decision-making process required when requesting HEMS. The National Association of EMS Physicians (NAEMSP) Task Force has offered a noncomprehensive overview of clinical and logistical situations in which air medical dispatch may be appropriate but stresses the importance of the provider's decision at the patient's side, which should never be overruled by a set of guidelines.[6] Furthermore, CAMTS has put forth standards for an appropriate use review process through trending and tracking requests. Table 1 summarizes these 3 sets of guidelines.

The use of HEMS is a medical decision requiring appropriate oversight and integration into regional systems of care, and guidelines were developed to assist EMS crews and hospital staff in determining which patients may benefit from transport by helicopter. The Wisconsin Helicopter Emergency Medical Services Utilization Guidelines were developed and approved by the Wisconsin EMS Board to provide EMS and hospital providers with a decision-making tool for the use of helicopter evaluation, evacuation, and transport. A primary goal of the guidelines is to focus on the care and transport needs for patients with time-sensitive emergencies and deliver them to a hospital that can provide specific interventions within a therapeutic window of time. A position paper was issued for the 2002 to 2003 Air Medical Services Committee of the NAEMSP regarding appropriate air medical dispatch. Additionally, CAMTS has set forth guidelines for helicopter transport. For the purpose of this study, the 10th Edition of Accreditation Standards from October 2015 was used because it was the active edition during the study; CAMTS released the 11th edition in October 2018.

The goal of this project was to determine if requests for HEMS align with published use guidelines. Education is paramount to improving the health of the individuals and communities we serve. This includes understanding how to safely, efficiently, and cost-effectively transport the patients we serve. To determine how best to educate health professionals on proper HEMS use, we must first understand why helicopters are being requested for transport. By understanding the alignment of transport requests with published guidelines, we can promote the proper use of HEMS.

Materials and Methods

The study was approved by the Medical College of Wisconsin's Institutional Review Board. A retrospective chart review was performed using reviewers working with the Department of Emergency Medicine Research Division. Reviewers read and familiarized themselves with the Wisconsin HEMS use guidelines, the NAEMSP guidelines, and the CAMTS guidelines. All records during a 6-month period from a regional Midwestern United States HEMS with 3 bases in 2 states were reviewed for potential inclusion in the study.

A retrospective chart review of 514 HEMS transport requests in Wisconsin occurring between June 1 and December 31, 2014, was performed. Adult and pediatric patients from June 1 to December 31, 2014, including those not transported because of instability or death, were included in the study. Flights that were aborted or canceled for other reasons, including, but not limited to, weather, maintenance, inadequate crew, or unavailable aircraft, were excluded. On average, 1 patient per base per day is transported by this regional HEMS organization. This number varies based on season and weather conditions. We anticipated reviewing approximately 350 charts from the study period.

Per usual operational policy, transported patients were flown to the nearest, most appropriate facility capable of providing definitive care. Included charts were reviewed to determine whether criteria for transport were met based on the guidelines set forth by the previously mentioned organizations. The percentages of transports deemed to have appropriately met criteria under each set of guidelines were calculated.

We analyzed flight and patient population characteristics and performed subgroup analyses. Each patient who was transported by HEMS was assigned to 1 or more of the following subgroups: trauma, ST segment elevation myocardial infarction (STEMI), stroke, sepsis, or

other medical condition. These were further subdivided into adult versus pediatric and male versus female populations. It was then determined whether HEMS transport requests for individual subgroups and collectively all subgroups followed 1 or more of the HEMS transport guidelines. To determine potential differences between the 3 sets of guidelines, chi-square analysis was performed. Data were further analyzed using the Fisher exact test to directly compare one group with another.

Results

A total of 514 charts were reviewed, 439 of which consisted of completed adult and pediatric patient transports that were subsequently analyzed. There were 73 aborted and canceled calls, with an additional call excluded from analysis because of inadequate documentation and another excluded because it involved transport of amputated digits without an actual patient. Figure 1 shows a diagram of the population of patients included in the data analysis.

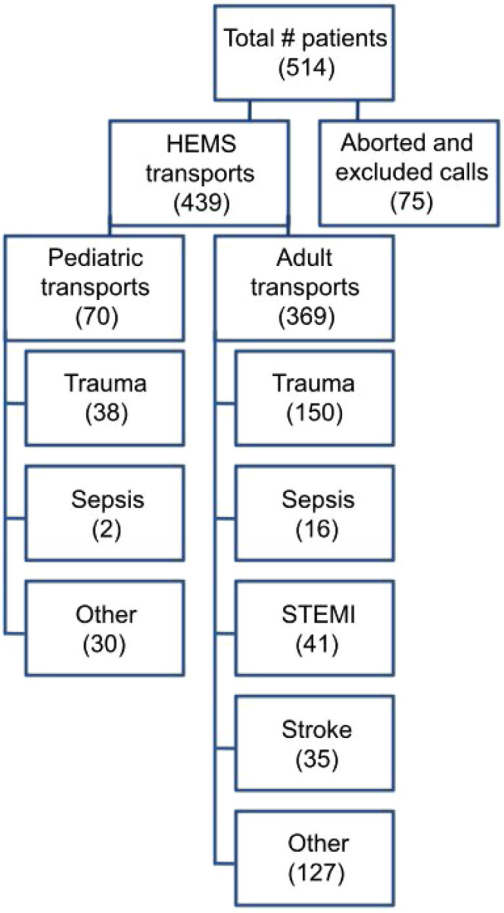

Figure 1. The total number of charts reviewed, the number of patients transported by HEMS, and the number of patients analyzed in each subgroup.

As depicted in Figure 2, of all HEMS transports, 42.8% were trauma, 9.3% were STEMI, 8.0% were stroke, 4.1% were sepsis, and 35.8% fell into the other medical condition subgroup, which included all transports that did not satisfy any other subgroup criteria.

Pediatric patients comprised 15.9% of all HEMS transports. Among all cases that fell into the trauma, sepsis, and other medical condition subgroups, pediatric cases comprised 20.2%, 11.1%, and 19.1% of these, respectively. There were no pediatric patients in the STEMI and stroke subgroups (Table 2).

The proportion of male patient transports at 64.7% exceeded that of females. Subgroup distributions for trauma, STEMI, stroke, sepsis, and other medical conditions among males and females were as follows (reported in terms of males): 76.1%, 68.3%, 51.4%, 44.4%, and 55.4%, respectively (Table 2).

In all HEMS transports, the CAMTS, NAEMSP, and Wisconsin HEMS guidelines were satisfied by 85.4%, 83.4%, and 53.1% of the transport requests, respectively. Figure 3 shows these findings.

Chi-square analysis suggested a statistically significant difference among these 3 sets of guidelines (Table 3). Analysis using the Fisher exact test revealed a significant difference between Wisconsin HEMS and CAMTS guidelines as well as Wisconsin HEMS and NAEMSP guidelines ($P < .0001$). This was true in all the subgroups except STEMI, which did not show a significant difference among the 3 sets of guidelines based on the chi-square results. According to the Fisher exact test, there was no difference between transport requests that met the criteria for the CAMTS and NAEMSP guidelines in total or in any of the subgroups.

Limitations

The principle limitation of this study is the interpretation of the different guidelines by the reviewers. Two people reviewed

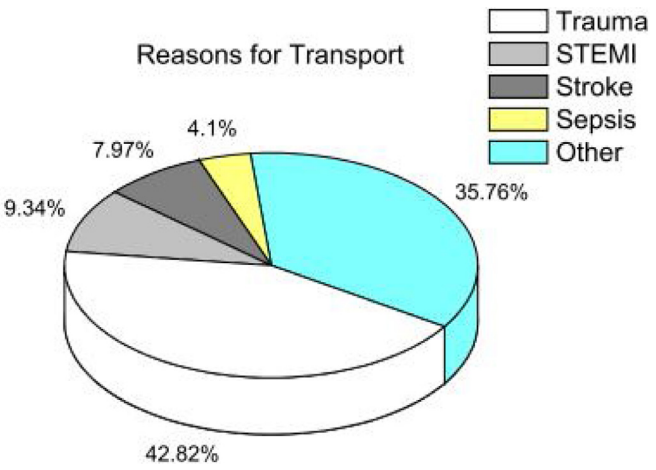

Figure 2. The HEMS transport subcategories.

Table 2
Patient and Flight characteristics

	Total transported (n=439)	Trauma (n=188)	STEMI (n=41)	Stroke (n=35)	Sepsis (n=18)	Other (n=157)
% Total transports	100	42.8	9.3	8.0	4.1	35.8
% Peds	15.9	20.2	0	0	11.1	19.1
% Male	64.7	76.1	68.3	51.4	44.4	55.4
Avg age, years (SD)	45.5(24)	37(21.2)	59.8(12.6)	59(18.7)	49.6(27.3)	48.4(26.3)
Avg Flight distance, miles (SD)	34.5(18.5)	27.9(10.7)	29.7(6.8)	31.1(15.3)	45.8(23.5)	43.1(23.5)

*(SD) = Standard deviation

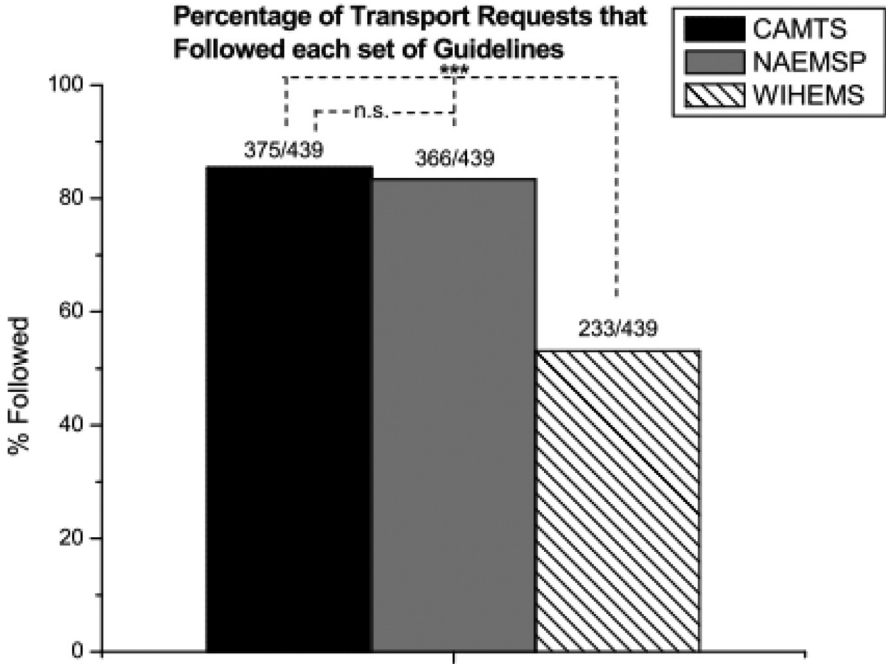

Figure 3. The percentage of transport requests that followed each set of guidelines. ***Statistically significant. n.s. = not significant.

Table 3
Proportions of HEMS transports that followed one or more sets of guidelines.

% Transports	CAMTS	NAEMSP	WI HEMS	Λ^2 p-value
Total	85.4	83.4	53.1	<0.0001
Pediatric	94.3	92.6	72.9	0.0002
Male	84.5	82.7	56.0	<0.0001
Trauma	80.9	82.4	56.9	<0.0001
STEMI	100.0	100.0	100.0	N.D.
Stroke	80.0	65.7	34.3	0.0003
Sepsis	94.4	83.3	38.9	0.0004
Other	87.3	84.1	42.0	<0.0001

*N.D. = No difference

the flights during the study period, but individual interpretation of the guidelines could skew the data. Some of the guideline criteria did not have clearly delineated parameters and were open to interpretation. Therefore, with the vague nature of some of the recommendations, one person may interpret the flight data as complying with the suggested guidelines, whereas the next person may not.

Another limitation is analysis of aborted calls. In each case, the helicopter launched from its designated base but did not land at the scene or transport a patient. In cases in which the patient died, it is clearly understood why a transport did not occur. In cases in which "services not needed" was documented, it is unknown why helicopter EMS was requested in the first place or what occurred to cause services not to be needed. Thus, it is not possible to determine whether these aborted calls were appropriate per the published guidelines. To better understand if dispatch and use guidelines are being followed properly, we need to know the reason for the initial dispatch and, ultimately, the cancellation of HEMS.

Finally, one must consider the final disposition of the patient. Because our HEMS teams transport patients to multiple hospitals in Wisconsin and Illinois, it is often difficult to obtain follow-up on those transported. Furthermore, this analysis was not included in our institutional review board proposal. To clearly understand whether HEMS transport was truly indicated, one should also consider such factors as final disposition, length of stay, and Injury Severity Score for Trauma.

Discussion

In this retrospective chart review, we detected a significant difference in the rate of adherence to the Wisconsin HEMS use guidelines and the NAEMSP guidelines in all subgroups except STEMI patients. Additionally, a significant difference in adherence existed between the Wisconsin HEMS use guidelines and the CAMTS guidelines, again in all subgroups except STEMI patients. However, no statistically significant difference existed between the NAEMSP guidelines and the CAMTS guidelines. This is not surprising because CAMTS is not an independent entity but has 21 member organizations that make up the CAMTS Board of Directors, one of which is NAEMSP.[7] Therefore, one would expect influences on guideline development from each organization. When all 3 guidelines align, as they do for STEMI, appropriate helicopter request, dispatch, and transport seem apparent. Complicating this is that none of these tools have undergone validation, which may make adherence in these same STEMI transports not as apparent. The Wisconsin HEMS use guidelines suggest certain parameters and vital signs in concordance with the Wisconsin Trauma Triage Guidelines. With clear parameters to follow, the Wisconsin HEMS use guidelines are clearly delineated for prehospital providers and physicians requesting transfer of trauma patients. The only subgroup in which the Wisconsin HEMS use guidelines

aligned with the NAEMSP and CAMTS guidelines were time-sensitive emergencies, so one must consider whether the Wisconsin HEMS tool is too narrow compared with the other 2 guidelines and possibly missing patients needing HEMS transport. On the other hand, it is possible that the NAEMSP guidelines and CAMTS guidelines are too broad and open to interpretation by the provider, and patients who are indeed appropriate for ground transport are actually being flown. Without clearly delineated parameters, interpretation is left to the provider, which could result in the disparities between the guidelines observed in this retrospective chart review. Further effort should be put forth to develop validated guidelines that clearly identify patients who should be transported by HEMS.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amj.2019.03.004.

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