Appropriate use of Helicopter Emergency Medical Services for transport of trauma patients: Guidelines from the Emergency Medical System Subcommittee, Committee on Trauma, American College of Surgeons

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A "trauma system" as defined by the American College of Surgeons' Committee on Trauma (ACSCOT) includes prehospital care of the trauma patient, including the emergency medical system (EMS) and helicopter emergency medical services (HEMS).[1] Appropriate use of HEMS for trauma patients can save lives. Inappropriate use of HEMS is a costly waste of health care resources and increases risk to patients and HEMS crews. Unfortunately, HEMS resources often operate outside the confines of an inclusive and integrated trauma and EMS system. The Airline Deregulation Act of 1978 left the authority to regulate the air medical industry to a largely nonmedical entity, the Federal Aviation Administration (FAA). In 2006, the Institute of Medicine specifically recommended that states be allowed to regulate the medical aspects of the system, so that "states assume regulatory oversight of the medical aspects of air medical services, including communications, dispatch, and transport protocols."[2] A 2009 National Transportation Safety Board (NTSB) investigation into a surge in fatal HEMS accidents led to recommendations to the Federal Interagency Commission on Emergency Medical Services (FICEMS) to develop national guidelines for the use and availability of HEMS by regional, state, and local authorities during emergency medical response system planning, including the integration of HEMS into the EMS system and the selection of patients for appropriate emergency transportation modes for urgent care.[3]

The mission of the ACSCOT is to develop and implement meaningful programs for trauma care in local, regional, national, and international arenas. The ACSCOT has developed standards since 1991 as verification criteria for trauma systems, including for prehospital trauma care. The EMS Subcommittee of the ACSCOT, after reviewing the pertinent literature and existing ACS trauma system verification criteria, recommends the following guidelines for appropriate use of HEMS for the transport of trauma patients.

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HEMS AND THE TRAUMA SYSTEM

The ACS has defined a trauma system as an organized, coordinated effort, in a defined geographic area, that delivers a spectrum of care to all injured patients and is integrated with the local public health system. The true value of a trauma system is derived from the seamless transition between each phase of care, integrating existing resources to achieve improved patient outcomes, measure outcomes, and improve performance.[1] In 2007, Hoyt and Coimbra[4] published a comprehensive article detailing the history, organization, and future directions of trauma systems within the United States. A meta-analysis of 14 studies between 1992 and 2003 reported a 15% mortality reduction when trauma care was provided in trauma centers in an established trauma system based on an odds ratio assessment.[5]

Timely access to definitive care has been shown to improve outcomes after traumatic injury and is considered to be a critical component of modern trauma care.[6,7] Access to trauma center care, however, is not consistent across the country, and patients without immediate access to this specialized resource have been shown to experience disproportionally worse outcomes.[7] Helicopter transport of the injured patient has been an integral component of many trauma systems in the United States since the 1970s, and the availability of helicopters has been credited with improving trauma center access for a significant percentage of the US population.[8,9] The aeromedical industry has expanded considerably during the last several decades with an estimated 400,000 helicopter EMS missions flown annually and almost 900 dedicated aeromedical programs in the United States alone.[10]

The principle that time from injury to definitive care is a critical factor in the survival of severely injured patients drives the perceived benefit of helicopter transport in the trauma population. Brown et al.[11] used the National Trauma Data Bank (NTDB) to demonstrate that trauma patients transported by helicopter were more severely injured, had longer transport times, came from further away, and required more hospital resources than trauma patients transported by conventional ground ambulances. Despite this, patients transported by helicopter were more likely to survive and were more likely to be discharged home after treatment when compared with patients transported by conventional ground ambulance. A similar pattern was seen in patients with an Injury Severity Score (ISS)

of greater than 15 who were undergoing interhospital transfer by helicopter when compared with conventional ambulance.[12]

Diaz et al.[13] demonstrated that helicopter transport was faster than ground transport if simultaneously automatically launched for a patient 10 miles from the trauma center and if requested by scene personnel for a patient 45 miles from the trauma center. This implies that the potential benefit from helicopter transport is most likely realized as the distance from the trauma center increases. For this reason, helicopters may not be beneficial in many urban areas if ground transport times to trauma centers are reasonably short.[14,15] Some authors have advocated local GIS mapping to choose the optimal mode of transport to minimize delay to definitive care.[15]

Despite wide use, the role of helicopters in the transport of civilian trauma patients remains controversial. Concerns over safety have intensified owing to an increase in helicopter crashes and a perceived absence of health agency regulatory HEMS oversight.[7] In addition, the indications for appropriate use of this costly and limited resource have yet to be clearly defined.

Many HEMS operators are not fully integrated into regional trauma systems where these exist. The NTSB has reported that there has been significant variability in compliance to safety practices among various HEMS operators.[16] However, most HEMS operators are voluntary participants in national associations, which provide operator guidelines.

Prehospital care within mature trauma systems is improved by the regionalization and rationalization of prehospital triage and decision-making, performance improvement processes and guidelines for provider training and ambulance equipment. This is part of a national vision for a fully integrated emergency care delivery system.[2]

- Optimal use of HEMS requires integration with the trauma system.

HEMS DISPATCH AND TRIAGE CRITERIA FOR TRAUMA PATIENTS

Appropriate use of HEMS for injured patients should be a priority for trauma system integration. The goal is to minimize undertriage and define an appropriate level of overtriage so that patients with severe injuries have access to immediate lifesaving interventions and rapid access to the highest level trauma center available, while those with more minor injuries can be managed in local hospitals or if specialty care is required, transported by ground EMS to the trauma center.

Galvagno et al.[17] using NTDB records for 2007 to 2009 showed an absolute risk reduction of 1.5% for HEMS versus ground transport of trauma patients to Level I trauma centers, with 65 patients needing to be transported by HEMS to save one additional life. The large number needed to treat may be an evidence of overtriage in the HEMS group. Overtriage is a triage decision that incorrectly results in transport of a trauma patient to a trauma center, which is determined retrospectively to have been unnecessary. Triage criteria for trauma transport by conventional ground EMS systems may result in an overtriage rate of 25% to 50%, which is considered acceptable because these criteria will produce an undertriage rate of 1% or less. Undertriaged patients are at risk of death by being transported to a nontrauma center.

Overtriage of HEMS for trauma patients remains a significant problem with a recent meta-analysis indicating that up to 60% of injured patients transported by air services have minor injuries and more than 25% are discharged from the trauma center within 24 hours of arrival.[18] Likewise, in a study of helicopter transport in an urban EMS system, more than 80% of pediatric patients transported to the pediatric trauma center had minor injuries (ISS < 15).[19] Overtriage leads to increase costs, increased exposure to the risks associated with HEMS transport, and an increased burden on the resources of the highest level trauma centers.[20]

There are several factors, which contribute to the decision to use HEMS. These may include access to a higher level of prehospital care provided by HEMS crews, more rapid access to a major trauma center based on distance or unfavorable geography for ground transport, need for evacuation of multiple casualties, and need to keep the local ground EMS service available to the local community. In many systems, HEMS personnel have advanced life support (ALS) training, which may not be available in rural EMS systems.[21,22]

In 2003, the National Association of EMS physicians published a position paper on air medical dispatch criteria.[23] While not confined to trauma patients, these guidelines did include specific criteria for injured patients (Table 1). For ease of comparison with the Centers for Disease Control and Prevention (CDC) field triage guidelines, we have grouped them in similar categories (Fig. 1). The specific literature supporting each of these criteria was not referenced. The state of Massachusetts has adopted similar dispatch guidelines, and a review of adherence to those guidelines for scene transport of injured patients suggested regional variability in guideline adherence across the state, which could not be explained by patient or logistical factors.[24] These authors emphasize the importance of a review of the use and education program to accompany triage guidelines (Table 2).

In 2006, the CDC convened an expert panel to review the ACSCOT guideline for the field triage of injured patients to trauma centers.[1] A second panel was then convened in 2009 to review and update the 2006 guideline[25] and again in 2011.[26] This panel reviewed all the available literature to define the patient and event characteristics associated with an increased risk of severe injury and thus supporting transport to a trauma center. While these guidelines were targeted to ground EMS services, they provide a good framework for evaluation of patients that may benefit from HEMS transport as well. These triage guidelines are designed to be implemented sequentially such that if the patient meets the initial steps in the algorithm, a decision is made to transport to the highest level trauma center available, and the subsequent steps need not be evaluated. Step 1 of the triage criteria focus on physiologic criteria, which are associated with severe injury. Step 2 focuses on obvious anatomic injuries. Step 3 includes mechanistic criteria, and Step 4 includes special considerations such as the extremes of age and medical comorbidities. Steps 1 and 2 emphasize the need to transport to the highest level trauma center available, and thus, these criteria seem most directly applicable to HEMS transport. Patients meeting Step 1 criteria may require ALS interventions,

TABLE 1. National Association of EMS Physicians Guidelines for Air Medical Dispatch: Scene Response

Category	Dispatch Criteria
Physiologic	Trauma score < 12
	Unstable vital signs (hypotension or tachypnea)
	GCS score < 10 or deteriorating mental status
Anatomic	Multisystem injuries (e.g., long bone fractures in different extremities or injury to >2 body regions)
	Skull fracture
	Neurologic presentation suggestive of spinal cord injury
	Major chest wall injury (e.g., flail chest)
	Pneumothorax/hemothorax
	Suspected cardiac injury
	Significant abdominal pain after blunt trauma
	Presence of a "seat belt sign" or other abdominal wall contusion
	Obvious rib fracture below the nipple line
	Major pelvic fracture (e.g., unstable pelvic ring, open pelvic fracture, or pelvic fracture with hypotension)
	Partial or total amputation of a limb (exclusive of digits)
	Finger/thumb amputation when emergent surgical evaluation is indicated and rapid surface transport is not available)
	Fracture or dislocation with vascular compromise
	Extremity ischemia
	Open long bone fractures
	Major burns
	>20% total body surface area
	Involvement of the face, head, hands, feet, or genitalia
	Inhalational injury
	Electrical or chemical burns
	Burns with associated injuries
	Patients with near-drowning injuries
Mechanism	Ejection from vehicle
	Pedestrian or cyclist struck by motor vehicle
	Death in same passenger compartment as patient
	Ground provider perception of significant damage to patient's passenger compartment
	Penetrating trauma to the abdomen, pelvis, chest, neck, or head
Special Considerations	Significant trauma in patients <12 years old, >55 years old, or pregnant patients

which in some regions may only be available by HEMS. When the distance to the trauma center is significant, patients meeting Step 1 and 2 criteria may benefit from more rapid transport by HEMS. However, in urban areas where ground ALS is available and transport time to the highest level trauma center is short, there may be no advantage to HEMS transport. Steps 3 and 4 are more controversial and do not mandate transport to the highest level of trauma center care. Step 3 criteria were selected based on a 20% positive predictive value (PPV) of significant injury, and thus, up to 80% of patients in these circumstances who do not meet Step 1 and 2 criteria are likely to have minor injuries. These patients may be best served by an evaluation in the local center and subsequent interfacility transfer, should specialty care be required.

Literature that directly assesses the accuracy of HEMS dispatch criteria is limited. In 2009, Ringburg et al.[27] undertook a systematic review of the literature to evaluate all published HEMS dispatch criteria. They identified 34 articles describing 49 dispatch criteria. There were 9 physiologic criteria, 11 anatomic criteria, 22 mechanism of injury criteria, and 7 special considerations or logistic criteria. Only 5 of the 34 articles addressed the accuracy of HEMS criteria, and of these, 3 represented Level III evidence, 1 Level IV, and 1 Level V. This analysis suggested that the mechanism of injury criteria had a positive predictive value of only 27%. The only mechanism criterion that appears with a PPV greater than 50% was ejection from the vehicle (PPV, 59%). Only one article assessed the HEMS dispatch criteria for anatomic injury, and it reported a low undertriage rate (13%) but a high rate of overtriage.[28] Evaluation of the physiologic criteria demonstrated varying results, but decreased level of consciousness was a consistently good discriminator for HEMS dispatch with minimal overtriage or undertriage. A limitation of all these studies is that they evaluate the criteria individually rather than in a sequential fashion as recommended in the CDC guidelines.

In an effort to address this need, Brown et al.[29] recently evaluated the National Trauma Triage Protocol (NTTP) to assess whether this universally available tool could help scene EMS providers predict which patients would benefit from helicopter transport. They demonstrated an independent survival advantage for patients transported by helicopter that met certain NTTP criteria (physiologic, anatomic, and age) on the scene. Specifically, patients that have Glasgow Coma Scale (GCS) score of less than 14, a respiratory rate less than 10 breaths per minute or greater than 29 breaths per minute, or older than 55 years had improved survival if transported by helicopter. In addition, patients with any one of the three physiologic criteria plus any one of the eight anatomic criteria had improved survival if transported by helicopter. This study assessed the process in the sequential fashion recommended by the CDC in the NTTP.

Trauma systems need to define target rates for undertriage and overtriage of these patients to the highest level centers. More research is needed to guide the development of national guidelines for scene transport of injured patients by HEMS. Focus should be in defining those patients most likely to benefit from ALS interventions and rapid evaluation and management in a Level I or II trauma center. In addition, logistical factors need to be included including distance from the trauma center, geographic restrictions for ground transport, and multiple casualty incidents.

HEMS has been shown to be cost-effective in various clinical situations when used appropriately. Gearhart et al.[30] reported that helicopter air medical transport of trauma patients compared favorably with other commonly used emergency medical interventions. In situations where helicopter air medical transport afforded a survival benefit, their findings suggested that this service was a cost-effective option in the trauma patient population.[30] Ringburg et al.[31] also showed helicopter transport to be cost-effective in a population of trauma patients in the Netherlands. The Medicare fee schedule for HEMS provides a per-trip rate of $3,308 (urban) and $4,962

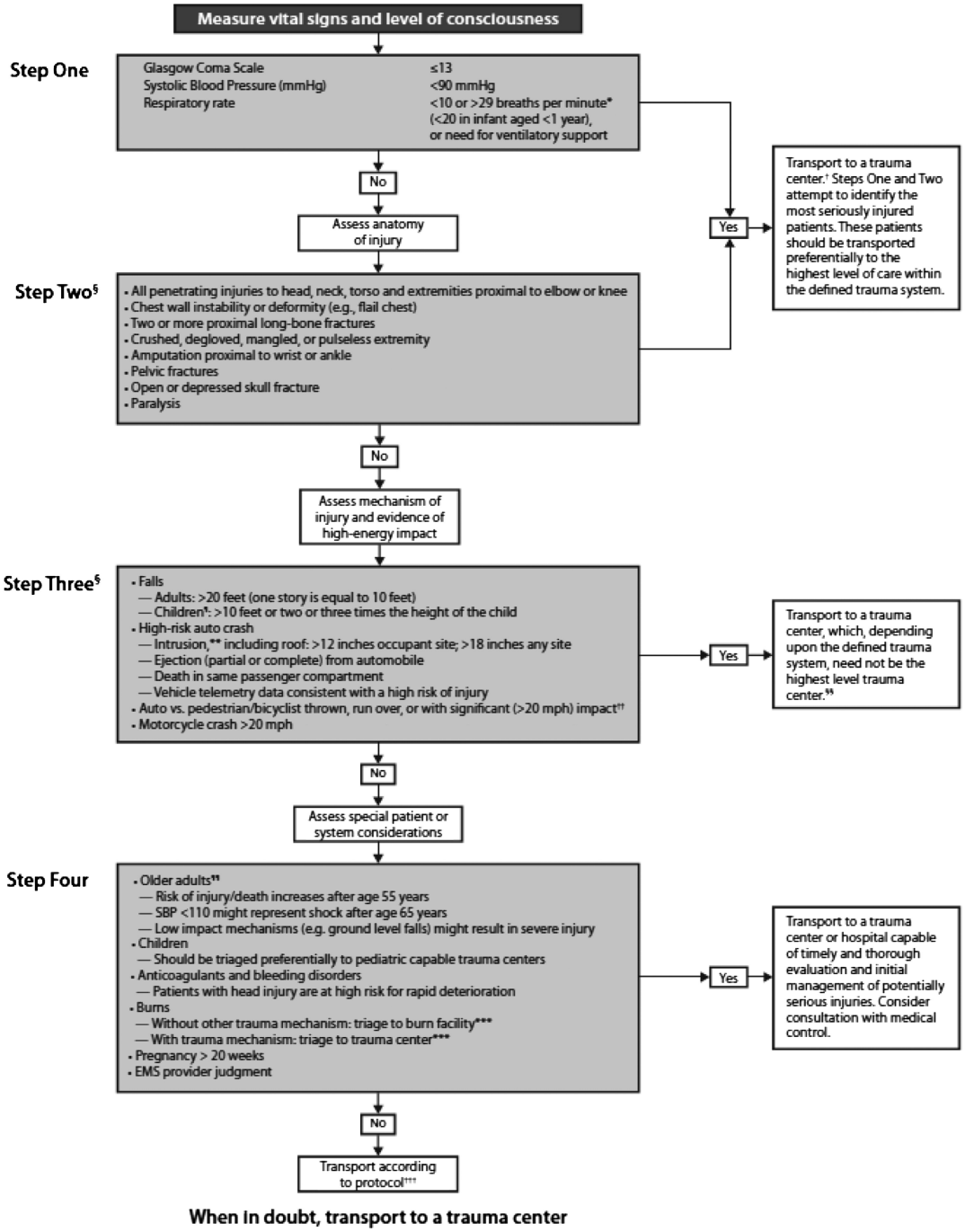

Figure 1. CDC guidelines for field triage of injured patients—United States, 2011.

(rural). Mileage rates are also paid at $21.53 (urban) and $32.30 (rural) per mile. The NTDB study by Galvagno et al.[11] calculated that the cost of HEMS transport to Level I trauma centers per additional life saved was approximated $325,000.

- Field triage criteria, such as those developed by the CDC expert panel, should be standardized within the trauma system and be used for evaluation for transport of trauma patients by EMS or HEMS to appropriate trauma centers.
  - ○ Use of HEMS for trauma must be solely based on the needs of patients. Triage criteria do not include the insurance payor status of the patient.
- Dispatch of HEMS units is most appropriately and safely accomplished by a regionalized medical dispatch system collaborating with the trauma system. The correct HEMS operator and aircraft selected for trauma patients should be based on criteria aligned with the trauma system.

TABLE 2. Guidelines for Appropriate Use of HEMS for Transport of Trauma Patients

EMS Subcommittee, ACSCOT

The trauma system, as defined by the ACSCOT, includes prehospital care of the trauma patient, including HEMS. Appropriate use of HEMS for trauma patients can save lives. Inappropriate use of HEMS is a costly waste of health care resources and increases risk to patients and HEMS crews. Development of national standards for HEMS use is a priority, and the ACSCOT will provide assistance to FICEMS and other agencies currently developing standards. The ACSCOT promotes the following guidelines:

1. The optimal use of HEMS requires integration with the trauma system.
2. Field triage criteria, such as those developed by NHTSA and the CDC, should be standardized within the trauma system for adult and pediatric patients and be used for evaluation for transport of trauma patients by EMS or HEMS to appropriate trauma centers.

   a. Selection of HEMS for transport of trauma patients must be solely based on the medical needs of patients. Triage criteria do not include the insurance payor or provider network status of the patient.

   b. Dispatch of HEMS units is most appropriately and safely accomplished by a regionalized medical dispatch system collaborating with the trauma system. The HEMS operator and aircraft selected for trauma patients should be based on criteria aligned with the trauma system.
3. Interfacility transfer of trauma patients requires two-way transferring physician–to–receiving physician communication, which includes determination of the appropriate mode of transport for the patient and care anticipated en route. It should be recognized by all providers that HEMS may not be the most rapid or safest mode of transport in every situation.
4. HEMS, like ground-based EMS for trauma, requires high-quality medical direction for care of the trauma patient.

   a. Online medical direction should be provided by two-way communication with a physician.

   b. Offline medical direction should be provided by protocols, including operating procedures that are reviewed by physicians and aligned with the trauma system. Surgeons should participate and provide leadership with the HEMS medical director for the development of HEMS trauma protocols.
5. HEMS trauma patient records must be maintained during transport and must be reviewed by physicians for effectiveness and compliance with preestablished trauma system procedures. They should be available for review by the PIPS for the trauma system and for the trauma registry. The use of all EMS transport, including HEMS, must be reviewed by a performance improvement process for the trauma center, including feedback to HEMS medical direction and HEMS crews.
6. Research strategies for HEMS use for trauma patients should be identified and supported, including via the NTDB.
7. HEMS medical crews must be appropriately trained to provide prehospital and interfacility care of trauma patients of all ages and understand the triage criteria, treatment protocols, transportation methods, and destination facilities for the trauma system. HEMS crews should have appropriate recurrent trauma training and continuing education appropriate for their scope of practice, including advanced trauma life support, TNCC, ATCN, PALS, and/or PHTLS.
8. HEMS aircraft must have appropriate space and equipment for prehospital and interfacility care of trauma patients of all ages, including life support equipment for anticipated contingencies such as airway management, ventilation, oxygen, intravenous fluids, medications and spinal immobilization.
9. Trauma centers and the trauma system must contribute to a culture of safety for EMS and HEMS, including participation in safety management systems as appropriate. Trauma centers must ensure that their heliports have been properly registered with the FAA and will appear in FAA aviation databases. Trauma centers must ensure that communications procedures, including radio, have been established and aligned with HEMS operators, including contingencies for multiple inbound helicopters.
   - HEMS, like ground-based EMS for trauma, requires high-quality medical direction for care of the trauma patient.
   - ○ Online medical direction should be provided by two-way communication with a physician.
   - Offline medical direction should be provided by protocols, including operating procedures that are reviewed by physicians and aligned with the trauma system. Surgeons should participate and provide leadership with the HEMS medical director in the development of HEMS trauma protocols.

NHTSA, National Highway Traffic Safety Administration; PALS, Pediatric Advanced Life Support course.

INTERFACILITY TRANSPORT OF TRAUMA PATIENTS BY HEMS

HEMS interfacility transports make up a significant proportion of HEMS flights. These flights typically occur after initial patient stabilization in a Level III or IV trauma center or a nontrauma center, for the patient to reach a required higher level of care. Most literature suggests an improvement in mortality when HEMS is used for interfacility transport.[29,32] Such flights may require management of a patient receiving intensive care, including intubation and mechanical ventilation, multiple intravenous drips, vasopressor medications, and transfusions. Boyd et al.[32] found a 25% reduction in mortality versus ground transport, when HEMS was used for transportation from rural emergency rooms. HEMS interfacility flights compared with ground EMS are also associated with higher rates of endotracheal intubation (50% vs. 25%) and transfusions (32% vs. 10%). In a retrospective chart review of rural trauma transfers, Urdaneta et al.[33] found that interfacility HEMS transport was essential in 14%, helpful in 12.9%, and "not a factor" in 56.6% of cases.

The Emergency Medical Treatment and Labor Act was designed to prevent transfer of patients solely based on ability to pay. The Emergency Medical Treatment and Labor Act also includes requirements for the referring physician and facility to identify a receiving facility with available space and appropriate personnel that has agreed to accept the patient and requires that patients are hemodynamically stable before transport, unless when medically necessary after the referring facilities best effort and that appropriate transport is selected with a vehicle with life-support equipment and staff able to meet anticipated contingencies during transport.[34]

The ACS' *Resources for the Optimal Care of the Injured Patient 2006* manual states that the interhospital transport of an acute trauma patient to a higher level of care is a medical decision that is made based on the patient needs and not on insurance or provider network requirements. The manual includes guidelines that include the necessity of referring physician to accepting physician communication, including determination of the appropriate mode of transport by the referring physician in consultation with the receiving surgeon.[1] Thus, the selection of HEMS over other transport should be discussed between referring and receiving physicians.

These guidelines also indicate that the trauma system is responsible for ensuring prompt transport between hospitals once a transfer decision is made, that all transfers are reviewed for performance improvement patient safety, and that transportation

is selected commensurate with the patient's severity of injury. Compliance with these guidelines obviously would require the participation of HEMS in the trauma system, in patient safety measures, and performance improvement process.

- Interfacility transfer of trauma patients requires two-way transferring physician–to–receiving physician communication, which includes determination of the appropriate mode of transport for the patient and care anticipated en route. It should be recognized by all physicians that HEMS may not be the most rapid or safest mode of transport in every situation.

TRAUMA PERFORMANCE IMPROVEMENT PROCESSES AND HEMS

Adopting an evidence-based approach to health care improves quality and outcomes in trauma and EMS systems. Quality improvement programs such as the ACSCOT Performance Improvement Process (PIPS) are a requirement at verified trauma centers and are applied to verified trauma systems including prehospital care components. Variability in trauma outcomes may reflect variations in quality of care, and trauma care quality improvement processes may be central to improved trauma outcomes. Error-free care in EMS and trauma centers occurs in only a slight majority of patients,[35] and elimination of error is addressed by prospective data collection, data review, and feedback to providers.

- Use of all EMS transport, including HEMS, must be reviewed by a performance improvement process for the trauma center, including feedback to HEMS medical direction and HEMS crews.

TRAINING AND EQUIPPING HEMS PERSONNEL FOR PREHOSPITAL TRAUMA CARE

Creation of a system of care for trauma patients includes the prehospital emergency medical system, which also includes HEMS. Adoption of prehospital trauma care training, such as Pre-Hospital Trauma Life Support course (PHTLS), has had a positive effect on paramedics' trauma skills and may contribute to reduced mortality.

Current ACSCOT trauma system verification criteria indicate that prehospital personnel must be trained to understand the operation of the regional trauma system, including understanding triage criteria, medical direction, treatment protocols, transportation methods, and destination facilities. These personnel should also be trained in appropriate record keeping and participate in PIPS processes and feedback.

Vehicles involved in prehospital care, including HEMS, must be equipped for the expected contingencies of trauma patients during transport.

- HEMS medical crews must be appropriately trained to provide prehospital and interfacility care of trauma patients and understand the triage criteria, treatment protocols, transportation methods, and destination facilities for the trauma system. HEMS crews should have appropriate recurrent trauma training and continuing education appropriate for their scope of practice, including advanced trauma life support, Trauma Nurse Core Course (TNCC), Advanced Trauma Course Nurses (ATCN), and/or PHTLS.
- HEMS aircraft must have appropriate space and equipment for prehospital and interfacility care of trauma patients, including life support equipment for anticipated contingencies such as airway management, ventilation, oxygen, intravenous fluids, medications, and spinal immobilization.

TRAUMA, HEMS, AND THE CULTURE OF SAFETY

The increasing number of EMS aircraft accidents continues to raise concern. From 1988 to 1997, there was an average of 5.0 fatal HEMS accidents per year. From 1998 to 2008, the average rate of fatal HEMS accidents was 12.4 per year. The number of flight hours by HEMS aircraft can only be estimated, but the fatal accident rate in 2008 was estimated at 1.9 per 100,000 flight hours, which was worse than other types of commercial aviation, including the average general aviation rate of 1.2 per 100,000 flight hours. In 2007, HEMS aircrews were considered to be the occupational group with the highest work-related risk of death. The risk to individual patients during an HEMS transport in a 34-year study is approximately 0.74 per 100,000 patients flown.[36]

The Air Medical Physician Association reported in November 2002 that the time of day where these flights occur may contribute to accidents. This report indicated that although 38% of all helicopter EMS flights occur at night, 49% of accidents during a 20-year period occurred during nighttime hours. The report also cited controlled flight into terrain, in particular during takeoff and landing, as a common problem, as well as collision with objects (wires were the most common obstacles for EMS helicopters), inaccurate weather forecasts (approximately 26% of helicopter EMS accidents were weather related), and communications problems with air traffic control or lack of communications due to remote locations and high terrain.[37] The Air Medical Physician Association report also noted that accidents occurred more often when flight crews were en route to pick up a patient than at any other time during the flight.

In 2006, the NTSB published its findings after a special investigation into a series of air medical crashes and identified the following recurring safety issues:

- Less stringent requirements for EMS operations conducted without patients on board.
- A lack of aviation flight risk evaluation programs for EMS operations.
- A lack of consistent, comprehensive flight dispatch procedures for EMS operations.
- No requirements to use technologies such as terrain awareness and warning systems to enhance flight safety.[38]

Numerous advisory notices have been developed and issued by the FAA regarding decision-making skills for air medical pilots, risk and danger recognition for pilots and flight crews, and the promotion of risk assessment models for air medical EMS operators. An investigative update by NTSB after the surge HEMS fatal accidents in 2009 led to 30 safety

recommendations being made. The FAA to date has proposed to adopt a minority of these recommendations, and "Improve the Safety of Emergency Medical Services (EMS) Flights" remains on the "NTSB's Most Wanted Safety Improvements List."[3]

The concept of a "culture of safety," which began with the airlines, has been advocated for HEMS aviation and hospitals. This requires organizational commitment of resources to address safety concerns. Trauma system providers can contribute to the HEMS culture of safety by ensuring hospital helipads are properly equipped by FAA guidelines (18% of ACS-verified trauma center helipads were not registered with the FAA in 2010) (Doucet J, personal communication, 2012).[39] Compliance with federal and state regulations and guidelines for hospital helipads should be a priority for receiving facilities, to reduce risk to patients and aircrew. Communications procedures and contingencies for multiple inbound aircraft should be coordinated with HEMS operators to avoid accidents such as the 2009 Flagstaff HEMS collision accident.

Providers should recognize that the safety of an HEMS flight is the first priority and that a decision to request HEMS should not require the acceptance of any unnecessary risks to the aircrew or patient. Refusal of an HEMS crew to fly due to operational limitations or safety issues should not be second-guessed by referring facilities. A dangerous example is "helicopter shopping," contacting multiple HEMS operators to fly in a weather that another HEMS operator has already refused to fly in, without disclosing the first refusal to other operators.[40] Fatal accidents have occurred after such requests.

Referring and receiving facilities should have a coordinated air medical safety program with HEMS, which includes identification of safe landing sites, ingress and egress routes, proper loading and unloading procedures, communications with pilots and dispatchers. There should be safety procedures in proximity to an operating helicopter, including policies for "hot" (rotors turning) loading and unloading.

- Trauma centers and the trauma system must contribute to a culture of safety for EMS and HEMS, including participation in safety management systems as appropriate.
- Trauma centers must ensure that their heliports have been properly registered with the FAA and appear in FAA and aviation databases. Trauma centers must ensure that safety and communications procedures, including radio, have been established and aligned with HEMS operators, including contingencies for multiple inbound helicopters.

SUMMARY

The ACSCOT believes that the development of national standards for HEMS use is a priority and will provide assistance to FICEMS and other agencies currently developing standards. Research strategies for HEMS use for trauma patients should be identified and supported.

AUTHORSHIP

J.D. and E.B. designed the study. All authors collected, analyzed, and interpreted the data, and drafted the manuscript.

DISCLOSURE

The authors declare no conflicts of interest.

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