

**Aeromedical Guidelines Should be Utilized to Allocate a Critical Resource**

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**Objectives:** We sought to examine the effectiveness of Helicopter-based Emergency Medical Services (HEMS) in our trauma center. The specialized training, often greater experience, and additional skills of HEMS personnel would theoretically best suit them to the care of the sickest of the sick of trauma patients. In our experience, we saw that patients who had minor injuries were often transported by helicopter. Conversely, we would also often receive more severely injured patients by ground. Our impressions were anecdotal or based on small samples. We hypothesized that there were many patients who were being transported by HEMS that did not meet commonly accepted trauma triage criteria and that many were minimally injured and did not have life-threatening injuries based on injury severity scores and their disposition from the emergency department. We also sought to see retrospectively if there was a risk adjusted mortality benefit to transport by HEMS. There has been work recently by groups looking to determine the most appropriate criteria for Helicopter EMS, most notably the Air Medical Prehospital Triage Score<sup>1</sup>. There is also political/legal pressure to triage appropriately as a bill was recently passed in Virginia required informed decision making for patients who are to be transported by HEMS<sup>2</sup>.

**Methods:** We applied accepted HEMS criteria to all patients over 11 years of our single center (ACS Level 1) trauma registry who had complete data for comparison. We examined patients by whether they met triage criteria and whether they were transported by HEMS or Ground-based EMS (GEMS) direct from the scene. Criteria examined were the CDC national Field Triage Guidelines (which the ACS has previously endorsed parts of for determining HEMS utilization appropriateness) and those proposed by the National Association of EMS Physicians. We focused on physiologic parameters that could be determined in the field; include Glasgow Coma Scale (GCS)  $\leq 13$  or 10, Systolic BP  $< 90$  mmHg, and respiratory rate  $< 10$  or  $> 29$  breaths per minute. We compared GEMS and HEMS groups using our Relative Mortality Metric (RMM)<sup>1</sup>, W-scores, TRISS scores<sup>2</sup>, and measures of hospital care received. T-tests or ANOVA were used to compare parametric variables between groups. Categorical variables were compared using the Chi squared and Fisher's Exact tests.

**Results:** We included 5231 patients in our study. We found that patients who met any physiologic HEMS criteria (MC) had higher injury severity scores (ISS) and were more likely to require immediate critical intervention such as ICU admission ( $p < 0.001$ ). Patients in the HEMS MC group had better performance on the Comparative Performance Trend RMM (figure 2), which means that more patients survived than expected, especially in the very low Probability of Survival group. The GEMS MC group did not cross the anticipated mortality line, meaning that their performance could not be definitively shown to be better than expected. There was no clear advantage to

HEMS or GEMS in the DMC group as both subgroups did not cross the isomortal line. Patients who did not meet HEMS criteria comprised 64% of HEMS transports to our center over this timeframe.

**Conclusion:** This is a large single center retrospective analysis attempting to better characterize the usage of HEMS resources in our region. While this is a retrospective analysis, patients who met accepted HEMS criteria appeared to benefit from air transport as evidenced by improved actual survival compared to expected survival using accepted benchmarks. Those who did not meet criteria appeared to have similar risk adjusted mortality regardless of transport mode. Along these lines, we found that HEMS was often utilized in injured patients who did not require life-saving interventions or ICU admission. In our region, HEMS is often used based on mechanism of injury and the “possibility” of serious injury, as well as to avoid taking ground EMS units out of their primary service area for extended periods of time. HEMS is a comparatively high-risk transport mode; we have been fortunate to have not had a helicopter incident in these 11 years, but we should still be judicious with this resource. This data suggests that the lack of a consistent triage system is resulting in the unnecessary use of HEMS resources and use of prehospital triage criteria could improve utilization. The criteria examined are all easily obtainable in the field and referring hospitals and could be used to better determine who would benefit from critical care helicopter transport. A larger multi-center or multi-regional trial that prospectively obtained accurate prehospital vital signs would be a logical next step.

1. Brown JB, Gestring ML, Guyette FX, et al. Development and Validation of the Air Medical Prehospital Triage Score for Helicopter Transport of Trauma Patients. *Ann Surg.* 2016;264(2):378-385. doi:10.1097/SLA.0000000000001496
2. LIS > Bill Tracking > SB663 > 2018 session. <https://lis.virginia.gov/cgi-bin/legp604.exe?181+sum+SB663>. Accessed November 17, 2019.

**Table 1: Overall registry analysis**

	All EMS			
	Total	GEMS	HEMS	p value
<b>Gross n</b>	5231	2923	2308	
<i>Mean Hospital Days</i>	7.56	5.32	10.39	< .001
<i>ED Disposition to Operating Room</i>	15.4%	12.6%	18.8%	< .001
<i>ED Disposition to ICU</i>	32.6%	22.0%	46.0%	< .001
<i>ED Disposition as Expired</i>	0.6%	0.1%	1.4%	<0.001
<i>Mean GCS</i>	11.4	14.64	12.0	< .0001
<i>Mean ISS</i>	10.59±8.621	8.7	14.8	< .0001
<i>Gross Mortality</i>	4.6%	2.4%	7.6%	< .001

<sup>a</sup>Probability of Survival. <sup>b</sup>Sum of Probability of Survival for each patient in group. GEMS: Ground-based Emergency Medical Services, HEMS: Helicopter-based Emergency Medical Services

**Table 2: Triage Criteria Analysis**

	Meets any Criteria (MC)				Doesn't meet criteria (DMC)			
	Total	GEMS	HEMS	p value	Total	GEMS	HEMS	p value
<b>Gross n</b>	1076	251	825		4155	2672	1483	
<i>Mean Hospital Days</i>	14.0	9.2	15.4	< .001	5.9	5.0	7.6	< .001
<i>ED Disposition to Operating Room</i>	20.4	1.6	20.8	0.614	14.0	12.0	17.7	< .001
<i>ED Disposition to ICU</i>	60.2	45.4	64.7	< .001	25.4	19.7	35.7	< .001
<i>ED Disposition as Expired</i>	3.3	19.1	3.9	0.118	0.1	0.03	0.00%	N/A
<i>Mean GCS</i>	7.81	6.74	11.3	<0.001	14.9	14.9	15.0	< .001
<i>Mean ISS</i>	19.1	20.4	14.9	<0.001	9.4	11.7	8.1	< .001
<i>Gross Mortality</i>	17.8	12.7	19.4	< 0.021	1.25	1.38	0.01	0.372

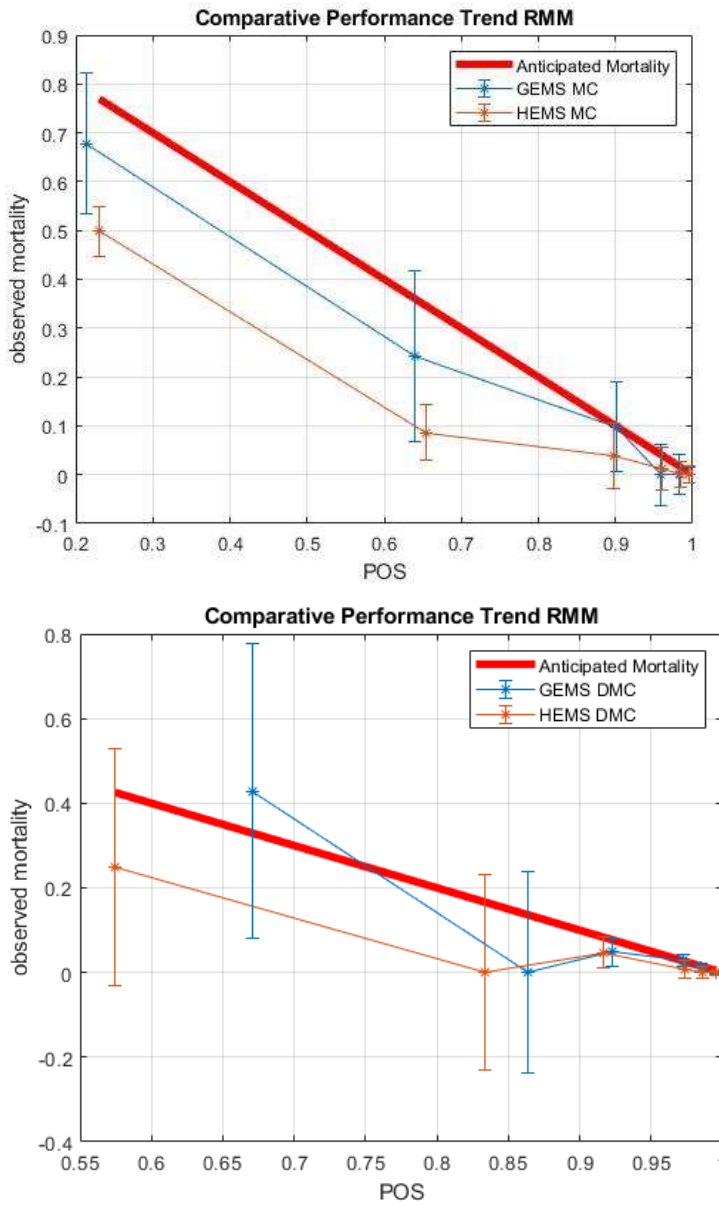


Figure 1 and 2: Relative Mortality Performance Trend for groups based on their transport mode and if they met criteria