Helicopter EMS transport outcomes literature: Annotated review of articles published 2012-2013

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Abstract

Helicopter EMS (HEMS) and its possible association with outcomes improvement continues to be a subject of discussion. As is the case with other scientific discourse, debate over HEMS usefulness should be framed around an evidence-based assessment of the relevant literature. In an effort to facilitate the academic pursuit of assessment of HEMS utility, in late 2000 the National Association of EMS Physicians’ (NAEMSP) Air Medical Task Force prepared annotated bibliographies of the HEMS-related outcomes literature. As a result of that work, two review articles, one covering HEMS use in nontrauma and the other in trauma, published in 2002 in Prehospital Emergency Care surveyed HEMS outcomes-related literature published between 1980 and mid-2000. The project was extended with subsequent reviews covering the literature through 2011 (these reviews are posted on the website of the Critical Care Transport Collaborative Outcomes Research Effort: www.cctcore.org). This review continues the series, outlining outcomes-associated HEMS literature for the years 2012 and 2013. Some of the articles may actually have electronic or print-journal publication dates in in 2011 or 2014; these articles are included if they also had either electronic or print publication dates of 2012 or 2013.

Introduction

Despite the frequency of HEMS transport, there remains controversy surrounding its use and benefits. In 2002, two annotated bibliographies prepared by the National Association of EMS Physicians’ (NAEMSP) Air Medical Task Force addressed the HEMS outcomes-related literature for trauma and nontrauma diagnoses.\textsuperscript{1,2} Although commentary was provided for each article, the bibliographies and their summaries of over 50 studies were intended to serve primarily as a central reference listing to aid parties interested in HEMS research. The bibliography has been updated to cover studies published through 2011.\textsuperscript{3-5} The current paper aims to extend the previous reviews, assessing outcomes studies published during the year 2012 and through the current month (September) 2013. As with earlier reviews in the series, the article summaries include commentary intended to place the research into perspective. The primary goal of this article, like the prior reviews, is to present the most important HEMS out-
comes literature published in the 2012-13 time frame as an aid to those who wish to explore the evidence basis for HEMS use.

**Methods**

A computerized literature search was performed as outlined in previous published reviews.\(^1\text{-}^5\) The same databases and general approach was used for the current review. The search database was the National Library of Medicine’s MEDLINE (online Index Medicus).

As noted for the previous reviews, eligibility for article inclusion was usually easy to determine, but there was inevitably some degree of subjectivity. The authors acknowledge that the process of article selection may have excluded some worthy research, and emphasize that the attempt to capture all relevant papers probably missed some studies.

The papers that are included in this review are categorized into diagnostic areas. For interpretation of the trauma studies, some knowledge of TRISS methodology (survival probability based upon trauma and injury severity scores as well as age and injury mechanism) is helpful. TRISS is outlined in detailed elsewhere.\(^6\) Within categories, articles are listed chronologically with earlier papers first.

One paper that is noteworthy but not discussed here – because it is a review in and of itself – is the Cochrane review of HEMS for scene response.\(^7\) This review, which was accepted in 2012 and published on-line in 2013, is characterized by complexities that preclude its easy summary here. The Cochrane review will be updated within a year to include more recent studies, and it is likely that that review’s conclusions will be stronger upon its review (this is based upon personal communication by this author, who is a co-author of the Cochrane review, with that review’s principal author).

**CARDIAC**\(^8\)


**Objective** The study goals were to first assess logistics/time advantages offered by HEMS as
compared to ground transport of STEMI patients for primary PCI, and then to translate time savings calculations in mortality benefit estimates.

**Methods**

*Study design* This was a retrospective consecutive-case review. The methods called for use of advanced geographic information software (GIS) to calculate alternate-mode transport times for whichever transport mode was not used in a given case.

*Setting* The study was set at a tertiary cardiac receiving center (Oklahoma Heart Institute in Tulsa, Oklahoma).

*Time frame* Study patients were transported January 2010 through June 2011.

*Patients* Eligible patients were those who had STEMI diagnosis and who underwent air or ground EMS interfacility transport from an ED to the Oklahoma Heart Institute. There were 97 patients (66 air and 31 ground).

*Results* The speculative nature of the study translated into a number of different results calculations being reported; each calculation was based upon different assumptions about tying pre-PCI time savings to mortality benefit. Among the study’s main results were a finding that there were 1.7 lives saved per 100 transports, solely due to time savings accrued with HEMS use. Among the other results were a finding that, for those patients who did go by ground EMS, use of HEMS would have doubled the proportion of cases reaching PCI within 120 minutes of initial hospital presentation; in 9 out of 10 cases HEMS time savings was calculated to have surpassed the *a priori*-defined clinically significant margin of 15 minutes. For the 6 ground-transported cases in which HEMS was documented to be unavailable due to weather, zero patients made it to PCI within 120 minutes; calculations estimated that 4/6 of these patients would have made it to PCI within 120 minutes if helicopter transport had been used.

*Authors’ conclusions* Based solely upon considerations of time savings, and using the cardiology literature’s estimates correlating earlier primary PCI with mortality improvement, HEMS use saved a clinically significant 1.7 lives per 100 transports (number needed to transport to save one life, 59).

*Commentary* This paper, written by some of those preparing this review, had a number of weaknesses that severely limit its application. Those limitations fall largely into one of three
categories. First, there are limitations to the use of “estimated times” for non-used modes of transport. Second, there is a something of a leap of faith required to tie the time savings surrogate endpoint to the meaningful endpoint of mortality improvement. Third, there could be mechanisms that HEMS can impact mortality (and morbidity) that are not accounted for in a study focusing solely on times. These three areas of limitations are discussed in detail in the paper. The authors’ overall conclusions are that the data should serve as the basis for a larger analysis (which is now ongoing) to assess whether the “NNT” of 59 is consistently estimated in different areas. If the results of the initial study are replicated in the larger n analysis, the NNT of 59 begins to approach utility as a variable in the cost-effectiveness analyses that are so important for HEMS and policy-makers.

**Neurology & Neurosurgery**

- Olson MD, Rabinstein AA. Does helicopter emergency medical service transfer offer benefit to patients with stroke? *Stroke* 2012; 43: 878-880.

**Objective** The study goal was to assess whether air versus ground transport of ischemic stroke patients who were post-thrombolysis, was associated with any outcomes difference.

**Methods**

*Study design* This was a retrospective consecutive-case review.

*Setting* The study was set at a tertiary receiving center (Mayo Clinic, in Minnesota).

*Time frame* Study patients were transported between 2002 and 2010.

*Patients* Eligible patients were those who had ischemic stroke diagnosis and institution of thrombolytic therapy, prior to transport. There were 122 patients (94 air and 28 ground).

*Results* The main results were a lack of finding of intratransport or post-transport incidents and outcomes differences, between the air and ground EMS groups. Time from activation to arrival at the receiving center, was significantly shorter in the air-transported patients (53 versus 68 minutes).

*Authors’ conclusions* There were no differences in transport events, post-transport events, or overall outcomes associated with air versus ground transport of post-tPA stroke patients. Ground transport should be considered for these patients, unless they are being considered
for time-critical rescue therapy (e.g. emergency endovascular intervention).

**Commentary** The authors’ statement that savings of 15 minutes doesn’t matter in patient who have already received time-windowed therapy (tPA), is supported by their data and by common sense. Few, if any, experts in HEMS or stroke have advocated use of air transport post-tPA when there is no time-windowed therapy at the receiving end. Of course, it’s not always easy to know who will need rescue therapy, and the routine use of ground EMS incurs some low – but nonzero – risk that time lost will translate into outcomes worsening. The authors’ statement that savings of 15 minutes is not clinically significant is of course true when there is no need for time-critical therapy at the receiving end. For those patients who may have an extra 15 minutes of cerebral ischemia before rescue therapy, the question is debatable. It is certainly the case that savings of 15 minutes is clinically and statistically significant, for STEMI patients undergoing transport for PCI.¹⁰

**Trauma – Scene & Interfacility Combined Population**¹¹


**Objective** The study’s goal was to determine whether increasing the distance between nearest HEMS bases and home residence or referring facility, is associated with increasing trauma mortality.

**Methods**

*Study design* This was a retrospective cohort analysis. The design used a geographic information software (GIS) approach to generate distances which were used in multivariate modeling. Multivariate regression adjusted for a breadth of potential logistic, systems, and patient-related confounders.

*Setting* The study was population-based, in the state of Pennsylvania.

*Time frame* Study patients were those transported during the decade 1997-2007.

*Patients* The study included scene and interfacility-transport of adults (>15), by ground or air, to any level I or II trauma center in the state.
Results  The results included discussion of logistics and changes over time, of a variety of factors (e.g. scene vs. interfacility casemix, injury acuity). For purposes of this review, the major results were that there was a positive and statistically direct and strong association between mortality and scene trauma geographic location and a “close” HEMS base, with the cutoff for “close” defined at 11 miles’ distance. For patients residing more than 20 miles from a trauma center, increasing distance from an airbase is associated with increasing risk of death.

Authors’ conclusions  Proximity to an airbase is associated with improved mortality for scene-transported trauma patients when the injury scene was more than 11 miles’ distance from a trauma center. While the benefit was statistically significant starting at 11 miles’ distance, it became clinically significant at 20 miles’ distance from the trauma center (1% mortality worsening per mile, for increasing distance from trauma scene to airbase location). The association between HEMS proximity and improved outcome remained present when analysis adjusted for acuity and other parameters. There was no benefit to proximity to multiple airbases, and there was no benefit to airbase proximity for interfacility transports.

Commentary  The study took an interesting approach, of using “distance to helicopter base” as a surrogate for air medical services availability, and then assessing whether proximate HEMS improved trauma outcome. The finding that having a nearby HEMS base was positively associated with trauma outcome is a suggestive, although admittedly coarse, indicator of the positive impact HEMS has on trauma outcomes. Of course, having a HEMS base nearby doesn’t always mean that the aircraft will be stationed at the base (or available if stationed there), and some analyses are probably weakened by the use of the patient’s home address as a surrogate for injury location. However, over a large cohort such as the one in this study, the power of numbers is compelling. The authors’ detailed statistical analysis included accounting for many potential confounders, although it does remain possible that helicopter availability is a surrogate for better-developed trauma systems. The study’s fascinating natural experiment design, based upon the proliferation of the HEMS services in Pennsylvania, does seem to negate many of these potential confounders. Furthermore, the authors’ conclusion is in line with common sense: if one is more than about 20 miles from a trauma center then having a helicopter nearby is coarsely associated with improved trauma mortality.

**Objective** The study’s goal was to determine whether transport mode was associated with outcomes differences in severely injured trauma patients transported from the scene.

**Methods**

*Study design* This was a retrospective review of cases accrued for study in a prehospital fluid resuscitation project. The design was thus a secondary analysis of data collected for another research project (*i.e.* not an analysis of administrative data).

*Setting* The trauma centers in the study were 10: 8 in the U.S. (Level I centers) and 2 in Canada (described by the authors as equivalent to Level II U.S. centers).

*Time frame* Study patients were those transported during 2006-2009.

*Patients* The study included 703 air and 1346 ground transported patients who were at least 15 years in age, transported from trauma scenes. Exclusions included reception of at least 2000 mL of fluid before transport, as well as “non-severe” trauma. Severe trauma was defined as being hypovolemic shock (SBP less than 70 or SBP less than 90 with HR at least 109) or severe TBI (GCS <9) or both; these three groups (Shock+TBI, TBI-only, Shock-only) comprised the three main study cohorts.

**Results** The HEMS patients were more likely to be blunt trauma victims, more likely to be in the TBI cohort, and had a lower GCS with higher ISS (and New ISS). HEMS patients had lower TRISS probability of survival ($P_s$). Overall, the confidence intervals for the multivariate analyses of outcomes association with transport mode all crossed the null value. For the Shock+TBI cohort, HEMS’ point estimate for 28-day survival improvement was 1.11 with 95% CI 0.82-1.51. For the Shock-only cohort, the HEMS survival improvement point estimate was 1.31 (95% CI 0.76-2.25). For the TBI-only cohort, the HEMS survival improvement point estimate was 0.91 (0.63-1.33). Despite being (far) more severely injured, HEMS patients were less likely than ground EMS patients to be acidotic upon trauma center arrival.
Authors’ conclusions  In the current study, we found no difference in outcome between ground and air transport suggesting that either approach may be appropriate and that air medical services, implemented in the manner observed in these randomized controlled trials, may overcome limitations of distance and access to specialty care.

Commentary  The study grew out of well-conducted analyses of prehospital fluid resuscitation. Like many secondary analyses, the study has weaknesses related to its assessment of data for endpoints other than those intended. Exclusion of patients receiving 2000 mL fluid before transport would preferentially eliminate HEMS patients, thus risking selection bias. Furthermore, missing data were potentially problematic; there is little detail provided on the multiple imputation techniques used to deal with these inevitably tricky problems. An additional problem was the lack of adjustment for the critical variable of transport distance, which would obviously be greater for HEMS patients. There is something in this paper for both sides of the HEMS debate. For the “HEMS doesn’t improve outcome” crowd – which clearly includes those writing the editorial discussion appearing just after the paper – there is the overall negative result in multivariate analysis. Upon closer examination, however, the authors’ own conclusion (see above) appears more appropriate. Not only was there the potential for methodological shortcomings accounting for the negative p values despite point estimates favorable to HEMS (e.g. 31% outcomes improvement point estimate for HEMS transport of shock-only patients), but the TRISS results also were favorable. For two of the three study cohorts (Shock+TBI and TBI-only) there was a statistically significant difference between TRISS-predicted mortality in HEMS and ground EMS groups. In both of these cohorts, the actual mortality was statistically similar. Thus, HEMS allows for patients with statistically lesser chance of survival, to reach actual survival rates equal to those of lesser-acuity ground EMS patients. This finding renders more reasonable the conclusion of the authors about the potential value of HEMS.

**Objective**  The study’s goal was to determine whether transport mode was associated with differences in mortality (during index hospitalization) in severely injured trauma patients transported from the scene.

**Methods**

*Study Design*  This was a retrospective analysis of data from the National Trauma Data Bank (NTDB).

*Setting*  The NTDB patients comprising the study set were cared for at U.S. level I and II trauma centers. NTDB does not include information on the crew configuration of HEMS programs providing transports.

*Time Frame*  The study used NTDB data from the commencement in 2007, of new NTDB data gathering methods that optimized data quality. Patients were those who were in the NTDB from 2007 through 2009.

*Patients*  Adult patients (at least 18) transported from the scene by ground (n = 161,566) or HEMS (n = 61,909) to Level I or Level II trauma centers. Patients who died in the ED were excluded from analysis.

*Analysis*  The analysis was quite complex, involving generation of many logistic regression models and incorporating varying treatments for missing data. Propensity scores, cluster analysis (by trauma center), and sensitivity analyses were among the advanced statistical techniques used; logistic regression diagnostics were also calculated.

*Results*  In the most conservative model (propensity scored logistic regression), the odds ratio for HEMS association with mortality improvement was 1.16 for Level I center-bound patients, and 1.15 for patients taken to Level II centers; both findings were significant in logistic regression calculations with favorable model performance characteristics. The “number needed to transport” to save a life, was 65 for Level I and 69 for Level II centers. This corresponded to an absolute mortality reduction of 1.5% for Level I trauma center patients and 1.4% for Level II trauma center transports.

*Authors’ Conclusions*  In patients with ISS at least 15 (who are hard to identify at the time of triage), HEMS is associated with significant mortality improvement. Further studies should use the mortality results as a starting point for cost-effectiveness calculations, but these stud-
ies should also include nonmortality benefits of HEMS. Incorporation of distance (not possible in the current study due to NTDB limitations) as an instrumental variable is recommended for future studies assessing the association between HEMS and trauma outcomes.

**Commentary**  This study, arguably the most methodologically complete in the HEMS literature, clearly demonstrated outcomes improvement for HEMS transport of those with ISS at least 15. The authors’ discussion includes detailed explanation of the fine-tuned approach to NTDB data use, and there are also many points in the discussion on NTDB limitations (e.g. lack of reliable information on distance, time, or crew configuration). Every logistic regression model generated in the study demonstrated a significant association between HEMS transport and trauma outcome. The authors made a case that there were other, unmeasured but nonetheless potentially important, likely HEMS benefits besides mortality. The authors also point out that the data do not address the critical question of triage. The study’s acknowledgment of the current inability to prospectively define which patients will have ISS>15, is quite useful for inclusion in such a major (*JAMA*) paper; despite the obvious nature of the triage problem it is elided in many discussions of HEMS (over)use.


**Objective**  The study’s goal was to evaluate the effect of Helicopter Emergency Medical Services (HEMS) on trauma patient mortality and the effect of prehospital time on the association between HEMS and mortality.

**Methods**

*Study Design*  This was a retrospective matched-pair cohort study.

*Setting*  The study patients were cared for in the Netherlands (Tilburg).

*Time Frame*  Patients were drawn from the hospital’s admissions 2003 to 2008.

*Patients*  The study included all trauma patients treated by EMS, assisted by HEMS, and admitted at the study hospital (St. Elisabeth) during the designated time period (*n* = 186 in the HEMS group and same number in the ground EMS-only group). Patients presenting directly
to St. Elisabeth by non-EMS means, and those transferred from another hospital, were excluded.

**Analysis** The study first accrued patients meeting the HEMS cohort criteria, and then matched ground EMS-only patients on age, ISS, gender, severe TBI (AIS at least 4), and mechanism. Age and ISS were categorized before matching; physiology (RTS) was adjusted for in the regression analysis but not matched upon. Pearson chi-squared tests were used to compare categorical variables, Independent t-tests were used to compare linear continuous variables, and Mann-Whitney tests were used to compare non-linear continuous data. The comparison for treatment by HEMS and EMS was made for both traumatic brain injury (TBI) patient group as well as the group without TBI.

**Results** The odds ratio of in-hospital mortality of patients treated by HEMS and EMS compared to those treated by EMS only was 1.0 for the total study population, 1.3 for patients with TBI and 0.9 for patients without TBI, respectively. These numbers show a number needed to treat (NNT) of 22 TBI via HEMS to allow 1 additional patient to survive one calendar day after initial trauma compared to patients without HEMS transport. For patients without TBI, 272 patients need to be treated by the HEMS to save one additional life in the first calendar day. The HEMS NNT to survive the hospital admission is minus fifteen for patients with TBI and 129 for patients without TBI. After adjusting for the time between the trauma and patient arrival at the ED, the risk of early trauma fatality for TBI patients treated by the HEMS decreased from an odds ratio of 0.8 to an odds ratio of 0.6. The risk of in-hospital mortality for TBI patients treated by the HEMS decreased from an odds ratio of 1.3 to an odds ratio of 0.8.

**Authors’ Conclusions** The data in the present study cannot prove the benefit of HEMS in the Netherlands.

**Commentary** Matching is a difficult analytic approach; the potential for difficulties (e.g. residual confounding by RTS and intubation status as in this paper) is great. In this paper, the matching clearly failed and the study is left with a standard problem in the HEMS trauma literature: having to try and adjust for markedly different patient acuity as assessed at the time of transport. The study n was too low to include all of the relevant covariates in a multivariate model (20 outcomes per covariate is the usual requirement), which is presumably why
matching was required. The small study $n$ also translated into very wide CIs: the point estimates for both all-patient and TBI-patient were both consistent with the overall HEMS literature numbers (OR of 0.8) but the CIs for both endpoints were indicative of low power (0.4-1.7 for all patients; 0.2 to 3.3 for TBI). When considered in comparison to the numerous studies from the Netherlands (assessing essentially the same sorts of population) that found similar point estimates but with statistical significance,\textsuperscript{17-19} the impact of this paper on the literature is uncertain.


**Objective** The study’s goal was to evaluate the effect of Helicopter Emergency Medical Services (HEMS) on trauma patient mortality and the effect of prehospital time on the association between HEMS and mortality.

**Methods**

\textit{Study Design} This was a retrospective database study.

\textit{Setting} The study patients were cared for in myriad settings across the U.S.

\textit{Time Frame} Patients were drawn from the 2007 data of the National Trauma Data Bank (NTDB).

\textit{Patients} The study included all adult (>17 years) scene trauma patients transported by ground or air EMS, with complete ISS and RTS data ($n = 192,422$) in the NTDB.

\textit{Analysis} The approach was mainly use of logistic regression that adjusted for variables of age, sex, ISS, RTS, injury type, hypotension, trauma center designation level, and EMS time. The variable of prehospital time was dichotomized at the 60-minute cutoff. Multiple subgroup analyses were also performed. There was no multiple imputation or other analytic treatment of missing-variables cases. For prehospital times data, an additional category was added (to the existing categories of <60’ or >60’) for “unknown.” Patients without ISS or RTS simply excluded from analysis altogether.

**Results** The overall impact of HEMS on mortality was significantly favorable. The OR for the main outcomes model was 1.78 (95% CI 1.65-1.92) and the OR for the model including pre-
hospital time was 1.62 (95% CI 1.50-1.76). The authors’ results includes finding that “a positive effect of air transport on survival is present across all injury severity ranges.” However, with regard to RTS there was a positive effect only on those cases with RTS <6 (OR 2.28, 95% CI 2.10-2.49); with RTS at least 6 there was a deleterious effect of HEMS transport on survival (OR 0.83, 95% CI 0.74-0.94).

Authors’ Conclusions There is an across-the-board favorable impact of HEMS transport on patients with all ranges of injury severity, that appears to be unrelated to prehospital times as assessed in this study. HEMS’ positive impact is limited to patients with physiologic derangement as indicated by RTS less than 6; HEMS appears to be harmful for patients who are less severely physiologically deranged. Factors other than trauma times (e.g. crew expertise) most likely mediate the salutary effect of air medical transport on trauma outcomes.

Commentary This was a study from the 2007 NTDB database, which has now provided full or partial data for at least three major studies of HEMS transport and outcomes. Given the positive results from the previous analyses including the same 2007 data, the overall finding that HEMS improves outcomes is expected. The authors point out that their new angle is the focus on assessing prehospital transport times. These data were not assessed in previous studies, largely because of the unreliability of the numbers and the fact that so many cases had missing prehospital times. As the authors themselves point out, previous attempts to look at the NTDB times data have yielded no evidence for impact of times on HEMS’ positive mortality effect. The current study – as pointed out by the authors in their discussion – is limited by the absence of critical data for many parameters (e.g. prehospital RTS). EMS time was unknown for nearly half (46%) of cases. The authors’ choice of dichotomizing transport times into <60 or >60 (with a third group for “unknown”) is certainly a defensible approach, but nevertheless (as pointed out by the discussion after the paper in the J Trauma) it risks muddy waters in terms of time-distance relationship (i.e. 50 minutes’ air transport time corresponds to a greater distance than 50 minutes’ ground transport time). Furthermore, the study could be argued to suffer significantly from the absence of any attempt (e.g. multiple imputation) to deal with missing data in an NTDB dataset that was already subjected to all of the biases inherent in a convenience sample.
The authors’ finding that HEMS transport was most beneficial in cases with the most physiologic derangement got a lot of attention in the post-paper discussion published in the pages following the article, but this seems hardly surprising given the widely understood fact that HEMS will help neither the trivially nor the mortally injured. As for the finding that HEMS – despite being found to be positive in impacting mortality across the entire injury severity range – is somehow worsening outcome in those patients with lesser physiologic derangement, the most likely explanation to these reviewers seems (by far) to be data-related (e.g. missing data) and confounding, rather than some heretofore unidentified mechanism by which flight worsens outcome only in those patients with more stable vital signs.


**Objective** The study’s goal was to evaluate the effect of Helicopter Emergency Medical Services (HEMS) on scene trauma patient mortality.

**Methods**

**Study Design** This was a retrospective database study.

**Setting** The study patients were cared for in Level I and Level II hospitals in Germany. Patients were transported by physician-staffed air or ground EMS; all prehospital care crews included physicians.

**Time Frame** Patients were drawn from the 2007, 2008, and 2009 calendar years.

**Patients** The study included scene-transported patients in the German Society for Trauma Surgery, who were taken by air or ground to Level I or II centers, and who had ISS of at least 9 and complete study data.

**Analysis** Multivariate logistic regression was used to adjust for about a dozen variables, and assessed HEMS versus ground EMS outcomes using standardized mortality comparisons predicted by both TRISS (using prehospital data only, with ISS) and RISC (Revised Injury Severity Classification; in this study RISC included initial hospital data).

**Results** The study collected data from a cohort of 13,220 patients; ground EMS transported
8,231 and HEMS 4,989. Patients in the HEMS cohort were more seriously injured, required significantly more on-scene treatment requiring much longer on-scene times (40 vs. 30 minutes), and had greater need for ICU services with longer hospital stays. Analysis adjusted for the obvious acuity difference between the air and ground cohorts using the TRISS and RISC prognostic scores to generate fair comparison of mortality rates. HEMS use was associated with statistically and clinically significant outcomes improvement when measured by models incorporating either TRISS or RISC; in the primary analysis the HEMS-associated mortality reduction point estimate was 25% (95% CI, 64-86%).

**Authors’ Conclusions** Despite a higher level of injury and consequential augmentation in complexity within the HEMS cohort, patients transported by air exhibited survival benefit as compared to ground EMS.

**Commentary** This large-scale study adds to the weight of the evidence supporting HEMS use for patients with “significant” trauma. The use of the standard covariates to adjust for baseline differences in ground and air casemix was complemented by some novel study characteristics. First was the fact that both ground and air transported patients were attended by prehospital physicians. Little information was available about possible differences between ground and air physicians, but the general point is that this “variable” in prehospital care probably did not “vary” too much between patients in the two study cohorts. Second, the study assessed only those patients transported to Level I and Level II centers. Inclusion of patients transported to non-trauma centers has in the past been a shortcoming of some studies. Third, as the authors themselves point out, the use of either of the acuity adjustment scales (TRISS or RISC) has inherent flaws, but the use of both ground and air patients and a standardized mortality prediction approach – with subsequent direct comparison of HEMS versus ground – minimizes the impact of TRISS/RISC flaws on the overall study results.

One of the most important issues with respect to the study, is its contribution to the literature defining what constitutes a “significant” injury. While most literature uses the lower cutoff of ISS > 15, these authors chose *a priori* to assess patients with ISS at least 9. First, the use of this ISS cutoff means that the 21% relative reduction in TRISS-predicted mortality should not be extrapolated to the predicted benefit associated with HEMS use overall (*i.e.* for
the full set of HEMS scene transports that includes patients with lower ISS). Second, and equally importantly, those modeling the utilization review and appropriateness criteria for HEMS should consider the mounting evidence that HEMS improves outcome in patients with ISS lower cutoff below the traditional number of 15. The use of lower ISS scores to define need for HEMS is increasingly defensible, given the current study data (ISS cutoff of 9) and other evidence that there are improved outcomes when HEMS is deployed for patients with ISS lower cutoff below 15 (e.g. ISS > 11 in a Canadian study and ISS > 12 in an Australian study). In one sense, this paper’s solid methodology and large-scale dataset are useful in (yet another) demonstration of HEMS scene trauma outcomes improvement in the general range of the preponderance of the extant literature. Arguably, the most important “take-home” message of this study is the strong suggestion that regional planners and triage developers should strongly consider using an ISS of at least 9 as defining potential utility for HEMS.

References

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