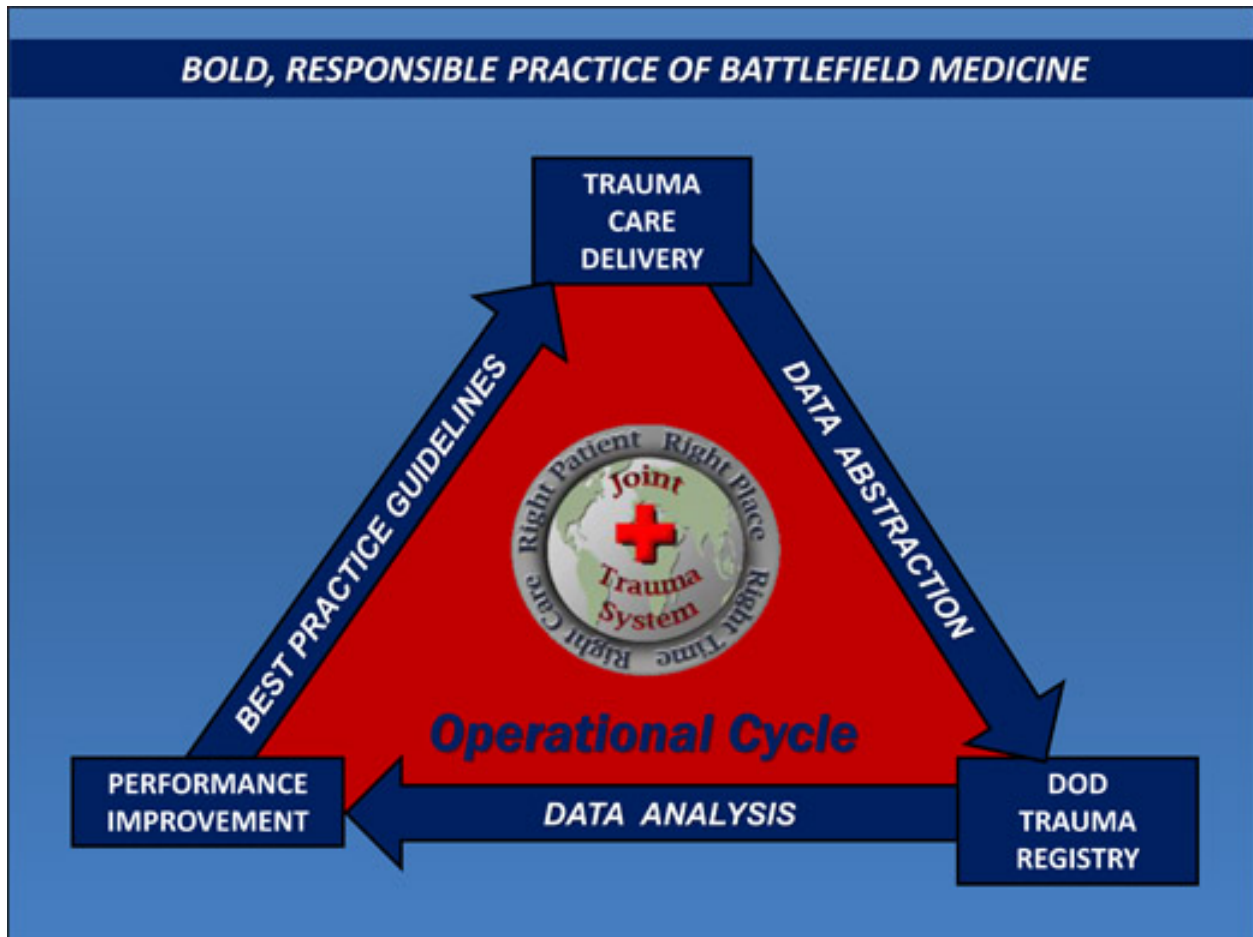


Committee on En Route Combat Casualty Care  
(CoECCC)



Journal Watch

4<sup>th</sup> Quarter

2016

## Journal Watch Key Terminology Searched:

Air Medical Transport; Austere; Delayed; Emergencies; EMS; Evacuation; High Altitude Cerebral Edema; High Altitude Pulmonary Edema; Mass Casualty; MEDEVAC; Outcome; Pre-hospital; Prolonged Specialty Care Transport; Tactical Combat Casualty Care; Transport; Trauma

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# Abstracts

[Air Med J](#). 2016 Jul-Aug;35(4):212-5. doi: 10.1016/j.amj.2016.04.006. Epub 2016 May 17.

## Challenges and Resources for New Critical Care Transport Crewmembers: A Descriptive Exploratory Study.

[Alfes CM](#)<sup>1</sup>, [Steiner S](#)<sup>2</sup>, [Rutherford-Hemming T](#)<sup>3</sup>.

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### Abstract

#### OBJECTIVE:

The purpose of this study was to identify the challenges new crewmembers experience in the critical care transport (CCT) environment and to determine the most valuable resources when acclimating to the transport environment. To date, no study has focused on the unique challenges nor the resources most effective in CCT training.

#### METHODS:

This descriptive exploratory study was conducted with a convenience survey sent to the 3 largest professional CCT organizations: the Association of Air Medical Services, the Air and Surface Transport Nurses Association, and the Association of Critical Care Transport.

#### RESULTS:

The study survey responses revealed that more education and training are needed. Novice crewmembers identified areas in safety, communication, environment, and crew resource management as particularly challenging. Responses also validate the need for more simulation training, especially for CCT of low-volume/high-risk patient populations.

#### CONCLUSION:

Results of this survey provide valuable insight for improving training effectiveness of health care professionals transitioning to the CCT environment. More information regarding best practice on the frequency and timing of CCT simulation training should be collected, particularly for simulations completed in the transport environment.

## **Preflight Variables Are Associated With Increased Ventilator Days and 30-Day Mortality in Trauma Casualties Evacuated by Critical Care Air Transport Teams: An Exploratory Retrospective Study.**

[Barnard E](#)<sup>1</sup>, [Mora AG](#)<sup>1</sup>, [Bebarta VS](#)<sup>1</sup>.

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### **Abstract**

#### **BACKGROUND:**

There are no tools to predict outcomes in the U.S. Air Force Critical Care Air Transport Team (CCATT) trauma patients. The objective of this study was to identify associations between preflight variables and outcomes that could assist planning of ongoing critical care.

#### **METHODS:**

This Institutional Review Board approved retrospective study included all patients evacuated from Afghanistan by CCATT between 2007 and 2011. Preflight variables were assessed for associations and examined in logistic regression models. Ventilator time over 72 hours, and 30-day mortality were the primary and secondary outcomes respectively.

#### **RESULTS:**

1,308 trauma patients (24 years, 98% male) were included; 72% blast. Injury severity score (odds ratio [OR] = 1.04 [1.03-1.06]), preflight packed red blood cell units transfused (OR = 1.05 [1.04-1.07]), and preflight intubated status (OR = 11.9 [8.53-16.89]) were independently associated with increased ventilator days; a composite produced an area under the curve of 0.85 with 86% sensitivity and 56% specificity. Injury severity score (OR = 1.06 [1.03-1.09]), prothrombin time (OR = 2.13 [1.18-4.47]), preflight intubated status (OR = 9.2 [1.88-166.11]), and whole blood (OR = 3.18 [1.38-7.04]) were associated with 30-day mortality; a composite produced an area under the curve of 0.84 with 71% sensitivity and 57% specificity.

#### **CONCLUSION:**

In our large CCATT study a number of preflight variables were associated with outcomes, which may assist in the future planning of critical care services.

## Development and Validation of the Air Medical Prehospital Triage Score for Helicopter Transport of Trauma Patients.

[Brown JB](#)<sup>1</sup>, [Gestring ML](#), [Guyette FX](#), [Rosengart MR](#), [Stassen NA](#), [Forsythe RM](#), [Billiar TR](#), [Peitzman AB](#), [Sperry JL](#).

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### Abstract

#### OBJECTIVE:

The aim of this study was to develop and internally validate a triage score that can identify trauma patients at the scene who would potentially benefit from helicopter emergency medical services (HEMS).

#### SUMMARY BACKGROUND DATA:

Although survival benefits have been shown at the population level, identification of patients most likely to benefit from HEMS transport is imperative to justify the risks and cost of this intervention.

#### METHODS:

Retrospective cohort study of subjects undergoing scene HEMS or ground emergency medical services (GEMS) in the National Trauma Databank (2007-2012). Data were split into training and validation sets. Subjects were grouped by triage criteria in the training set and regression used to determine which criteria had a survival benefit associated with HEMS. Points were assigned to these criteria to develop the Air Medical Prehospital Triage (AMPT) score. The score was applied in the validation set to determine whether subjects triaged to HEMS had a survival benefit when actually transported by helicopter.

#### RESULTS:

There were 2,086,137 subjects included. Criteria identified for inclusion in the AMPT score included GCS <14, respiratory rate <10 or >29, flail chest, hemo/pneumothorax, paralysis, and multisystem trauma. The optimal cutoff for triage to HEMS was  $\geq 2$  points. In subjects triaged to HEMS, actual transport by HEMS was associated with an increased odds of survival (AOR 1.28; 95% confidence interval [CI] 1.21-1.36,  $P < 0.01$ ). In subjects triaged to GEMS, actual transport mode was not associated with survival (AOR 1.04; 95% CI 0.97-1.11,  $P = 0.20$ ).

#### CONCLUSIONS:

The AMPT score identifies patients with improved survival following HEMS transport and should be considered in air medical triage protocols.

## A prospective study of ketamine versus haloperidol for severe prehospital agitation.

[Cole JB](#)<sup>1,2</sup>, [Moore JC](#)<sup>2</sup>, [Nystrom PC](#)<sup>2</sup>, [Orozco BS](#)<sup>1,2</sup>, [Stellpflug SJ](#)<sup>3</sup>, [Kornas RL](#)<sup>2</sup>, [Fryza BJ](#)<sup>2</sup>, [Steinberg LW](#)<sup>2</sup>, [O'Brien-Lambert A](#)<sup>2</sup>, [Bache-Wiig P](#)<sup>2</sup>, [Engebretsen KM](#)<sup>3</sup>, [Ho JD](#)<sup>2</sup>.

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- <sup>3</sup>c Department of Emergency Medicine , Regions Hospital , St. Paul , MN , USA.

### Abstract

#### CONTEXT:

Ketamine is an emerging drug for the treatment of acute undifferentiated agitation in the prehospital environment, however no prospective comparative studies have evaluated its effectiveness or safety in this clinical setting.

#### OBJECTIVE:

We hypothesized 5 mg/kg of intramuscular ketamine would be superior to 10 mg of intramuscular haloperidol for severe prehospital agitation, with time to adequate sedation as the primary outcome measure.

#### METHODS:

This was a prospective open label study of all patients in an urban EMS system requiring chemical sedation for severe acute undifferentiated agitation that were subsequently transported to the EMS system's primary Emergency Department. All paramedics were trained in the Altered Mental Status Scale and prospectively recorded agitation scores on all patients. Two 6-month periods where either ketamine or haloperidol was the first-line therapy for severe agitation were prospectively compared primarily for time to adequate sedation. Secondary outcomes included laboratory data and adverse medication events.

**RESULTS:** 146 subjects were enrolled; 64 received ketamine, 82 received haloperidol. Median time to adequate sedation for the ketamine group was 5 minutes (range 0.4-23) vs. 17 minutes (range 2-84) in the haloperidol group (difference 12 minutes, 95% CI 9-15). Complications occurred in 49% (27/55) of patients receiving ketamine vs. 5% (4/82) in the haloperidol group. Complications specific to the ketamine group included hypersalivation (21/56, 38%), emergence reaction (5/52, 10%), vomiting (5/57, 9%), and laryngospasm (3/55, 5%). Intubation was also significantly higher in the ketamine group; 39% of patients receiving ketamine were intubated vs. 4% of patients receiving haloperidol.

#### CONCLUSIONS:

Ketamine is superior to haloperidol in terms of time to adequate sedation for severe prehospital acute undifferentiated agitation, but is associated with more complications and a higher intubation rate.

## **Prehospital Endotracheal Intubation in Warm Climates: Caution is Required.**

[Daniel Y](#)<sup>1</sup>, [Habas S](#)<sup>1</sup>, [Cruc M](#)<sup>2</sup>.

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### **Abstract**

#### **BACKGROUND:**

Out-of-hospital endotracheal intubation is a frequent procedure for trauma care. Nevertheless, in warm climates, sunlight and heat can interfere with the flow of the usual procedure. They can affect the equipment and hinder the operator. There are few data on this issue. The presentation of this case highlights three common complications that may occur when intubating under a hot and bright sun.

#### **CASE REPORT:**

A 23-year-old man had a car accident in Djibouti, at 11:00 a.m., in broad sunlight. The heat was scorching. Due to a severe head trauma, with a Glasgow Coma Scale score of 8, it was decided to perform an endotracheal intubation. The operator faced three problems: the difficulty of seeing inside the mouth in the bright sunlight, the softening of the tube under the influence of the heat, and the inefficiency of colorimetric CO<sub>2</sub> detectors in the warm atmosphere in confirming the proper endotracheal tube placement. WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?: Solutions are simple, but must be known and planned ahead, prior to beginning the procedure: Putting a jacket over his head while doing the laryngoscopy would solve the problem of dazzle; adjuncts like a stylet or gum elastic bougie have to be used at the outset to fix the softening problem; alternative methods to exhaled CO<sub>2</sub> detection, such as the syringe aspiration technique, to confirm the proper tube placement, should be available.



## Description of Medication Administration by Emergency Medical Services during Mass-casualty Incidents in the United States.

[El Sayed M](#)<sup>1</sup>, [Tamim H](#)<sup>2</sup>, [Mann NC](#)<sup>3</sup>.

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- <sup>3</sup>4Department of Pediatrics, University of Utah School of Medicine, Salt Lake City, Utah USA.

### Abstract

#### BACKGROUND:

Emergency Medical Services (EMS) preparedness and availability of essential medications are important to reduce morbidity and mortality from mass-casualty incidents (MCIs).

#### OBJECTIVES:

This study describes prehospital medication administration during MCIs by different EMS service levels.

#### METHODS:

The US National EMS Public-Release Research Dataset maintained by the National Emergency Medical Services Information System (NEMSIS) was used to carry out the study. Emergency Medical Services activations coded as MCI at dispatch, or by EMS personnel, were included. The Center for Medicare and Medicaid Services (CMS) service level was used for the level of service provided. A descriptive analysis of medication administration by EMS service level was carried out.

#### RESULTS:

Among the 19,831,189 EMS activations, 53,334 activations had an MCI code, of which 26,110 activations were included. There were 8,179 (31.3%) Advanced Life Support (ALS), 5,811 (22.3%) Basic Life Support (BLS), 399 (1.5%) Air Medical Transport (AMT; fixed or rotary), and 38 (0.2%) Specialty Care Transport (SCT) activations. More than 80 different medications from 18 groups were reported. Seven thousand twenty-one activations (26.9%) had at least one medication administered. Oxygen was most common (16.3%), followed by crystalloids (6.9%), unknown (5.2%), analgesics (3.2%) mainly narcotics, antiemetics (1.5%), cardiac/vasopressors/inotropes (0.9%), bronchodilators (0.9%), sedatives (0.8%), and vasodilators/antihypertensives (0.7%). Overall, medication administration rates and frequencies of medications groups significantly varied between EMS service levels ( $P < .01$ ) except for "Analgesia (other)" ( $P = .40$ ) and "Pain medications (nonsteroidal anti-inflammatory drug; NSAID)" ( $P = .07$ ).

#### CONCLUSION:

Medications are administered frequently in MCIs, mainly Oxygen, crystalloids, and narcotic pain medications. Emergency Medical Services systems can use the findings of this study to better prepare their stockpiles for MCIs.

## **Prognostic factors of early outcome and discharge status in patients undergoing surgical intervention following traumatic intracranial hemorrhage.**

[Fujii T](#)<sup>1</sup>, [Moriel G](#)<sup>1</sup>, [Kramer DR](#)<sup>2</sup>, [Attenello F](#)<sup>1</sup>, [Zada G](#)<sup>1</sup>.

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### **Abstract**

Over the past several decades, the rate of traumatic brain injury (TBI)-related emergency room visits in the United States has steadily increased, yet mortality in these patients has decreased. This improvement in outcome is largely due to advances in prehospital care, intensive care unit management, and the effectiveness of neurosurgical procedures, such as decompressive craniectomies. It is imperative to identify clinical factors predictive of patients who benefit from early mobilization of resources and operative treatment. Equally important is the identification of patients with good prognostic signs among patients receiving surgical intervention for TBI. We conducted a retrospective chart review of 181 patients requiring craniectomies and craniotomies for decompression or evacuation of an intracranial hemorrhage following TBI at a single level I trauma center between 2008-2010. Demographic features and perioperative clinical characteristics of these patients were examined in relation to favorable outcomes, defined as discharge to home or a rehabilitation facility, and unfavorable outcomes, defined as in-hospital mortality or discharge to step-down medical facilities. Younger age, greater Glasgow Coma Scale (GCS) score on admission, absence of preoperative coagulopathies, absence of hyponatremia, and absence of fever were all independent predictors of favorable outcome. Additionally, increased operative duration and increased length of hospital stay were identified as independent predictors of negative outcomes after surgery. This work supports some of the current prognostic models in the literature and identifies additional clinical variables with predictive value of early outcome and discharge status in patients undergoing surgical evacuation of traumatic intracranial hemorrhages.

## **Tactical Study of Care Originating in the Prehospital Environment (Tacscope): Acute Traumatic Coagulopathy on the Contemporary Battlefield.**

[Gerhardt RT](#)<sup>1</sup>, [Glassberg E](#), [Holcomb JB](#), [Mabry RL](#), [Schreiber MB](#), [Spinella PC](#).

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### **Abstract**

#### **BACKGROUND:**

Uncontrolled major hemorrhage and delayed evacuation remain substantial contributors to potentially survivable combat death, along with mission, environment, terrain, logistics, and hostile action. Life-saving interventions and the onset of acute traumatic coagulopathy (ATC) may also contribute.

#### **OBJECTIVE:**

Analyze US casualty records from the DoD Trauma Registry, using International Normalized Ratio (INR) of 1.5 for onset of ATC.

#### **METHODS:**

Retrospective cohort study from September 2007 to June 2011, inclusive. Independent variable was INR. Primary dependent variables were transfusion volume, massive transfusion (MT) defined as >10 units RBC/fresh whole blood in first 24h, and 30-day survival. We used T test and chi-square analysis. Our IRB reviewed and exempted this study.

#### **RESULTS:**

In total, 8,913 cases were available. Fifty one percent had complete data with INR. Of excluded cases, 98.9% survived, average injury severity scales (ISS) was 7 (IQR 1-8), and less than 1% received MT. Among included cases, 98.5% survived, average ISS was 10 (IQR 2-14), average INR was 1.16 (CI95 1.14-1.17), and 2.7% received MT. There were 383 cases with ATC (8.4%). After stratification, we found that ATC cases were more likely to die (odds ratio (OR) 28, CI 16-48), receive MT (OR 9.6, CI 6.4-14.4), and were acidotic (pH 7.27 (7.24-7.31) vs. 7.38 (7.38-7.39)). Other significant differences included Injury Severity Score, Revised Trauma Score, blast mechanism, and penetrating injury.

#### **CONCLUSION:**

ATC is substantially associated with greater injury severity, MT, and mortality. Prehospital identification of MT casualties may expedite triage and evacuation, and enable remote damage control resuscitation to delay ATC onset and improve outcomes.

[US Army Med Dep J](#). 2016 Apr-Sep;(2-16):15-23.

## **Surveillance of Disease and Nonbattle Injuries During US Army Operations in Afghanistan and Iraq.**

[Hauret KG](#)<sup>1</sup>, [Pacha L](#), [Taylor BJ](#), [Jones BH](#).

### **Author information**

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### **Abstract**

Disease and nonbattle injury (DNBI) are the leading causes of morbidity during wars and military operations. However, adequate medical data were never before available to service public health centers to conduct DNBI surveillance during deployments. This article describes the process, results and lessons learned from centralized DNBI surveillance by the US Army Center for Health Promotion and Preventive Medicine, predecessor of the US Army Public Health Command, during operations in Afghanistan and Iraq (2001-2013). The surveillance relied primarily on medical evacuation records and in-theater hospitalization records. Medical evacuation rates (per 1,000 person-years) for DNBI were higher (Afghanistan: 56.7; Iraq: 40.2) than battle injury rates (Afghanistan: 12.0; Iraq: 7.7). In Afghanistan and Iraq, respectively, the leading diagnostic categories for medical evacuations were nonbattle injury (31% and 34%), battle injury (20% and 16%), and behavioral health (12% and 10%). Leading causes of medically evacuated nonbattle injuries were sports/physical training (22% and 24%), falls (23% and 26%) and military vehicle accidents (8% and 11%). This surveillance demonstrated the feasibility, utility, and benefits of centralized DNBI surveillance during military operations.

## **Airway Management: A Structured Curriculum for Critical Care Transport Providers.**

[Kuszajewski ML](#)<sup>1</sup>, [O'Donnell JM](#)<sup>2</sup>, [Phrampus PE](#)<sup>3</sup>, [Robey WC 3rd](#)<sup>4</sup>, [Tuite PK](#)<sup>5</sup>.

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- <sup>5</sup>University of Pittsburgh School of Nursing, Pittsburgh, PA, USA.

### **Abstract**

#### **OBJECTIVE:**

Airway assessment and management are vital skills for the critical care transport provider. Nurses and paramedics often enter a transport program with limited or no exposure to airway management. Many programs lack a structured curriculum to show skill competence. Optimal methods in the development of airway management competence and the frequency of training needed to maintain skills have not been clearly defined. Because of this lack of standardization, the actual level of competence in both new and experienced critical care transport providers is unknown.

#### **METHODS:**

A pretest, post-test repeated measures approach using an online curriculum combined with a deliberate practice model was used. Competence in airway management was measured using 3 evaluation points: static mannequin head, simulation scenario, and the live patient.

#### **RESULTS:**

A convenience sample of critical care transport providers participated (N = 9). Knowledge improvement was significant, with a higher percentage of participants scoring above 85% on the post-test compared with the pretest (P = .028). Mean scores in completion of the airway checklist pre- versus postintervention were significantly increased on all 3 evaluation points (P < .001 for all comparisons). Significant changes were noted in the response profile evaluating participants' confidence in their ability to verbalize indications for endotracheal intubation (P < .05).

#### **CONCLUSION:**

The development of a standardized, blended learning curriculum combined with deliberate simulation practice and rigorous assessment showed improvements in multiple areas of airway assessment and management.

## Intra-aortic Balloon Pump-Dependent Patient Transports by Critical Care Paramedics.

[MacDonald RD](#)<sup>1</sup>, [Allendes F](#)<sup>2</sup>.

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- <sup>2</sup>Department of Emergency Medicine, McMaster University, Hamilton, Ontario, Canada.

### Abstract

#### OBJECTIVE:

Transport of intra-aortic balloon pump (IABP)-dependent patients between hospitals is increasingly common. The transports are typically time-sensitive and require personnel familiar with IABP operation and management of a potentially unstable patient. This study examined transports performed by specially trained critical care paramedics in a large air medical and land critical care transport service.

#### METHODS:

This retrospective, descriptive review prospectively collected data for IABP-dependent patient transports in Ontario, Canada in a 10-year interval beginning September 2003. Call records and patient care reports were reviewed to capture demographic, patient care, adverse events, and transport-related data. Adverse events, including resuscitation medication, procedure, and patient instability, were independently reviewed by 2 investigators.

#### RESULTS:

There were 162 IABP-dependent patients transported. Seventy-one were performed by land critical care transport vehicles, 60 by helicopter, and 31 by fixed wing aircraft. The mean patient age was  $63.7 \pm 13.8$  years; the majority (72.2%) were men. Fifty-nine patients (36.4%) were inotrope or vasopressor dependent, and 46 (28.4%) were intubated and mechanically ventilated. The most common indications for IABP insertion were acute myocardial infarction requiring prompt surgical intervention ( $n = 70$ ), bridge to definitive care ( $n = 41$ ), and cardiogenic shock ( $n = 37$ ). The mean transport time was  $92.7 \pm 79.4$  minutes. There were 48 adverse events in 35 patients, most commonly hypotension (systolic blood pressure  $< 90$  mm Hg,  $n = 18$ ) and tachyarrhythmia requiring therapy ( $n = 12$ ). There were 3 IABP-related events and 3 cases in which the transport vehicle was inoperable resulting in a transport delay. One patient with cardiogenic shock died before departing the sending hospital. Paramedics managed all events without assistance from other health care personnel.

#### CONCLUSION:

Specially trained critical care flight paramedics can safely transport potentially unstable IABP-dependent patients to definitive cardiac surgical care.

## Characteristics and Outcomes of Blood Product Transfusion During Critical Care Transport.

[Mena-Munoz J](#), [Srivastava U](#), [Martin-Gill C](#), [Suffoletto B](#), [Callaway CW](#), [Guyette FX](#).

### Abstract

#### BACKGROUND:

Civilian out-of-hospital transfusions have not been adequately studied. This study seeks to characterize patients receiving out-of-hospital blood product transfusion during critical care transport.

#### STUDY DESIGN AND METHODS:

We studied patients transported by a regional critical care air-medical service who received blood products during transport. This service carries two units of uncrossmatched packed Red Blood Cells (pRBCs) on every transport in addition to blood obtained from referring facilities. The pRBC are administered according to a protocol for the treatment of hemorrhagic shock or based on medical command physician order. Transfusion amount was categorized into three groups based on the volume transfused (<350 mL, 350-700 mL, >700 mL). The association between prehospital transfusion and in-hospital outcomes (mortality, subsequent blood transfusion and emergent surgery) was estimated using logistic regression models, controlling for age, first systolic blood pressure, first heart rate, Glasgow Coma Score, time of transfer, and length of hospital admission.

#### RESULTS:

Among the 1,440 critical care transports with transfusions examined, 81% were for medical patients, being gastrointestinal hemorrhage the most common indication (26%, CI 24-28%). pRBC transfusions were associated with emergent surgery (OR = 1.81, 95% CI = 1.31-2.52) and in-hospital transfusions (OR = 2.00, 95% CI = 1.46-2.76). Those with transfusions >700 mL were associated with emergent surgery (OR = 1.79, 95% CI = 1.10-2.92) and mortality (OR = 2.11; 95% CI = 1.21-3.69).

#### CONCLUSIONS:

In this sample, the majority of patients receiving blood products during air-medical transport were transfused for medic conditions; gastrointestinal hemorrhage was the most common chief complaint. The pRBC transfusions were associated with emergent surgery and in-hospital transfusion. Transfusions of >700 mL were associated with mortality.

## Blood transfusion: In the air tonight?

Miller BT<sup>1</sup>, Du L, Krzyzaniak MJ, Gunter OL, Nunez TC.

### Author information

- <sup>1</sup>From the Department of Surgery, Vanderbilt University Medical Center, Nashville, Tennessee.

### Abstract

#### BACKGROUND:

The use of prehospital blood transfusion (PBT) in air medical transport has become more widespread. However, the effect of PBT remains unknown. The aim of this study was to examine the impact of PBT on 24-hour and overall in-hospital mortality.

#### METHODS:

This is a retrospective cohort study of all trauma patients carried by air medical transport from the scene to a Level I trauma center from 2007 to 2013. We excluded patients who died on the helipad or in the emergency department. Primary outcomes measured were 24-hour and overall in-hospital mortality. Multivariable logistic regressions using all available patient data or the propensity score (for receiving PBT)-matched patient data were performed to study the effect of PBT on these outcomes.

#### RESULTS:

Of the 5,581 patients included in the study, 231 (4%) received PBT. Multivariable regression analyses did not show evidence of PBT effect on 24-hour in-hospital mortality (odds ratio [OR], 1.22; 95% confidence interval [CI], 0.61-2.44) and on overall in-hospital mortality (OR, 1.20; 95% CI, 0.55-1.79). In addition, using 1:1 propensity score-matched data, the analysis did not show evidence of PBT effect on 24-hour in-hospital mortality (OR, 1.04; 95% CI, 0.54-1.98) and on overall in-hospital mortality (OR, 1.05; 95% CI, 0.56-1.96). Factors associated with increased 24-hour mortality were advanced age, penetrating injury, increased blood transfusion requirement in the first 24 hours, and decreased Glasgow Coma Scale (GCS) score ( $p < 0.05$ ). These factors were also associated with overall mortality, in addition to increased Injury Severity Score (ISS) ( $p < 0.05$ ).

#### CONCLUSION:

This is the largest study to date of trauma patients who received PBT and were transported from the scene by air medical transport. Our results show no effect of PBT on 24-hour and overall in-hospital mortality. Previous studies also suggest no benefit of PBT, which is counterintuitive to damage-control resuscitation. Prospective data on PBT are needed to assess risk, cost, and benefit.



## **En Route Use of Analgesics in Nonintubated, Critically Ill Patients Transported by U.S. Air Force Critical Care Air Transport Teams.**

[Mora AG](#)<sup>1</sup>, [Ganem VJ](#)<sup>1</sup>, [Ervin AT](#)<sup>1</sup>, [Maddry JK](#)<sup>1</sup>, [Bebarta VS](#)<sup>1</sup>.

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### **Abstract**

#### **INTRODUCTION:**

U.S. Critical Care Air Transport Teams (CCATTs) evacuate critically ill patients with acute pain in the combat setting. Limited data have been reported on analgesic administration en route, and no study has reported analgesic use by CCATTs. Our objective was to describe analgesics used by CCATTs for nonintubated, critically ill patients during evacuation from a combat setting.

#### **METHODS:**

We conducted an institutional review board-approved, retrospective review of CCATT records. We included nonintubated, critically ill patients who were administered analgesics in flight and were evacuated out of theater (2007-2012). Demographics, injury description, analgesics and anesthetics, and predefined clinical adverse events were recorded. Data were presented as mean  $\pm$  standard deviation or percentage (%).

#### **RESULTS:**

Of 1,128 records, we analyzed 381 subjects with the following characteristics: age  $26 \pm 7.0$  years; 98% male; and 97% trauma (70% blast, 17% penetrating, 11% blunt, and 3% burn). The injury severity score was  $19 \pm 9$ . Fifty-one percent received morphine, 39% hydromorphone, 15% fentanyl, and 5% ketamine. Routes of delivery were 63% patient-controlled analgesia (PCA), 32% bolus intravenous (IV) administration, 24% epidural delivery, 21% continuous IV infusions, and 9% oral opioids. Patients that were administered local anesthetics (nerve block or epidural delivery) with IV opioids received a lower total dose of opioids than those who received opioids alone. No differences were associated between analgesics and frequency of complications in flight or postflight.

#### **CONCLUSION:**

About half of nonintubated, critically ill subjects evacuated out of combat by CCATT received morphine and more than half had a PCA. In our study, ketamine was not frequently used and pain scores were rarely recorded. However, we detected an opioid-sparing effect associated with local anesthetics (regional nerve blocks and epidural delivery).

## Accuracy of Perceived Estimated Travel Time by EMS to a Trauma Center in San Bernardino County, California.

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### Abstract

#### INTRODUCTION:

Mobilization of trauma resources has the potential to cause ripple effects throughout hospital operations. One major factor affecting efficient utilization of trauma resources is a discrepancy between the prehospital estimated time of arrival (ETA) as communicated by emergency medical services (EMS) personnel and their actual time of arrival (TOA). The current study aimed to assess the accuracy of the perceived prehospital estimated arrival time by EMS personnel in comparison to their actual arrival time at a Level II trauma center in San Bernardino County, California.

#### METHODS:

This retrospective study included traumas classified as alerts or activations that were transported to Arrowhead Regional Medical Center in 2013. We obtained estimated arrival time and actual arrival time for each transport from the Surgery Department Trauma Registry. The difference between the median of ETA and actual TOA by EMS crews to the trauma center was calculated for these transports. Additional variables assessed included time of day and month during which the transport took place.

#### RESULTS:

A total of 2,454 patients classified as traumas were identified in the Surgery Department Trauma Registry. After exclusion of trauma consults, walk-ins, handoffs between agencies, downgraded traumas, traumas missing information, and traumas transported by agencies other than American Medical Response, Ontario Fire, Rialto Fire or San Bernardino County Fire, we included a final sample size of 555 alert and activation classified traumas in the final analysis. When combining all transports by the included EMS agencies, the median of the ETA was 10 minutes and the median of the actual TOA was 22 minutes (median of difference=9 minutes,  $p<0.0001$ ). Furthermore, when comparing the difference between trauma alerts and activations, trauma activations demonstrated an equal or larger difference in the median of the estimated and actual time of arrival ( $p<0.0001$ ). We also found month and time of day to be associated with variability in the difference between the median of the estimated and actual arrival time ( $p=0.0082$  and  $p=0.0005$  for month and time of the day, respectively).

**CONCLUSION:** EMS personnel underestimate their travel time by a median of nine minutes, which may cause the trauma team to abandon other important activities in order to respond to the emergency department prematurely. The discrepancy between ETA and TOA is unpredictable, varying by month and time of day. As such, a better method of estimating patient arrival time is needed.

## **Five-year Retrospective Review of Physician and Non-physician Performed Ultrasound in a Canadian Critical Care Helicopter Emergency Medical Service.**

[O'Dochartaigh D](#), [Douma M](#), [MacKenzie M](#).

### **Abstract**

#### **OBJECTIVE:**

To describe the use of prehospital ultrasonography (PHUS) to support interventions, when used by physician and non-physician air medical crew (AMC), in a Canadian helicopter emergency medical service (HEMS).

#### **METHODS:**

A retrospective review was conducted of consecutive patients who underwent ultrasound examination during HEMS care from January 1, 2009 through March 10, 2014. An a priori created data form was used to record patient demographics, type of ultrasound scan performed, ultrasound findings, location of scan, type of interventions supported by PHUS, factors that affected PHUS completion, and quality indicator(s). Data analysis was performed through descriptive statistics, Student's t-test for continuous variables, Z-test for proportions, and Mann-Whitney U Test for nonparametric data. Outcomes included interventions supported by PHUS, factors associated with incomplete scans, and quality indicators associated with PHUS use. Differences between physician and AMC groups were also assessed.

#### **RESULTS:**

PHUS was used in 455 missions, 318 by AMC and 137 by physicians. In combined trauma and medical patients, in the AMC group interventions were supported by PHUS in 26% of cases (95% CI 18-34). For transport physicians the percentage support was found to be significantly greater at 45% of cases (95% CI 34-56)  $p = < 0.006$ . Incomplete PHUS scans were common and reasons included patient obesity, lack of time, patient access, and clinical reasons. Quality indicators associated with PHUS were rarely identified.

#### **CONCLUSIONS:**

The use of PHUS by both physicians and non-physicians was found to support interventions in select trauma and medical patients.

## **Brain hypoxia is exacerbated in hypobaria during aeromedical evacuation in swine with traumatic brain injury.**

[Scultetus AH<sup>1</sup>](#), [Haque A](#), [Chun SJ](#), [Hazzard B](#), [Mahon RT](#), [Harssema MJ](#), [Auker CR](#), [Moon-Massat P](#), [Malone DL](#), [McCarron RM](#).

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### **Abstract**

#### **BACKGROUND:**

There is inadequate information on the physiologic effects of aeromedical evacuation on wounded war fighters with traumatic brain injury (TBI). At altitudes of 8,000 ft, the inspired oxygen is lower than standard sea level values. In troops experiencing TBI, this reduced oxygen may worsen or cause secondary brain injury. We tested the hypothesis that the effects of prolonged aeromedical evacuation on critical neurophysiologic parameters (i.e., brain oxygenation [PbtO<sub>2</sub>]) of swine with a fluid percussion injury/TBI would be detrimental compared with ground (normobaric) transport.

#### **METHODS:**

Yorkshire swine underwent fluid percussion injury/TBI with pretransport stabilization before being randomized to a 4-hour aeromedical transport at simulated flight altitude of 8,000 ft (HYPO, n = 8) or normobaric ground transport (NORMO, n = 8). Physiologic measurements (i.e., PbtO<sub>2</sub>, cerebral perfusion pressure, intracranial pressure, regional cerebral blood flow, mean arterial blood pressure, and oxygen transport variables) were analyzed.

#### **RESULTS:**

Survival was equivalent between groups. Measurements were similar in both groups at all phases up to and including onset of flight. During the flight, PbtO<sub>2</sub>, cerebral perfusion pressure, and mean arterial blood pressure were significantly lower in the HYPO than in the NORMO group. At the end of flight, regional cerebral blood flow was lower in the HYPO than in the NORMO group. Other parameters such as intracranial pressure, cardiac output, and mean pulmonary artery pressure were not significantly different between the two groups.

#### **CONCLUSION:**

A 4-hour aeromedical evacuation at a simulated flight altitude of 8,000 ft caused a notable reduction in neurophysiologic parameters compared with normobaric conditions in this TBI swine model. Results suggest that hypobaric conditions exacerbate cerebral hypoxia and may worsen TBI in casualties already in critical condition.

## Simulated Aeromedical Evacuation Exacerbates Experimental Brain Injury.

[Skovira JW](#)<sup>1</sup>, [Kabadi SV](#)<sup>1</sup>, [Wu J](#)<sup>1</sup>, [Zhao Z](#)<sup>1</sup>, [DuBose J](#)<sup>2</sup>, [Rosenthal R](#)<sup>3</sup>, [Fiskum G](#)<sup>1</sup>, [Faden AI](#)<sup>1</sup>.

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### **Abstract**

Aeromedical evacuation, an important component in the care of many patients with traumatic brain injury (TBI), particularly in war zones, exposes them to prolonged periods of hypobaria. The effects of such exposure on pathophysiological changes and outcome after TBI are largely unexplored. The objective of this study was to investigate whether prolonged hypobaria in rats subjected to TBI alters behavioral and histological outcomes. Adult male Sprague-Dawley rats underwent fluid percussion induced injury at 1.5-1.9 atmospheres of pressure. The effects of hypobaric exposure (6 h duration; equivalent to 0.75 atmospheres) at 6, 24, and 72 h, or 7 days after TBI were evaluated with regard to sensorimotor, cognitive, and histological changes. Additional groups were evaluated to determine the effects of two hypobaric exposures after TBI, representing primary simulated aeromedical evacuation (6 h duration at 24 h after injury) and secondary evacuation (10 h duration at 72 h after injury), as well as the effects of 100% inspired oxygen concentrations during simulated evacuation. Hypobaric exposure up to 7 days after injury significantly worsened cognitive deficits, hippocampal neuronal loss, and microglial/astrocyte activation in comparison with injured controls not exposed to hypobaria. Hyperoxia during hypobaric exposure or two exposures to prolonged hypobaric conditions further exacerbated spatial memory deficits. These findings indicate that exposure to prolonged hypobaria up to 7 days after TBI, even while maintaining physiological oxygen concentration, worsens long-term cognitive function and neuroinflammation. Multiple exposures or use of 100% oxygen further exacerbates these pathophysiological effects.

## Choosing appropriate comparison group participants in studies of veterans: Characteristics of orthopedically injured and uninjured Operation Enduring Freedom/Operation Iraqi Freedom/Operation New Dawn veterans.

[Troyanskaya M](#)<sup>1,2</sup>, [Pastorek NJ](#)<sup>1,2</sup>, [Scheibel RS](#)<sup>1,2</sup>, [Petersen NJ](#)<sup>1,3</sup>, [Walder A](#)<sup>1,3</sup>, [Henson HK](#)<sup>1,2</sup>, [Levin HS](#)<sup>1,2,4,5,6</sup>.

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### Abstract

**INTRODUCTION:** Research addressing deployment-related traumatic brain injury (TBI) is fairly complex due to a high prevalence of comorbid conditions, multiple exposures, and the lack of acute medical records. Therefore, there is a need for a well-defined, matching comparison group. This study compared deployment-related characteristics, everyday functioning, and cognitive performance in recently deployed veterans who had not sustained any injuries with those who had orthopedic injuries during deployment, but who were without a history of TBI.

**METHOD:** Participants included 45 individuals who had been deployed and who were without injuries and a group of 27 individuals who reported at least one orthopedic injury during deployment. The Mayo-Portland Adaptability Inventory-4, Community Integration Questionnaire, Veterans RAND 36 Item Health Survey, Brief Pain Inventory, Barratt Impulsiveness Scale-11, and posttraumatic stress disorder (PTSD) Checklist-Civilian (PCL-C) were used to assess daily functioning. Cognitive performance was measured using the Controlled Oral Word Association Test, Trail Making Test, Color-Word Interference Test, and Verbal Selective Reminding Test. The two groups were compared using t tests based on equal variances. The effect size was calculated.

**RESULTS:** There were no between-group differences, with all variables having p-values  $>.1$  and small to medium effect sizes.

### DISCUSSION:

Orthopedic injuries sustained during deployment that did not require evacuation or hospitalization did not have any lasting effect on participants' health, cognition, and daily functioning relative to other deployed individuals with no history of injury. These results indicate the two groups are comparable and that their data could be potentially combined to create a single comparison group. Due to the small sample available for this study, the current results are considered preliminary, and further investigation is needed.

## **Adult Intraosseous Access by Advanced EMTs: A Statewide Non-Inferiority Study.**

[Wolfson DL](#), [Tandoh MA](#), [Jindal M](#), [Forgione PM](#), [Harder VS](#).

### **Abstract**

#### **OBJECTIVE:**

Intraosseous (IO) access is increasingly being used as an alternative to peripheral intravenous access, which is often difficult or impossible to establish in critically ill patients in the prehospital setting. Until recently, only Paramedics performed adult IO access. In 2014, Vermont Emergency Medical Services (EMS) expanded the Advanced Emergency Medical Technicians (AEMTs) scope of practice to include IO access in adult patients. This study compares successful IO access in adults performed by AEMTs compared to Paramedics in the prehospital setting.

#### **METHODS:**

All Vermont EMS patient encounters between January 1, 2013 and November 30, 2015 were examined, and 543 adult patients with a documented IO access insertion attempt were identified. The proportion of successful IO insertions was compared between AEMTs and Paramedics using a Chi-Squared statistic and a non-inferiority test.

#### **RESULTS:**

There was no significant difference in the percentage of successful IO access between AEMTs and Paramedics [95.2% and 95.6%, respectively;  $P = 0.84$ ]. The confidence interval around this 0.4% difference (95% confidence interval = -4.2, 3.2) was within a pre-specified delta of  $\pm 10\%$  indicating non-inferiority of AEMTs compared to Paramedics.

#### **CONCLUSIONS:**

This study's finding that successful IO access was not different among AEMTs and Paramedics lends evidence in support of expanding the scope of practice of AEMTs to include establishing IO access in adults.

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# Abstracts

[Prehosp Emerg Care](#). 2016 Aug 5:1-7. [Epub ahead of print]

## Confidence-Competence Mismatch and Reasons for Failure of Non-Medical Tourniquet Users.

[Baruch EN](#), [Kragh JF](#), [Berg AL](#), [Aden JK](#), [Benov A](#), [Shina A](#), [Shlaifer A](#), [Ahimor A](#), [Glassberg E](#), [Yitzhak A](#).

### Abstract

#### OBJECTIVE:

Tourniquet application is a lifesaving skill taught worldwide in first aid bleeding control courses. We observed performance among non-medical users of tourniquets in their confidence, competence, and reasons for failure.

#### METHODS:

179 Israeli military recruits without prior medical training underwent their standard first aid course where they learned Combat Application Tourniquet (CAT; Composite Resources, Rock Hill, SC, USA) use. After course completion, they self-reported confidence in tourniquet use. User performance was assessed 7-14 days later using a HapMed™ mannequin that assessed time, pressure, and blood loss. Competent performance required in aggregate: 1) use with pressure of 200 mmHg or more, 2) hemorrhage volume of less than 638 mL, and 3) correct placement of the tourniquet. For failed performance, a reason for failure was reported independently by both the user and an expert observer.

#### RESULTS:

45 of 179 user performances (25%) were competent. Users who reported high confidence had only a slightly higher chance of achieving competence in tourniquet application ( $r = 0.17$ ,  $p = 0.022$ ). The most common reason for failure was excess slack in the CAT's strap (experts 55%, users 39%), and too few turns of the windlass (23% and 31%, respectively) was the second most common reason. Expert and user evaluations had poor agreement ( $\kappa = 0.44$ , 95% CI 0.32-0.56).

#### CONCLUSION:

The most common reason for failed use of tourniquets among non-medical users was excess slack in the tourniquet strap. Users self-evaluated their performance inaccurately and demonstrated a confidence-competence mismatch. These pitfalls in performance may help tourniquet instructors improve training of caregivers.

## Tactical damage control resuscitation in austere military environments.

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### Abstract

#### BACKGROUND:

Despite the early uses of tourniquets and haemostatic dressings, blood loss still accounts for the vast majority of preventable deaths on the battlefield. Over the last few years, progress has been made in the management of such injuries, especially with the use of damage control resuscitation concepts. The early application of these procedures, on the field, may constitute the best opportunity to improve survival from combat injury during remote operations.

#### DATA SOURCES:

Currently available literature relating to trauma-induced coagulopathy treatment and far-forward transfusion was identified by searches of electronic databases. The level of evidence and methodology of the research were reviewed for each article. The appropriateness for field utilisation of each medication was then discussed to take into account the characteristics of remote military operations.

#### CONCLUSIONS:

In tactical situations, in association with haemostatic procedures (tourniquet, suture, etc), tranexamic acid should be the first medication used according to the current guidelines. The use of fibrinogen concentrate should also be considered for patients in haemorrhagic shock, especially if point-of-care (POC) testing of haemostasis or shock severity is available. If POC evaluation is not available, it seems reasonable to still administer this treatment after clinical assessment, particularly if the evacuation is delayed. In this situation, lyophilised plasma may also be given as a resuscitation fluid while respecting permissive hypotension. Whole blood transfusion in the field deserves special attention. In addition to the aforementioned treatments, if the field care is prolonged, whole blood transfusion must be considered if it does not delay the evacuation.

## **Intraosseous access in the obese patient: assessing the need for extended needle length.**

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### **Abstract**

#### **BACKGROUND:**

Intraosseous (IO) access can be complicated by obesity. Successful placement of a 25 mm IO needle is unlikely when soft tissue depth exceeds 20 mm.

#### **OBJECTIVES:**

The authors examined the relationship between body mass index (BMI), the ability to palpate the tibial tuberosity (TT), and soft tissue depth at recommended IO insertion sites.

#### **METHODS:**

Obese emergency department patients were assessed for a palpable TT and received ultrasound measurement of the soft tissue depth at recommended IO insertion sites. Linear and logistic regression were used to determine cut-off BMI values predicting soft tissue depth >20 mm.

#### **RESULTS:**

Seventy-five patients were enrolled with a mean BMI of 47.2. The mean soft tissue depth at the proximal humerus, proximal tibial, and distal tibial were 29.6 [95% CI 27.5-31.7] mm, 11.0 [8.9-13.0] mm, and 10.7 [9.4-12.1] mm, respectively. In 5 patients without a palpable TT the soft tissue depth exceeded 20 mm at all three anatomic sites. A BMI  $\geq 43$  and BMI  $\geq 60$  predicted a soft tissue depth >20 mm at the proximal tibia and distal tibia, respectively, while no reliable BMI cut-off was identified at the proximal humerus.

#### **CONCLUSIONS:**

In obese adults with a palpable TT or BMI  $\leq 43$  a 25 mm IO needle is likely adequate at the proximal and distal tibial insertion sites. Empiric use of an extended 45 mm IO needle is advisable at the proximal humeral insertion site in obese patients.

## **Fulminant high altitude blindness.**

[Mashkovskiy E](#)<sup>1</sup>, [Szawarski P](#)<sup>2</sup>, [Ryzhkov P](#)<sup>3</sup>, [Goslar T](#)<sup>4</sup>, [Mrak I](#)<sup>5</sup>.

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### **Abstract**

Prolonged altitude exposure even with acclimatization continues to present a physiological challenge to all organ systems including the central nervous system. We describe a case of a 41-year-old Caucasian female climber who suffered severe visual loss that was due to possible optic nerve pathology occurring during a high altitude expedition in the Himalayas. This case is atypical of classic high altitude cerebral oedema and highlights yet another danger of prolonged sojourn at extreme altitudes.

## **Accidental hypothermia-an update : The content of this review is endorsed by the International Commission for Mountain Emergency Medicine (ICAR MEDCOM).**

[Paal P](#)<sup>1,2,3</sup>, [Gordon L](#)<sup>4,5</sup>, [Strapazzon G](#)<sup>6,7</sup>, [Brodmann Maeder M](#)<sup>6,7,8</sup>, [Putzer G](#)<sup>9</sup>, [Walpoth B](#)<sup>10</sup>, [Wanscher M](#)<sup>11</sup>, [Brown D](#)<sup>6,12</sup>, [Holzer M](#)<sup>13</sup>, [Broessner G](#)<sup>14</sup>, [Brugger H](#)<sup>9,7</sup>.

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### **Abstract**

#### **BACKGROUND:**

This paper provides an up-to-date review of the management and outcome of accidental hypothermia patients with and without cardiac arrest.

#### **METHODS:**

The authors reviewed the relevant literature in their specialist field. Summaries were merged, discussed and approved to produce this narrative review.

#### **RESULTS:**

The hospital use of minimally-invasive rewarming for non-arrested, otherwise healthy, patients with primary hypothermia and stable vital signs has the potential to substantially decrease morbidity and mortality for these patients. Extracorporeal life support (ECLS) has revolutionised the management of hypothermic cardiac arrest, with survival rates approaching 100 % in some cases. Hypothermic patients with risk factors for imminent cardiac arrest (temperature <28 °C, ventricular arrhythmia, systolic blood pressure <90 mmHg), and those who have already arrested, should be transferred directly to an ECLS-centre. Cardiac arrest patients should receive continuous cardiopulmonary resuscitation (CPR) during transfer. If prolonged transport is required or terrain is difficult, mechanical CPR can be helpful. Delayed or intermittent CPR may be appropriate in hypothermic arrest when continuous CPR is impossible. Modern post-resuscitation care should be implemented following hypothermic arrest. Structured protocols should be in place to optimise pre-hospital triage, transport and treatment as well as in-hospital management, including detailed criteria and protocols for the use of ECLS and post-resuscitation care.

### **CONCLUSIONS:**

Based on new evidence, additional clinical experience and clearer management guidelines and documentation, the treatment of accidental hypothermia has been refined. ECLS has substantially improved survival and is the treatment of choice in the patient with unstable circulation or cardiac arrest

## Is pain really undertreated? Challenges of addressing pain in trauma patients during prehospital transport and trauma resuscitation.

[Spilman SK](#)<sup>1</sup>, [Lechtenberg GT](#)<sup>2</sup>, [Hahn KD](#)<sup>3</sup>, [Fuchsen EA](#)<sup>4</sup>, [Olson SD](#)<sup>4</sup>, [Swegle JR](#)<sup>4</sup>, [Vaudt CC](#)<sup>5</sup>, [Sahr SM](#)<sup>4</sup>.

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### Abstract

#### BACKGROUND:

Prior research has documented the inadequacy of pain management for trauma patients in the emergency department (ED), with rates of pain assessment and opioid administration averaging about 50%. Such rates, however, may be misleading and do not adequately capture the complexity of pain management practices in a trauma population. The goal of the study was to determine if pain was undertreated at the study hospital or if patient acuity explained the timing and occurrence of pain treatment in the prehospital setting and the ED.

#### METHODS:

A retrospective study was performed at a Level 1 adult trauma centre in the Midwest. The trauma registry was used to identify patients who received a trauma activation during the study period (June-November 2012; N=313). Using the first set of patient vitals and ISS, patients were grouped into three categories: physiologically stable with low injury severity (n=132); physiologically stable with moderate to severe injury (n=122); and physiologically unstable with severe injury (n=56). Differences were assessed with Kruskal-Wallis and chi-square tests.

#### RESULTS:

Patients who were physiologically unstable were the least likely to receive a standardised pain assessment and the least likely to receive an opioid in the ED. Patients who were physiologically stable at entry to the ED but sustained a severe injury were the most likely to receive an opioid. Time to first pain assessment and time to first opioid did not differ by patient acuity.

#### CONCLUSIONS:

Results confirm that patient acuity greatly affects the ability to effectively and appropriately manage pain in the initial hours after injury. This study contributes to the literature by noting areas for improvement but also in explaining why delaying pain treatment may be appropriate in certain patient populations.

## Tranexamic Acid for Recurring Subdural Hematomas Following Surgical Evacuation: A Clinical Case Series.

[Stary JM](#)<sup>1</sup>, [Hutchins L](#)<sup>1</sup>, [Vega RA](#)<sup>1</sup>.

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### **Abstract**

**Background** Chronic subdural hematomas (SDHs) are commonly encountered in neurosurgery. Optimal management of SDHs remains a significant challenge. Current treatment options generally include supportive care or surgical intervention. A significant proportion of patients have surgery; however, the reoperation rate is considered high. There are also cases in which additional surgical procedures would carry significant morbidity, and as a result, there is a need for nonsurgical medical therapies. We describe the use of tranexamic acid (TXA) as a nonsurgical option for the treatment of recurrent SDHs following surgery. **Methods** Patients were identified as candidates for potential TXA therapy and followed prospectively. The decision to administer TXA was made on the basis of history, presentation, and prognosis after further surgical intervention. Data collected included patient imaging, treatment administered, and both radiologic and clinical outcomes. **Results** Three patients underwent surgical evacuation of a chronic SDH (two via burr hole washout and one via craniotomy). All patients had recurrence identified on subsequent imaging. Two patients had poorer predicted outcomes if additional surgical intervention was necessary, and one refused additional surgical intervention. TXA was administered, in the same dosing and scheduled course, to all patients. Complete resolution was observed on imaging, and in the case of the patient who was symptomatic, clinical improvement was also noted. **Conclusion** TXA may be considered for the treatment of recurrent SDHs following surgical evacuation in patients for whom additional surgery would add significant morbidity.



## Multiparametric Magnetic Resonance Investigation of Brain Adaptations to 6 Days at 4350 m.

[Verges S](#)<sup>1</sup>, [Rupp T](#)<sup>2</sup>, [Villien M](#)<sup>3</sup>, [Lamalle L](#)<sup>4</sup>, [Troprés I](#)<sup>4</sup>, [Poquet C](#)<sup>3</sup>, [Warnking JM](#)<sup>3</sup>, [Estève F](#)<sup>3</sup>, [Bouzat P](#)<sup>3</sup>, [Krainik A](#)<sup>3</sup>.

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### Abstract

#### OBJECTIVE:

Hypoxic exposure in healthy subjects can induce acute mountain sickness including headache, lethargy, cerebral dysfunction, and substantial cerebral structural alterations which, in worst case, can lead to potentially fatal high altitude cerebral edema. Within this context, the relationships between high altitude-induced cerebral edema, changes in cerebral perfusion, increased brain parenchyma volume, increased intracranial pressure, and symptoms remain unclear.

#### METHODS:

In 11 subjects before and after 6 days at 4350 m, we performed multiparametric magnetic resonance investigations including anatomical, apparent diffusion coefficient and arterial spin labeling sequences.

#### RESULTS:

After the altitude stay, while subjects were asymptomatic, white matter volume ( $+0.7 \pm 0.4\%$ ,  $p = 0.005$ ), diffusion ( $+1.7 \pm 1.4\%$ ,  $p = 0.002$ ), and cerebral blood flow ( $+28 \pm 38\%$ ;  $p = 0.036$ ) were significantly increased while cerebrospinal fluid volume was reduced ( $-1.4 \pm 1.1\%$ ,  $p = 0.009$ ). Optic nerve sheath diameter (used as an index of increased intracranial pressure) was unchanged from before ( $5.84 \pm 0.53$  mm) to after ( $5.92 \pm 0.60$  mm,  $p = 0.390$ ) altitude exposure. Correlations were observed between increases in white matter volume and diffusion ( $\rho = 0.81$ ,  $p = 0.016$ ) and between changes in CSF volume and changes in ONSD s ( $\rho = -0.92$ ,  $p = 0.006$ ) and symptoms during the altitude stay ( $\rho = -0.67$ ,  $p = 0.031$ ).

#### CONCLUSIONS:

These data demonstrate white matter alterations after several days at high altitude when subjects are asymptomatic that may represent the normal brain response to prolonged high altitude exposure.

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# Abstracts

[Scand J Trauma Resusc Emerg Med.](#) 2016 Oct 12;24(1):124.

## Unmanned aerial vehicles (drones) in out-of-hospital-cardiac-arrest.

[Claesson A](#)<sup>1</sup>, [Fredman D](#)<sup>2</sup>, [Svensson L](#)<sup>2</sup>, [Ringh M](#)<sup>2</sup>, [Hollenberg J](#)<sup>2</sup>, [Nordberg P](#)<sup>2</sup>, [Rosenqvist M](#)<sup>3</sup>, [Djarv T](#)<sup>2</sup>, [Österberg S](#)<sup>2</sup>, [Lennartsson J](#)<sup>4</sup>, [Ban Y](#)<sup>4</sup>.

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### Abstract

**BACKGROUND:** The use of an automated external defibrillator (AED) prior to EMS arrival can increase 30-day survival in out-of-hospital cardiac arrest (OHCA) significantly. Drones or unmanned aerial vehicles (UAV) can fly with high velocity and potentially transport devices such as AEDs to the site of OHCA. The aim of this explorative study was to investigate the feasibility of a drone system in decreasing response time and delivering an AED.

**METHODS:** Data of Global Positioning System (GPS) coordinates from historical OHCA in Stockholm County was used in a model using a Geographic Information System (GIS) to find suitable placements and visualize response times for the use of an AED equipped drone. Two different geographical models, urban and rural, were calculated using a multi-criteria evaluation (MCE) model. Test-flights with an AED were performed on these locations in rural areas.

**RESULTS:** In total, based on 3,165 retrospective OHCA in Stockholm County between 2006-2013, twenty locations were identified for the potential placement of a drone. In a GIS-simulated model of urban OHCA, the drone arrived before EMS in 32 % of cases, and the mean amount of time saved was 1.5 min. In rural OHCA the drone arrived before EMS in 93 % of cases with a mean amount of time saved of 19 min. In these rural locations during (n = 13) test flights, latch-release of the AED from low altitude (3-4 m) or landing the drone on flat ground were the safest ways to deliver an AED to the bystander and were superior to parachute release.

**DISCUSSION:** The difference in response time for EMS between urban and rural areas is substantial, as is the possible amount of time saved using this UAV-system. However, yet another technical device needs to fit into the chain of survival. We know nothing of how productive or even counterproductive this system might be in clinical reality.

### CONCLUSIONS:

To use drones in rural areas to deliver an AED in OHCA may be safe and feasible. Suitable placement of drone systems can be designed by using GIS models. The use of an AED equipped drone may have the potential to reduce time to defibrillation in OHCA.

## **SIMEDIS: a Discrete-Event Simulation Model for Testing Responses to Mass Casualty Incidents.**

[Debacker M](#)<sup>1</sup>, [Van Utterbeeck F](#)<sup>2</sup>, [Ullrich C](#)<sup>2</sup>, [Dhondt E](#)<sup>3</sup>, [Hubloue I](#)<sup>4</sup>.

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### **Abstract**

It is recognized that the study of the disaster medical response (DMR) is a relatively new field. To date, there is no evidence-based literature that clearly defines the best medical response principles, concepts, structures and processes in a disaster setting. Much of what is known about the DMR results from descriptive studies and expert opinion. No experimental studies regarding the effects of DMR interventions on the health outcomes of disaster survivors have been carried out. Traditional analytic methods cannot fully capture the flow of disaster victims through a complex disaster medical response system (DMRS). Computer modelling and simulation enable to study and test operational assumptions in a virtual but controlled experimental environment. The SIMEDIS (Simulation for the assessment and optimization of medical disaster management) simulation model consists of 3 interacting components: the victim creation model, the victim monitoring model where the health state of each victim is monitored and adapted to the evolving clinical conditions of the victims, and the medical response model, where the victims interact with the environment and the resources at the disposal of the healthcare responders. Since the main aim of the DMR is to minimize as much as possible the mortality and morbidity of the survivors, we designed a victim-centred model in which the casualties pass through the different components and processes of a DMRS. The specificity of the SIMEDIS simulation model is the fact that the victim entities evolve in parallel through both the victim monitoring model and the medical response model. The interaction between both models is ensured through a time or medical intervention trigger. At each service point, a triage is performed together with a decision on the disposition of the victims regarding treatment and/or evacuation based on a priority code assigned to the victim and on the availability of resources at the service point. The aim of the case study is to implement the SIMEDIS model to the DMRS of an international airport and to test the medical response plan to an airplane crash simulation at the airport. In order to identify good response options, the model then was used to study the effect of a number of interventional factors on the performance of the DMRS. Our study reflects the potential of SIMEDIS to model complex systems, to test different aspects of DMR, and to be used as a tool in experimental research that might make a substantial contribution to provide the evidence base for the effectiveness and efficiency of disaster medical management.

## Reporting Helicopter Emergency Medical Services in Major Incidents: A Delphi Study.

[Fattah S](#)<sup>1</sup>, [Johnsen AS](#)<sup>2</sup>, [Sollid SJ](#)<sup>3</sup>, [Wisborg T](#)<sup>4</sup>, [Rehn M](#)<sup>5</sup>; [HEMS Major Incident Reporting Collaborators](#), [Sóti Á](#)<sup>6</sup>, [Truhlář A](#)<sup>7</sup>, [Krüger AJ](#)<sup>8</sup>, [Gunnarsson B](#)<sup>9</sup>, [Gryth D](#)<sup>10</sup>, [Ohlén D](#)<sup>11</sup>, [Fevang E](#)<sup>9</sup>, [Sunde GA](#)<sup>12</sup>, [Breitenmoser I](#)<sup>13</sup>, [Kurola J](#)<sup>14</sup>, [Nurmi J](#)<sup>15</sup>, [Fredriksen K](#)<sup>16</sup>, [Rognås L](#)<sup>17</sup>, [Temesvari P](#)<sup>6</sup>, [Mikkelsen S](#)<sup>18</sup>, [Magnusson V](#)<sup>19</sup>, [Voelckel W](#)<sup>20</sup>.

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## **Abstract**

### **OBJECTIVE:**

Research on helicopter emergency medical services (HEMS) in major incidents is predominately based on case descriptions reported in a heterogeneous fashion. Uniform data reported with a consensus-based template could facilitate the collection, analysis, and exchange of experiences. This type of database presently exists for major incident reporting at [www.majorincidentreporting.net](http://www.majorincidentreporting.net). This study aimed to develop a HEMS-specific major incident template.

### **METHODS:**

This Delphi study included 17 prehospital critical care physicians with current or previous HEMS experience. All participants interacted through e-mail. We asked these experts to define data variables and rank which were most important to report during an immediate prehospital medical response to a major incident. Five rounds were conducted.

### **RESULTS:**

In the first round, the experts suggested 98 variables. After 5 rounds, 21 variables were determined by consensus. These variables were formatted in a template with 4 main categories: HEMS background information, the major incident characteristics relevant to HEMS, the HEMS response to the major incident, and the key lessons learned.

### **CONCLUSION:**

Based on opinions from European experts, we established a consensus-based template for reporting on HEMS responses to major incidents. This template will facilitate uniformity in the collection, analysis, and exchange of experience.

[J Spec Oper Med](#). Summer 2016;16(2):111-4.

## **Searching for Sustainability: How Niger's CASEVAC Success Is Leading the African Continent and Educating the GHE/IHS Community.**

[Flatau P.](#)

### **Abstract**

Against all odds and despite significant challenges and scarce resources, Niger's Armed Forces (FAN) continues to lead a successful casualty evacuation (CASEVAC) program. This program and the Special Operations Command Africa (SOCAFR) model that influenced it has become a template for the Global Health Engagement (GHE)/International Health Specialist (IHS) community. This article provides a summary of the overall CASEVAC mission, outlines the final phase sustainable execution of this program, and provides the reader with critical lessons learned for best practice GHE approaches



## **Tactical Study of Care Originating in the Prehospital Environment (Tacscope): Acute Traumatic Coagulopathy on the Contemporary Battlefield.**

[Gerhardt RT](#)<sup>1</sup>, [Glassberg E](#), [Holcomb JB](#), [Mabry RL](#), [Schreiber MB](#), [Spinella PC](#).

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### **Abstract**

#### **BACKGROUND:**

Uncontrolled major hemorrhage and delayed evacuation remain substantial contributors to potentially survivable combat death, along with mission, environment, terrain, logistics, and hostile action. Life-saving interventions and the onset of acute traumatic coagulopathy (ATC) may also contribute.

#### **OBJECTIVE:**

Analyze US casualty records from the DoD Trauma Registry, using International Normalized Ratio (INR) of 1.5 for onset of ATC.

#### **METHODS:**

Retrospective cohort study from September 2007 to June 2011, inclusive. Independent variable was INR. Primary dependent variables were transfusion volume, massive transfusion (MT) defined as >10 units RBC/fresh whole blood in first 24h, and 30-day survival. We used T test and chi-square analysis. Our IRB reviewed and exempted this study.

#### **RESULTS:**

In total, 8,913 cases were available. Fifty one percent had complete data with INR. Of excluded cases, 98.9% survived, average injury severity scales (ISS) was 7 (IQR 1-8), and less than 1% received MT. Among included cases, 98.5% survived, average ISS was 10 (IQR 2-14), average INR was 1.16 (CI95 1.14-1.17), and 2.7% received MT. There were 383 cases with ATC (8.4%). After stratification, we found that ATC cases were more likely to die (odds ratio (OR) 28, CI 16-48), receive MT (OR 9.6, CI 6.4-14.4), and were acidotic (pH 7.27 (7.24-7.31) vs. 7.38 (7.38-7.39)). Other significant differences included Injury Severity Score, Revised Trauma Score, blast mechanism, and penetrating injury.

#### **CONCLUSION:**

ATC is substantially associated with greater injury severity, MT, and mortality. Prehospital identification of MT casualties may expedite triage and evacuation, and enable remote damage control resuscitation to delay ATC onset and improve outcomes.

## Reduced Mortality by Physician-Staffed HEMS Dispatch for Adult Blunt Trauma Patients in Korea.

[Jung K<sup>1</sup>](#), [Huh Y<sup>2</sup>](#), [Lee JC<sup>2</sup>](#), [Kim Y<sup>2</sup>](#), [Moon J<sup>2</sup>](#), [Youn SH<sup>2</sup>](#), [Kim J<sup>3</sup>](#), [Kim TY<sup>3</sup>](#), [Kim J<sup>3</sup>](#), [Kim H<sup>3</sup>](#).

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### **Abstract**

The aim of this study was to investigate the efficiency of domestic physician-staffed helicopter emergency medical service (HEMS) for the transport of patients with severe trauma to a hospital. The study included patients with blunt trauma who were transported to our hospital by physician-staffed HEMS (Group P; n = 100) or nonphysician-staffed HEMS (Group NP; n = 80). Basic patient characteristics, transport time, treatment procedures, and medical treatment outcomes assessed using the Trauma and Injury Severity Score (TRISS) were compared between groups. We also assessed patients who were transported to the hospital within 3 h of injury in Groups P (Group P3; n = 50) and NP (Group NP3; n = 74). The severity of injury was higher, transport time was longer, and time from hospital arrival to operation room transfer was shorter for Group P than for Group NP ( $P < 0.001$ ). Although Group P patients exhibited better medical treatment outcomes compared with Group NP, the difference was not statistically significant ( $P = 0.134$  vs.  $0.730$ ). However, the difference in outcomes was statistically significant between Groups P3 and NP3 ( $P = 0.035$  vs.  $0.546$ ). Under the current domestic trauma patient transport system in South Korea, physician-staffed HEMS are expected to increase the survival of patients with severe trauma. In particular, better treatment outcomes are expected if dedicated trauma resuscitation teams actively intervene in the medical treatment process from the transport stage and if patients are transported to a hospital to receive definitive care within 3 hours of injury.

## Factors associated with the difficulty in hospital acceptance at the scene by emergency medical service personnel: a population-based study in Osaka City, Japan.

[Katayama Y](#)<sup>1</sup>, [Kitamura T](#)<sup>2</sup>, [Kiyohara K](#)<sup>3</sup>, [Iwami T](#)<sup>4</sup>, [Kawamura T](#)<sup>4</sup>, [Hayashida S](#)<sup>5</sup>, [Yoshiya K](#)<sup>1</sup>, [Ogura H](#)<sup>1</sup>, [Shimazu T](#)<sup>1</sup>.

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### Abstract

**OBJECTIVES:** To investigate the association between the difficulty in hospital acceptance at the scene by emergency medical service (EMS) personnel and prehospital demographic factors and reasons for EMS calls.

**DESIGN:** A retrospective, observational study.

**SETTING:** Osaka City, Japan.

**PARTICIPANTS:** A total of 100 649 patients transported to medical institutions by EMS from January 2013 to December 2013.

**PRIMARY OUTCOME MEASUREMENTS:** The definition of difficulty in hospital acceptance at the scene was EMS personnel making  $\geq 5$  phone calls to medical institutions until a decision to transport was determined. Multivariable analysis was used to assess the relationship between difficulty in hospital acceptance and prehospital factors and reasons for EMS calls.

**RESULTS:** Multivariable analysis showed the elderly, foreigners, loss of consciousness, holiday/weekend, and night-time to be positively associated with difficulty in hospital acceptance at the scene. As reasons for EMS calls, gas poisoning (adjusted OR 3.281, 95% CI 1.201 to 8.965), trauma by assault (adjusted OR 2.662, 95% CI 2.390 to 2.966), self-induced drug abuse/gas poisoning (adjusted OR 4.527, 95% CI 3.921 to 5.228) and self-induced trauma (adjusted OR 1.708, 95% CI 1.369 to 2.130) were positively associated with the difficulty in hospital acceptance at the scene.

### CONCLUSIONS:

Ambulance records in Osaka City showed that certain prehospital factors such as night-time were positively associated with difficulty in hospital acceptance at the scene, and reasons for EMS calls, such as self-induced drug abuse/gas poisoning, were also positive predictors for difficulty in hospital acceptance at the scene.

## Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review.

[Kelly C](#)<sup>1,2</sup>, [Hulme C](#)<sup>1</sup>, [Farragher T](#)<sup>1</sup>, [Clarke G](#)<sup>3</sup>.

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### Abstract

#### OBJECTIVES:

To investigate whether there is an association between differences in travel time/travel distance to healthcare services and patients' health outcomes and assimilate the methodologies used to measure this.

#### DESIGN:

Systematic Review. We searched MEDLINE, Embase, Web of Science, Transport database, HMIC and EBM Reviews for studies up to 7 September 2016. Studies were excluded that included children (including maternity), emergency medical travel or countries classed as being in the global south.

#### SETTINGS:

A wide range of settings within primary and secondary care (these were not restricted in the search).

#### RESULTS:

108 studies met the inclusion criteria. The results were mixed. 77% of the included studies identified evidence of a distance decay association, whereby patients living further away from healthcare facilities they needed to attend had worse health outcomes (eg, survival rates, length of stay in hospital and non-attendance at follow-up) than those who lived closer. 6 of the studies identified the reverse (a distance bias effect) whereby patients living at a greater distance had better health outcomes. The remaining 19 studies found no relationship. There was a large variation in the data available to the studies on the patients' geographical locations and the healthcare facilities attended, and the methods used to calculate travel times and distances were not consistent across studies.

#### CONCLUSIONS:

The review observed that a relationship between travelling further and having worse health outcomes cannot be ruled out and should be considered within the healthcare services location debate.

## **A markov decision process model for the optimal dispatch of military medical evacuation assets.**

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### **Abstract**

We develop a Markov decision process (MDP) model to examine aerial military medical evacuation (MEDEVAC) dispatch policies in a combat environment. The problem of deciding which aeromedical asset to dispatch to each service request is complicated by the threat conditions at the service locations and the priority class of each casualty event. We assume requests for MEDEVAC support arrive sequentially, with the location and the priority of each casualty known upon initiation of the request. The United States military uses a 9-line MEDEVAC request system to classify casualties as being one of three priority levels: urgent, priority, and routine. Multiple casualties can be present at a single casualty event, with the highest priority casualty determining the priority level for the casualty event. Moreover, an armed escort may be required depending on the threat level indicated by the 9-line MEDEVAC request. The proposed MDP model indicates how to optimally dispatch MEDEVAC helicopters to casualty events in order to maximize steady-state system utility. The utility gained from servicing a specific request depends on the number of casualties, the priority class for each of the casualties, and the locations of both the servicing ambulatory helicopter and casualty event. Instances of the dispatching problem are solved using a relative value iteration dynamic programming algorithm. Computational examples are used to investigate optimal dispatch policies under different threat situations and armed escort delays; the examples are based on combat scenarios in which United States Army MEDEVAC units support ground operations in Afghanistan.

## The pre-hospital administration of tranexamic acid to patients with multiple injuries and its effects on rotational thrombelastometry: a prospective observational study in pre-hospital emergency medicine.

[Kunze-Szikszay N](#)<sup>1</sup>, [Krack LA](#)<sup>2</sup>, [Wildenauer P](#)<sup>2</sup>, [Wand S](#)<sup>2</sup>, [Heyne T](#)<sup>2</sup>, [Walliser K](#)<sup>2</sup>, [Spering C](#)<sup>3</sup>, [Bauer M](#)<sup>2</sup>, [Quintel M](#)<sup>2</sup>, [Roessler M](#)<sup>2</sup>.

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### Abstract

#### BACKGROUND:

Hyperfibrinolysis (HF) is a major contributor to coagulopathy and mortality in trauma patients. This study investigated (i) the rate of HF during the pre-hospital management of patients with multiple injuries and (ii) the effects of pre-hospital tranexamic acid (TxA) administration on the coagulation system.

#### METHODS:

From 27 trauma patients with pre-hospital an estimated injury severity score (ISS)  $\geq 16$  points blood was obtained at the scene and on admission to the emergency department (ED). All patients received 1 g of TxA after the first blood sample was taken. Rotational thrombelastometry (ROTEM) was performed for both blood samples, and the results were compared. HF was defined as a maximum lysis (ML)  $>15\%$  in EXTEM.

**RESULTS:** The median (min-max) ISS was 17 points (4-50 points). Four patients (15 %) had HF diagnosed via ROTEM at the scene, and 2 patients (7.5 %) had HF diagnosed via ROTEM on admission to the ED. The median ML before TxA administration was 11 % (3-99 %) vs. 10 % after TxA administration (4-18 %;  $p > 0.05$ ). TxA was administered 37 min (10-85 min) before ED arrival. The ROTEM results before and after TxA administration did not significantly differ. No adverse drug reactions were observed after TxA administration.

**DISCUSSION:** HF can be present in severely injured patients during pre-hospital care. Antifibrinolytic therapy administered at the scene is a significant time saver. Even in milder trauma fibrinogen can be decreased to critically low levels. Early administration of TxA cannot reverse or entirely stop this decrease.

#### CONCLUSIONS:

The pre-hospital use of TxA should be considered for severely injured patients to prevent the worsening of trauma-induced coagulopathy and unnecessarily high fibrinogen consumption.

## Telehealth-Enabled Emergency Medical Services Program Reduces Ambulance Transport to Urban Emergency Departments.

[Langabeer JR 2nd](#)<sup>1</sup>, [Gonzalez M](#)<sup>2</sup>, [Alqusairi D](#)<sup>3</sup>, [Champagne-Langabeer T](#)<sup>4</sup>, [Jackson A](#)<sup>5</sup>, [Mikhail J](#)<sup>6</sup>, [Persse D](#)<sup>3</sup>.

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### Abstract

#### INTRODUCTION:

Emergency medical services (EMS) agencies transport a significant majority of patients with low acuity and non-emergent conditions to local emergency departments (ED), affecting the entire emergency care system's capacity and performance. Opportunities exist for alternative models that integrate technology, telehealth, and more appropriately aligned patient navigation. While a limited number of programs have evolved recently, no empirical evidence exists for their efficacy. This research describes the development and comparative effectiveness of one large urban program.

**METHODS:** The Houston Fire Department initiated the Emergency Telehealth and Navigation (ETHAN) program in 2014. ETHAN combines telehealth, social services, and alternative transportation to navigate primary care-related patients away from the ED where possible. Using a case-control study design, we describe the program and compare differences in effectiveness measures relative to the control group.

#### RESULTS:

During the first 12 months, 5,570 patients participated in the telehealth-enabled program, which were compared against the same size control group. We found a 56% absolute reduction in ambulance transports to the ED with the intervention compared to the control group (18% vs. 74%,  $P < .001$ ). EMS productivity (median time from EMS notification to unit back in service) was 44 minutes faster for the ETHAN group (39 vs. 83 minutes, median). There were no statistically significant differences in mortality or patient satisfaction.

#### CONCLUSION:

We found that mobile technology-driven delivery models are effective at reducing unnecessary ED ambulance transports and increasing EMS unit productivity. This provides support for broader EMS mobile integrated health programs in other regions.

## Combat MEDEVAC: A comparison of care by provider type for en route trauma care in theater and 30-day patient outcomes.

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### Abstract

**BACKGROUND:** Medical evacuation (MEDEVAC) is the movement and en route care of injured and medically compromised patients by medical care providers via helicopter. Military MEDEVAC platforms provide lifesaving interventions that improve survival in combat. There is limited evidence to support decision making related to en route care and allocation of resources. The association between provider type and en route care is not well understood. Our objective was to describe MEDEVAC providers and identify associations between provider type, procedures performed, and outcomes.

**METHODS:** We conducted an institutional review board-approved, retrospective record review of patients traumatically injured in combat, evacuated by MEDEVAC from the point of injury, between 2011 and 2014. Data abstracted included injury description, provider type, procedures performed, medications administered, survival, and 30-day outcomes. Subjects were grouped according to provider type: medics, paramedics, and ADVs (advanced-level providers to include nurses, physician assistants, and physicians). Groups were compared. Analyses were performed using  $\chi$  tests for categorical variables and analysis of variance tests (Kruskal-Wallis tests) for continuous variables;  $p < 0.05$  was considered significant.

**RESULTS:** The MEDEVAC records were reviewed, and data were abstracted from 1,237 subjects. The providers were composed of medics, 76%; paramedics, 21%; and ADVs, 4%. Patient and injury demographics were similar among groups. The ADVs were most likely to perform intubation, chest needle decompressions ( $p < 0.0001$ ), and hypothermia prevention ( $p = 0.01$ ). Paramedics were most likely to administer blood en route ( $p < 0.0001$ ). All other procedures were similar between groups. Paramedics were most likely to administer ketamine ( $p < 0.0001$ ), any analgesic ( $p < 0.0001$ ), or any medication en route ( $p < 0.0001$ ). Incidence rates of en route events (pain, hypoxia, abnormal hemodynamics, vital signs) were similar between provider types. In-theater and 30-day survival rates were similar between provider types.

### CONCLUSION:

Providers with higher-level training were more likely to perform more advanced procedures during en route care. Our study found no significant association between provider type and in-theater or 30-day mortality rates. Upon subgroup analysis, no difference was found in patients with an injury severity score greater than 16. More evidence is needed to determine the appropriate level of MEDEVAC personnel training and skill maintenance necessary to minimize combat mortality.



## Development and validation of a prehospital prediction model for acute traumatic coagulopathy.

[Peltan ID](#)<sup>1,2,3</sup>, [Rowhani-Rahbar A](#)<sup>4</sup>, [Vande Vusse LK](#)<sup>5</sup>, [Caldwell E](#)<sup>5</sup>, [Rea TD](#)<sup>6</sup>, [Maier RV](#)<sup>7</sup>, [Watkins TR](#)<sup>5</sup>.

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### Abstract

**BACKGROUND:** Acute traumatic coagulopathy (ATC) is a syndrome of early, endogenous clotting dysfunction that afflicts up to 30% of severely injured patients, signaling an increased likelihood of all-cause and hemorrhage-associated mortality. To aid identification of patients within the likely therapeutic window for ATC and facilitate study of its mechanisms and targeted treatment, we developed and validated a prehospital ATC prediction model.

**METHODS:** Construction of a parsimonious multivariable logistic regression model predicting ATC - defined as an admission international normalized ratio >1.5 - employed data from 1963 severely injured patients admitted to an Oregon trauma system hospital between 2008 and 2012 who received prehospital care but did not have isolated head injury. The prediction model was validated using data from 285 severely injured patients admitted to a level 1 trauma center in Seattle, WA, USA between 2009 and 2013.

**RESULTS:** The final Prediction of Acute Coagulopathy of Trauma (PACT) score incorporated age, injury mechanism, prehospital shock index and Glasgow Coma Score values, and prehospital cardiopulmonary resuscitation and endotracheal intubation. In the validation cohort, the PACT score demonstrated better discrimination (area under the receiver operating characteristic curve 0.80 vs. 0.70,  $p = 0.032$ ) and likely improved calibration compared to a previously published prehospital ATC prediction score. Designating PACT scores  $\geq 196$  as positive resulted in sensitivity and specificity for ATC of 73% and 74%, respectively.

### CONCLUSIONS:

Our prediction model uses routinely available and objective prehospital data to identify patients at increased risk of ATC. The PACT score could facilitate subject selection for studies of targeted treatment of ATC.

[N Engl J Med](#). 2016 Oct 27;375(17):1612-1615. Epub 2016 Oct 19.

## Wartime Lessons - Shaping a National Trauma Action Plan.

[Rasmussen TE](#)<sup>1</sup>, [Kellermann AL](#)<sup>1</sup>.

[Crit Care](#). 2016 Nov 8;20(1):362.

## Pre-hospital management of mass casualty civilian shootings: a systematic literature review.

[Turner CD](#)<sup>1</sup>, [Lockey DJ](#)<sup>2,3,4</sup>, [Rehn M](#)<sup>3,4,5</sup>.

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### Abstract

**BACKGROUND:** Mass casualty civilian shootings present an uncommon but recurring challenge to emergency services around the world and produce unique management demands. On the background of a rising threat of transnational terrorism worldwide, emergency response strategies are of critical importance. This study aims to systematically identify, describe and appraise the quality of indexed and non-indexed literature on the pre-hospital management of modern civilian mass shootings to guide future practice.

**METHODS:** Systematic literature searches of PubMed, Cochrane Database of Systematic Reviews and Scopus were conducted in conjunction with simple searches of non-indexed databases; Web of Science, OpenDOAR and Evidence Search. The searches were last carried out on 20 April 2016 and only identified those papers published after the 1 January 1980. Included documents had to contain descriptions, discussions or experiences of the pre-hospital management of civilian mass shootings.

**RESULTS:** From the 494 identified manuscripts, 73 were selected on abstract and title and after full text reading 47 were selected for inclusion in analysis. The search yielded reports of 17 mass shooting events, the majority from the USA with additions from France, Norway, the UK and Kenya. Between 1994 and 2015 the shooting of 1649 people with 578 deaths at 17 separate events are described. Quality appraisal demonstrated considerable heterogeneity in reporting and revealed limited data on mass shootings globally.

### CONCLUSION:

Key themes were identified to improve future practice: tactical emergency medical support may harmonise inner cordon interventions, a need for inter-service education on effective haemorrhage control, the value of senior triage operators and the need for regular mass casualty incident simulation.

## Alternative Destination Transport? The Role of Paramedics in Optimal Use of the Emergency Department.

[Neeki MM](#)<sup>1</sup>, [Dong F](#)<sup>2</sup>, [Avera L](#)<sup>1</sup>, [Than T](#)<sup>1</sup>, [Borger R](#)<sup>1</sup>, [Powell J](#)<sup>3</sup>, [Vaezazizi R](#)<sup>1</sup>, [Pitts R](#)<sup>1</sup>.

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### Abstract

#### INTRODUCTION:

Alternative destination transportation by emergency medical services (EMS) is a subject of hot debate between those favoring all patients being evaluated by an emergency physician (EP) and those recognizing the need to reduce emergency department (ED) crowding. This study aimed to determine whether paramedics could accurately assess a patient's acuity level to determine the need to transport to an ED.

#### METHODS:

We performed a prospective double-blinded analysis of responses recorded by paramedics and EPs of arriving patients' acuity level in a large Level II trauma center between April 2015 and November 2015. Under-triage was defined as lower acuity assessed by paramedics but higher acuity by EPs. Over-triage was defined as higher acuity assessed by paramedics but lower acuity by EPs. The degree of agreement between the paramedics and EPs' evaluations of patient's acuity level was compared using Chi-square test.

#### RESULTS:

We included a total of 503 patients in the final analysis. For paramedics, 251 (49.9%) patients were assessed to be emergent, 178 (35.4%) assessed as urgent, and 74 (14.7%) assessed as non-emergent/non-urgent. In comparison, the EPs assessed 296 (58.9%) patients as emergent, 148 (29.4%) assessed as urgent, and 59 (11.7%) assessed as non-emergent/non-urgent. Paramedics agreed with EPs regarding the acuity level assessment on 71.8% of the cases. The overall under- and over-triage were 19.3% and 8.9%, respectively. A moderate Kappa=0.5174 indicated moderate inter-rater agreement between paramedics' and EPs' assessment on the same cohort of patients.

#### CONCLUSION:

There is a significant difference in paramedic and physician assessment of patients into emergent, urgent, or non-emergent/non-urgent categories. The field triage of a patient to an alternative destination by paramedics under their current scope of practice and training cannot be supported.

## Endotracheal Tube Cuff Pressures in Patients Intubated Prior to Helicopter EMS Transport.

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### Abstract

#### INTRODUCTION:

Endotracheal intubation is a common intervention in critical care patients undergoing helicopter emergency medical services (HEMS) transportation. Measurement of endotracheal tube (ETT) cuff pressures is not common practice in patients referred to our service. Animal studies have demonstrated an association between the pressure of the ETT cuff on the tracheal mucosa and decreased blood flow leading to mucosal ischemia and scarring. Cuff pressures greater than 30 cmH<sub>2</sub>O impede mucosal capillary blood flow. Multiple prior studies have recommended 30 cmH<sub>2</sub>O as the maximum safe cuff inflation pressure. This study sought to evaluate the inflation pressures in ETT cuffs of patients presenting to HEMS.

#### METHODS:

We enrolled a convenience sample of patients presenting to UMass Memorial LifeFlight who were intubated by the sending facility or emergency medical services (EMS) agency. Flight crews measured the ETT cuff pressures using a commercially available device. Those patients intubated by the flight crew were excluded from this analysis as the cuff was inflated with the manometer to a standardized pressure. Crews logged the results on a research form, and we analyzed the data using Microsoft Excel and an online statistical analysis tool.

#### RESULTS:

We analyzed data for 55 patients. There was a mean age of 57 years (range 18-90). The mean ETT cuff pressure was 70 (95% CI= [61-80]) cmH<sub>2</sub>O. The mean lies 40 cmH<sub>2</sub>O above the maximum accepted value of 30 cmH<sub>2</sub>O (p<0.0001). Eighty-four percent (84%) of patients encountered had pressures above the recommended maximum. The most frequently recorded pressure was >120 cmH<sub>2</sub>O, the maximum pressure on the analog gauge.

#### CONCLUSION:

Patients presenting to HEMS after intubation by the referral agency (EMS or hospital) have ETT cuffs inflated to pressures that are, on average, more than double the recommended maximum. These patients are at risk for tracheal mucosal injury and scarring from decreased mucosal capillary blood flow. Hospital and EMS providers should use ETT cuff manometry to ensure that they inflate ETT cuffs to safe pressures.