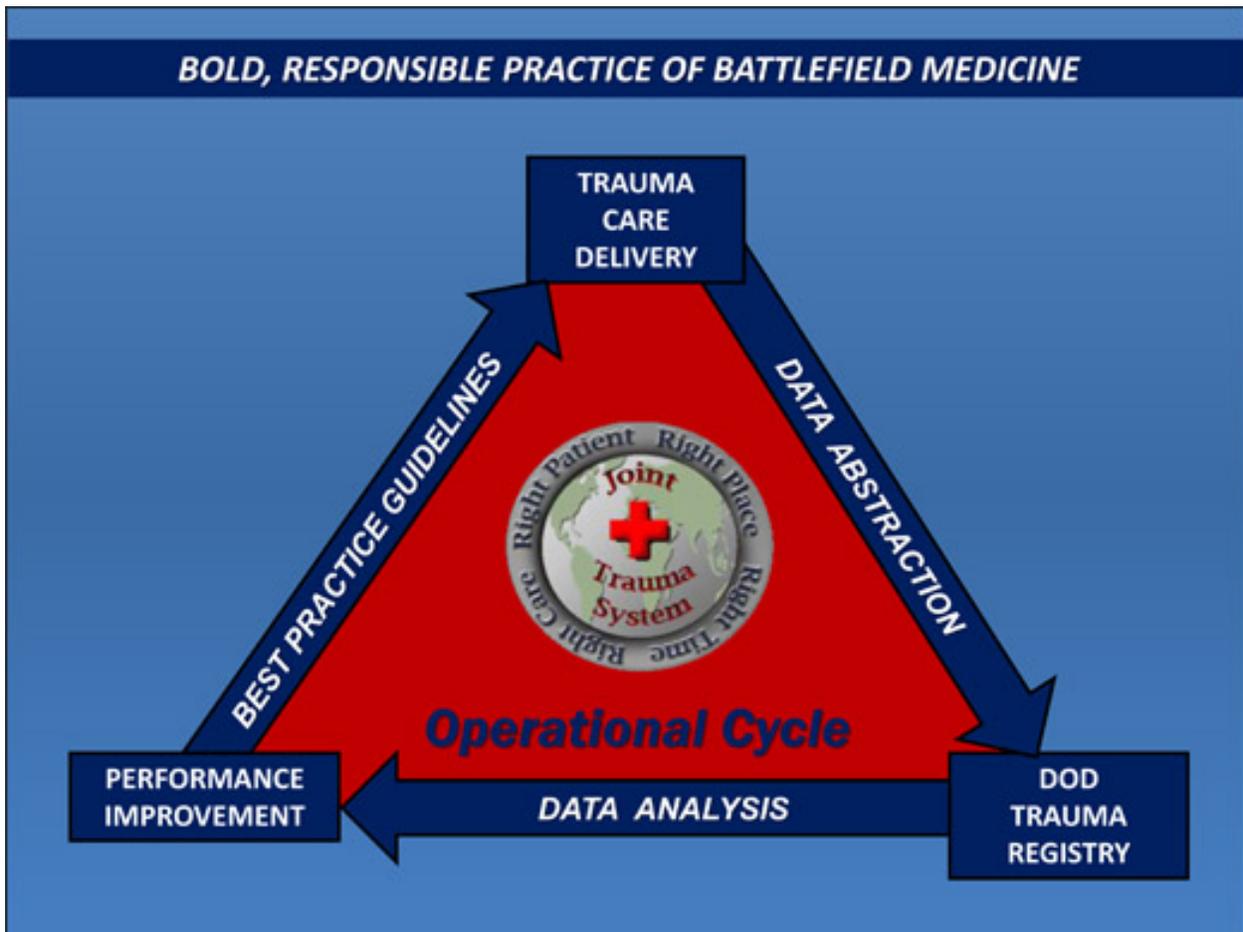


Committee on En Route Combat Casualty Care  
(CoERCCC)



Journal Watch

1st Quarter

2019

## Journal Watch Key Terminology Searched:

Emergency medical services  
Acute coronary syndrome  
Emergency care  
Aeromedical evacuation  
Traumatic brain injury  
Substances for disinfection  
Standardized operating procedures  
Forward MEDEVAC  
Trauma  
Helicopter  
Transportation Vibration  
Spinal cord injury  
Physically demanding occupation  
CASEVAC  
Tactical evacuation  
Drone transportation

Resuscitation  
Myocardial infarction  
Telemedicine  
Inflammation  
Air traffic  
Highly infectious diseases  
Combat  
Joint trauma system  
MRAP  
Porcine model  
Airway management  
ST-segment elevation  
Task analysis  
Ground Evacuation  
Inter-facility Transport

Treatment efficacy  
Pre-hospital  
Hypobaria  
Neuronal cell death  
Disinfection of aircraft  
Stabilization  
FLYP  
PECC  
SCI  
Shock  
Guideline  
Employment standards  
Vibration  
Battlefield Evacuation  
Drones

## **En Route Resuscitation - Utilization of CCATT to Transport and Stabilize Critically Injured and Unstable Casualties.**

[Maddy JK](#)<sup>1</sup>, [Ball EM](#)<sup>2</sup>, [Cox DB](#)<sup>3</sup>, [Flarity KM](#)<sup>4,5</sup>, [Bebarta VS](#)<sup>6</sup>.

### **Abstract**

**Introduction:** The U.S. Air Force utilizes specialized Critical Care Air Transport Teams (CCATT) for transporting "stabilized" patients. Given the drawdown of military forces from various areas of operation, recent CCATT operations have increasingly involved the evacuation of unstable and incompletely resuscitated patients from far forward, austere locations. This brief report describes unique cases representative of the evolving CCATT mission and provides future direction for changes in doctrine and educational requirements in preparation for en route combat casualty care.

**Methods and Materials:** This case series describes three patients who required significant resuscitation during CCATT transport from austere locations between April and November 2017. Approval for this project was received from the US Air Force 59th Medical Wing Institutional Review Board as non-research.

**Results:** Case 1: CCATT was dispatched to transport patient 1 who was reported to have a head injury after a fall. Upon evaluation of the patient onboard the aircraft, it was discovered that the patient was in cardiac arrest. Cardiopulmonary resuscitation was performed during tactical takeoff with frequent combat maneuvers. The patient developed a palpable pulse after three rounds of CPR, three doses of epinephrine, and one unit of packed red blood cells. Point of care laboratory analysis demonstrated a profoundly elevated lactate level. Cyanide poisoning was a concern but there was no antidote available in the available equipment set. After delivery to a medical facility, blood samples were positive for cyanide. Over the next 2 weeks, the patient improved and was discharged home, neurologically intact. Case 2: Patient 2 sustained complex blast injuries and bilateral lower extremity amputations. He required early transport for continuous renal replacement therapy (CRRT). The patient received 200 units of blood products in the 24 hours prior to transport and developed renal failure, pulmonary edema, and elevated ICP. During the 7 hour flight, Patient 2 received frequent adjustments of vasopressor medications, multiple Dakins solution soaks and flushes, and 1 unit of fresh frozen plasma. He remained alive 2 months later. Case 3: The team was notified to collect an urgent patient with a blast lung injury and bilateral lower extremity amputations. The ground team encountered difficulty ventilating the patient. Patient 3 arrived in the back of a pickup truck accompanied by medics and being bag valve mask ventilated with a pulse oximetry reading of 65%. He was secured to the floor of the aircraft which departed within 5 minutes of arrival. An ultrasound of the lungs showed no pneumothorax. By the end of the flight, the patient's oxygen saturation had risen to 95% and he was delivered to the emergency department in stable condition. He later passed away in the operating room due to severe blast lung and cardiac contusion.

**Conclusion:** This brief report demonstrates the need of CCATT in the transport of unstable patients from forward deployed locations. The Air Force has adapted and is continuing to adapt CCATT training, equipment, onboard diagnostics and therapies, and team members' clinical skills to meet en route care combat casualty needs.

[Mil Med.](#) 2018 Nov 1;183(11-12):e649-e658. doi: 10.1093/milmed/usy188.

## **Psychiatric Aeromedical Evacuations of Deployed Active Duty U.S. Military Personnel During Operations Enduring Freedom, Iraqi Freedom, and New Dawn.**

[Peterson AL](#)<sup>1,2,3</sup>, [Hale WJ](#)<sup>1,3</sup>, [Baker MT](#)<sup>4</sup>, [Cigrang JA](#)<sup>5</sup>, [Moore BA](#)<sup>1,3</sup>, [Straud CL](#)<sup>1</sup>, [Dukes SF](#)<sup>6</sup>, [Young-McCaughan S](#)<sup>1</sup>, [Gardner CL](#)<sup>4</sup>, [Arant-Daigle D](#)<sup>4</sup>, [Pugh MJ](#)<sup>1,2</sup>, [Williams Christians I](#)<sup>1</sup>, [Mintz J](#)<sup>1</sup>; [STRONG STAR Consortium](#).

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### **Abstract**

**Introduction:** The primary objective of this study was to describe the demographic, clinical, and attrition characteristics of active duty U.S. military service members who were aeromedically evacuated from Iraq and Afghanistan theaters with a psychiatric condition as the primary diagnosis. The study links the U.S. Transportation Command Regulating and Command and Control Evacuation System (TRAC2ES) data with the Defense Manpower Data Center (DMDC) to conduct an examination of the long-term occupational impact of psychiatric aeromedical evacuations on military separations and discharges.

**Materials and Methods:** Retrospective analyses were conducted on the demographic, clinical, and attrition information of active duty service members (N = 7,023) who received a psychiatric aeromedical evacuation from Iraq or Afghanistan between 2001 and 2013 using TRAC2ES data. Additionally, TRAC2ES database was compared with DMDC data to analyze personal and service demographics, aeromedical evacuation information, and reasons for military separation with the entire 2013 active duty force. Chi-square tests of independence and standardized residuals were used to identify cells with observed frequencies or proportions significantly different than expected by chance. Additionally, OR were calculated to provide context about the nature of any significant relationships.

**Results:** Compared with the active duty comparison sample, those with a psychiatric aeromedical evacuation tended to be younger, female, white, divorced or widowed, and less educated. They were also more likely to be junior enlisted service members in the Army serving in a Combat Arms military occupational specialty. The primary psychiatric conditions related to the aeromedical evacuation were depressive disorders (25%), adjustment disorders (18%), post-traumatic stress disorder (9%), bipolar disorders (6%), and anxiety disorders (6%). Approximately, 3% were evacuated for suicidal ideation and associated behaviors. Individuals who received a psychiatric aeromedical evacuation were almost four times as likely (53%) to have been subsequently separated from active duty at the time of the data analysis compared with other active duty service members (14%). The current study also found that peaks in the number of aeromedical evacuations coincided with significant combat operational events. These peaks almost always preceded or followed a significant operational event. An unexpected finding of the

present study was that movement classification code was not predictive of subsequent reasons for separation from the military. Thus, the degree of clinical supervision and restraint of a service member during psychiatric aeromedical evacuation from deployment proved to be unrelated to subsequent service outcome.

**Conclusions:** Psychiatric conditions are one of the leading reasons for the aeromedical evacuation of active duty military personnel from the military combat theater. For many active duty military personnel, a psychiatric aeromedical evacuation from a combat theater is the start of a military career-ending event that results in separation from active duty. This finding has important clinical and operational implications for the evaluation and treatment of psychiatric conditions during military deployments. Whenever possible, deployed military behavioral health providers should attempt to treat psychiatric patients in theater to help them remain in theater to complete their operational deployments. Improved understanding of the factors related to psychiatric aeromedical evacuations will provide important clinical and policy implications for future conflicts.

PMID: 3012491 DOI: [10.1093/milmed/usy188](https://doi.org/10.1093/milmed/usy188)

**Hypobaria during long-range flight resulted in significantly increased histopathological evidence of lung and brain damage in a swine model.**

[Scultetus AH<sup>1</sup>](#), [Jefferson MA](#), [Haque A](#), [Ho LTVT](#), [Hazzard B](#), [Saha BK](#), [Chun SJ](#), [Auker CR](#), [Moon-Massat PF](#), [McCarron RM](#), [Malone DL](#).

**Abstract**

**BACKGROUND:** Aeromedical evacuation to definitive care is standard in current military conflicts. However, there is minimal knowledge on the effects of hypobaria (HYPO) on either the flight crew or patients. The effects of HYPO were investigated using healthy swine.

**METHODS:** Anesthetized Yorkshire swine underwent a simulated 4 h "transport" to an altitude of 2,441 m (8,000 feet.; HYPO, N = 6) or at normobaric conditions (NORMO, N = 6). Physiologic and biochemical data were collected. Organ damage was assessed for hemorrhage, inflammation, edema, necrosis, and for lungs only, microatelectasis.

**RESULTS:** All parameters were similar prior to and after "transport" with no significant effects of HYPO on hemodynamic, neurologic, or oxygen transport parameters, nor on blood gas, chemistry, or complete blood count data. However, the overall Lung Injury Score was significantly worse in the HYPO than the NORMO group ( $10.78 \pm 1.22$  vs.  $2.31 \pm 0.71$ , respectively) with more edema/fibrin/hemorrhage in the subpleural, interlobular and alveolar space, more congestion in alveolar septa, and evidence of microatelectasis (vs. no microatelectasis in the NORMO group). There was also increased severity of pulmonary neutrophilic ( $1.69 \pm 0.20$  vs.  $0.19 \pm 0.13$ ) and histiocytic inflammation ( $1.83 \pm 0.23$  vs.  $0.47 \pm 0.17$ ) for HYPO versus NORMO, respectively. On the other hand, there was increased renal inflammation in NORMO compared with HYPO ( $1.00 \pm 0.13$  vs.  $0.33 \pm 0.17$ , respectively). There were no histopathological differences in brain (whole or individual regions), liver, pancreas, or adrenals.

**CONCLUSION:** Hypobaria, itself, may have an adverse effect on the respiratory system, even in healthy individuals, and this may be superimposed on combat casualties where there may be preexisting lung injury. The additional effects of anesthesia and controlled ventilation on these results are unknown, and further studies are indicated using awake models to better characterize the mechanisms for this pathology and the factors that influence its severity.

[IEEE J Transl Eng Health Med](#). 2018 Nov 6;6:4000107. doi: 10.1109/JTEHM.2018.2875704. eCollection 2018.

## **An Initial Investigation of Unmanned Aircraft Systems (UAS) and Real-Time Organ Status Measurement for Transporting Human Organs.**

[Scalea JR](#)<sup>1</sup>, [Restaino S](#)<sup>2</sup>, [Scassero M](#)<sup>3</sup>, [Blankenship G](#)<sup>2</sup>, [Bartlett ST](#)<sup>1,4</sup>, [Wereley N](#)<sup>5</sup>.

### **Abstract**

Organ transportation has yet to be substantially innovated. If organs could be moved by drone, instead of ill-timed commercial aircraft or expensive charter flights, lifesaving organs could be transplanted more quickly. A modified, six-rotor UAS was used to model situations relevant to organ transportation. To monitor the organ, we developed novel technologies that provided the real-time organ status using a wireless biosensor combined with an organ global positioning system. Fourteen drone organ missions were performed. Temperatures remained stable and low (2.5 °C). Pressure changes (0.37-0.86 kPa) correlated with increased altitude. Drone travel was associated with less vibration (<0.5 G) than was observed with fixed-wing flight (>2.0 G). Peak velocity was 67.6 km/h (42 m/h). Biopsies of the kidney taken prior to and after organ shipment revealed no damage resulting from drone travel. The longest flight was 3.0 miles, modeling an organ flight between two inner city hospitals. Organ transportation may be an ideal use-case for drones. With the development of faster, larger drones, long-distance drone organ shipment may result in substantially reduced cold ischemia times, subsequently improved organ quality, and thousands of lives saved.

**KEYWORDS:** Drone transportation; organ transplantation; transplant; transportation innovation; unmanned aircraft systems

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## **A Single-Center Experience of 900 Interhospital Transports on Extracorporeal Membrane Oxygenation.**

[Fletcher-Sandersjö A<sup>1</sup>](#), [Frenckner B<sup>2</sup>](#), [Broman M<sup>3</sup>](#).

### **Abstract**

**BACKGROUND:** The dawning of the extracorporeal membrane oxygenation (ECMO)-2 era, with the potential of decentralizing ECMO treatment, has stressed the need for research into the safety of ECMO transportations. The aim of this study was to (1) provide a comprehensive summary of transport arrangements and complications at a high-volume ECMO center, (2) determine predictors of severe complications occurring during transport, and (3) determine transport-related predictors of mortality.

**METHODS:** This was a retrospective population-based observational cohort study of all interhospital ECMO transports performed by the Karolinska University Hospital between 1996 and 2017. Medical records, clinical notes, and original transport protocols were collected and reviewed.

**RESULTS:** A total of 908 ECMO transports were performed. Neonatal and pediatric patients were more likely to be subjected to international transport, air transport, and longer transport distances and transport times. A severe complication occurred in 20% of transports and was significantly associated with venoarterial ECMO ( $p = 0.04$ ) and fixed-wing transport ( $p = 0.01$ ). Severe transport complications were not associated with increased mortality. Two patients passed away during transportation.

**CONCLUSIONS:** Severe complications during ECMO transportation recurrently occurred but did not affect mortality. We conclude that interhospital ECMO transportation is safe, when conducted by an experienced center, and patients should be transported for treatment at a high-volume ECMO center in accordance with the hub-and-spoke model whenever feasible.

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