

# Committee on Surgical Combat Casualty Care (CoSCCC)



**Journal Watch**

**4th Quarter**

**FY 2020**

## Journal Watch Key Terminology Searched:

Microcirculation	Trauma Management	Haemorrhage
Shock	Sublingual	Ethics committees
Human subject research	IDF	Institutional review board
Haemorrhagic shock	Multiple trauma	Shock index
Traumatic brain injury	Coagulopathy	Diagnostic accuracy
Plasma	Pre-hospital	Thrombelastography (TEG)
Transfusion	Trauma	Imaging
RBCs	Resuscitation	Severe trauma
Stability	Ultrasound	Afghanistan
Blast	Facial trauma	War
Amputation	Multiple	Transfusion
Traumatic Clinical outcomes	Clinical parameters	Damage control Surgery
Injury	Pelvic fracture	Battlefield Trauma
Coagulopathy	Cryoprecipitate	Fibrinogen
Fibrinogen concentrate	Massive transfusion	ABO
Viscoelastic haemostatic assays	Angiography	External fixation
Guidelines	Internal fixation	Pelvic ring
Fractures	X-ray	Pre-peritoneal pelvic packing
REBOA	Antibiotic prophylaxis	Long bone fractures
Orthopaedic trauma	Perioperative antibiotics	Surgical site infection
Wound ballistics	Faecal diversion	Primary repair
Cause of injury	Head injuries	Poly-trauma
Damage Control Resuscitation	Battlefield injury	Prolonged field care
Tension pneumothorax	Thoracotomy	Military Medicine
Blast Injury	Died of Wounds	Killed in Action
Combat casualty care	Medical treatment facility	Mortality
Surgical skills	Emergency surgery	Infection prevention
Novel Coronavirus	COVID-19	

# Shock Index as a Predictor of Massive Transfusion and Emergent Surgery on the Modern Battlefield

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## Abstract

### Background:

Shock Index (SI) has been used to predict the need for massive transfusion (MT) and emergent surgical procedures (ESP) in civilian trauma. We hypothesize that SI can reliably identify combat trauma patients that will require MT and ESP when applied to the resource-constrained, combat environment.

### Methods:

A retrospective review was performed within the Department of Defense Trauma Registry (2008-2016). SI was calculated using heart rate and systolic blood pressure on arrival to the initial facility with surgical capabilities. A threshold value of 0.8 was used to stratify patients into two groups (Group I, SI < 0.8; and Group II, SI ≥ 0.8). The need for MT, ESP, and mortality was compared. Regression analyses were conducted to determine the independent association of SI with MT and ESP.

### Results:

A total of 4008 patients were included. The mean age of the patients was 25.5 y, and the majority were predominately male (98%). Mechanisms of injury were blunt and blast injury (62%), penetrating injury (36.7%), and burn injury (0.5%). Overall, 77% of patients (n = 3070) were stratified to Group I, and 23% of patients (n = 938) were stratified to Group II, by SI. Group II patients had a significantly greater need for MT (8.4% versus 0.4%) and ESP (30.7% versus 6.5%), both P < 0.001. Regression analysis controlling for age, gender, Injury Severity Score, and Glasgow Coma Score confirmed that SI ≥ 0.8 was an independent risk factor for both MT and need for ESPs (P < 0.001).

### Conclusions:

SI is a significant predictor of the need for MT and ESPs in the military trauma population, representing a simple and potentially potent tool for triage and prediction of resource consumption in the resource-limited, austere setting.

**Keywords:** Combat trauma; Massive transfusion; Shock Index; Trauma; Triage.

Mil Med

# An analysis of radial pulse strength to recorded blood pressure in the Department of Defense Trauma Registry

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## Abstract

### Introduction:

Hemorrhage is the leading cause of potentially preventable death on the battlefield. The tactical combat casualty care guidelines recommend the use of the radial pulse strength to guide the administration of blood products or intravenous fluids when equipment for blood pressure monitoring is not available. Data supporting this measurement tool are limited. We sought to validate this method in a deployed trauma population.

### Materials and methods:

This is a secondary analysis of a previously published dataset from the Department of Defense Trauma Registry. In this subanalysis, we focused on emergency department radial pulse strength documented in conjunction with systolic blood pressure readings.

### Results:

Our predefined search codes captured 28,222 Department of Defense Trauma Registry casualties. Of those, 22,192 casualties had at least 1 radial pulse strength documented, with a total of 27,366 documented measurements total among the 22,192. The median age of casualties was 25 years, most were male (96.8%), U.S. military made up the largest proportion (44.2%), most were injured by explosive (55.8%), and most were in Afghanistan (67.0%) with a median injury severity score of 9. Mean systolic blood pressures were significantly different based on radial pulse strength: strong (129.6), weak (107.5), and absent (85.1). However, when using a binary threshold of 80 mmHg, there were 615 documented instances of hypotension. Within that 615, 55.6% had a strong radial pulse, 29.3% had a weak radial pulse, and 15.1% had an absent radial pulse ( $P < .001$ ).

### Conclusions:

Although mean systolic blood pressure was associated with radial pulse quality, when using a binary measurement of hypotension (systolic  $< 80$  mmHg) characterization of the radial pulse was not a reliable indicator of hypotension. Better methods for casualty monitoring must be employed to avoid missing opportunities for intervention.

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## The dose-dependent relationship between blood transfusions and infections after trauma: A population-based study

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### Abstract

#### Objective:

The relationship between total transfusion volume and infection in the trauma patient remains unclear, especially at lower volumes of transfusion. We sought to quantify the cumulative, independent impact of transfusion within 24 hours of admission on the risk of infection in trauma patients.

#### Methods:

Using the Trauma Quality Improvement Program 2013 to 2016 database, we included all patients who received blood transfusions in the first 4 hours. Patients who were transferred or had incomplete/wrongly coded information on transfusion volume were excluded. Patients were divided into 20 cohorts based on the total blood product volume transfused in the first 24 hours. A composite infection variable (INF) was created, including surgical site infection, ventilator-associated pneumonia, urinary tract infection, central line associated blood stream infection, and sepsis. Univariate and stepwise multivariable logistic regression analyses were performed to study the relationship between blood transfusion and INF, controlling for demographics (e.g., age, sex), comorbidities (e.g., cirrhosis, diabetes, steroid use), severity of injury (e.g., vital signs on arrival, mechanism, Injury Severity Score), and operative and angiographic interventions.

#### Results:

Of 1,002,595 patients, 37,568 were included. The mean age was  $42 \pm 18.6$  years, 74.6% were males, 68% had blunt trauma, and median Injury Severity Score was 25 [17-34]. Adjusting for all available confounders, odds of INF increased incrementally from 1.00 (reference, 0-2 units) to 1.23 (95% confidence interval, 1.11-1.37) for 4 units transfused to 4.89 (95% confidence interval, 2.72-8.80) for 40 units transfused. Each additional unit increased the odds of INF by 7.6%.

#### Conclusion:

Transfusion of the bleeding trauma patient was associated with a dose-dependent increased risk of infectious complications. Trauma surgeons and anesthesiologists should resuscitate the trauma patient until prompt hemorrhage control while avoiding overtransfusion.

**Level of evidence:** Retrospective cohort study, Therapeutic IV.

# Practical Considerations for a Military Whole Blood Program

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## Abstract

### Introduction:

Prehospital care in the combat environment has always been of great importance to the U.S. military, and trauma resuscitation has remained a cornerstone. More evidence continues to demonstrate the advantages of intervention with early transfusion of blood products at the point of injury. The military has recognized these benefits; as such, the Department of Defense Joint Trauma System and the Committee on Tactical Combat Casualty Care have developed new advanced resuscitation guidelines, which now encourage the use of whole blood (WB) in the prehospital setting.

### Materials and methods:

This general review of peer-reviewed journal articles was performed through an extensive electronic search from the databases of PubMed Central (MEDLINE) and the Cochrane Library.

### Results:

Based on this literature search, the current evidence suggests that transfusion with WB is safe and efficacious. Additionally, soldier function is preserved after donating fresh WB in the field. Currently, the collection and implementation of WB is accomplished through several different protocol-driven techniques.

### Conclusion:

WB has become the favored transfusion product as it provides all of the components of blood in a convenient package that is easy to store and transport. Specifically, group O WB containing low titers of anti-A and -B antibodies has become the transfusion product of choice, offering the ability to universally fluid resuscitate patients despite not knowing their blood group. This new ability to obtain low titer group O WB has transformed the approach to the management of hemorrhagic shock in the prehospital combat environment.

# Establishing an enduring Military Trauma Mortality Review: Misconceptions and lessons learned

## Authors

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## Abstract

Under direction from the Defense Health Agency, subject matter experts (SMEs) from the Joint Trauma System, Armed Forces Medical Examiner System, and civilian sector established the Military Trauma Mortality Review process. To establish the most empirically robust process, these SMEs used both qualitative and quantitative methods published in a series of peer-reviewed articles over the last 3 years. Most recently, the Military Mortality Review process was implemented for the first time on all battle-injured service members attached to the United States Special Operations Command from 2001 to 2018. The current Military Mortality Review process builds on the strengths and limitations of important previous work from both the military and civilian sector. To prospectively improve the trauma care system and drive preventable death to the lowest level possible, we present the main misconceptions and lessons learned from our 3-year effort to establish a reliable and sustainable Military Trauma Mortality Review process. These lessons include the following: (1) requirement to use standardized and appropriate lexicon, definitions, and criteria; (2) requirement to use a combination of objective injury scoring systems, forensic information, and thorough SME case review to make injury survivability and death preventability determinations; (3) requirement to use nonmedical information to make reliable death preventability determinations and a comprehensive list of opportunities for improvement to reduce preventable deaths within the trauma care system; and (4) acknowledgment that the military health system still has gaps in current infrastructure that must be addressed to globally and continuously implement the process outlined in the Military Trauma Mortality Review process in the future. LEVEL OF EVIDENCE: Level III.

# Anatomic injury patterns in combat casualties treated by forward surgical teams

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## Abstract

### Background:

Role 2 forward surgical teams provide damage-control resuscitation and surgery for life- and limb-threatening injuries. These teams have limited resources and personnel, so understanding the anatomic injury patterns seen by these teams is vital for providing adequate training and preparation prior to deployment. The objective of this study was to describe the spectrum of injuries treated at Role 2 facilities in Afghanistan.

### Methods:

Using Department of Defense Trauma Registry data, a retrospective, secondary data analysis was conducted. Eligible patients were all battle or non-battle-injured casualties treated by Role 2 forward surgical teams in Afghanistan from October 2005 to June 2018. Abbreviated Injury Scale (AIS) 2005 codes were used to classify each injury and Injury Severity Score (ISS) was calculated for each patient. Patients with multiple trauma were defined as patients with an AIS severity code >2 in at least two ISS body regions.

### Results:

The data set included 10,383 eligible patients with 45,225 diagnosis entries (range, 1-27 diagnoses per patient). The largest number of injuries occurred in the lower extremity/pelvis/buttocks (23.9%). Most injuries were categorized as minor (39.4%) or moderate (38.8%) in AIS severity, while the largest number of injuries categorized as severe or worse occurred in the head (13.5%). Among head injuries, 1,872 injuries were associated with a cerebral concussion or diffuse axonal injury, including 50.6% of those injuries being associated with a loss of consciousness. There were 1,224 patients with multiple trauma, and the majority had an injury to the extremities/pelvic girdle (58.2%). Additionally, 3.7% of all eligible patients and 10.5% of all patients with multiple trauma did not survive to Role 2 discharge.

### Conclusion:

The injury patterns seen in recent conflicts and demonstrated by this study may assist military medical leaders and planners to optimize forward surgical care in future environments, on a larger scale, and utilizing less resources.

**Level of evidence:** Epidemiological, Level III.

# Exploring Nonbattle Injury in the Deployed Military Environment Using the Department of Defense Trauma Registry

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## Abstract

### Introduction:

The impact of disease and nonbattle injury (DNBI) on casualty burden of military operations has historically been greater than that of battle-related injuries. The ratio of battle to DNBI casualties has changed as advances in equipment, hygiene, and infectious diseases have been made; however, during military operations in Iraq and Afghanistan, 30% of serious injuries treated or evacuated from the area of operations were secondary to NBI. Most DoD research and intervention efforts focus on battle injuries; NBI has received much less practical attention. We aimed to explore the potential utility of the largest Department of Defense casualty database in identifying potential intervention targets for preventing NBI events.

### Materials and methods:

Phase I was a comprehensive NBI literature review from historical and current military operations. Phase II was an IRB exempt initial examination of relevant data contained in the Department of Defense Trauma Registry (DoDTR). Phase I: A MEDLINE search using the terms "military", "injury", and "nonbattle/non battle" was performed, and articles containing useful data points to characterize the unique risks of the modern deployed military environment and identify potentially preventable NBI hazards in the modern deployed military environment were retrieved and reviewed in full-text. Phase II: This information was used to explore data within the DoDTR's and its ability to provide data to inform NBI prevention efforts in the following areas: most prevalent NBI causes, NBI location and timing related to operational tempo, characteristics of the population at risk for NBI.

### Results:

Phase I: Falls and motor vehicle crashes (MVCs) accounted for most of the serious NBI in Iraq and Afghanistan. No specific epidemiologic data was readily available to guide NBI prevention efforts. Phase II was limited to NBI and falls from Iraq and Afghanistan in the DoDTR. Only aggregate data were available with a total of 1829 falls and 1899 MVCs. Case fatality for falls was 1.1% and for MVCs 6.5%. The greatest frequency of NBI was in Iraq among U.S. Army personnel, but comparison of rates is not possible without reliable denominators for individual variables. Annual NBI incidence seems proportional to overall level of personnel deployed to each theater, but without knowledge of the true denominator of total deployed personnel, it is impossible to conclude definitively. The annual number of falls was stable throughout the period of highest operational tempo in Iraq (2003-2011), although MVCs were more common earlier in the operation (2003-2005), likely corresponding to greater operational maneuver.

### Conclusions:

The deployed military environment is dangerous and NBI presents a primary prevention target for expeditionary operations. The DoDTR is a database of detailed injury and medical care information and lacks much of the data required to perform a comprehensive epidemiologic NBI analysis. Specific

prevention recommendations cannot be made based solely on DoDTR data and integration with other DoD databases that assess operational and tactical data should be considered.

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