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# DISMOUNTED COMPLEX BLAST INJURY

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## REPORT OF THE ARMY DISMOUNTED COMPLEX BLAST INJURY TASK FORCE



Prepared by the Dismounted Complex Blast Injury Task Force  
For The Army Surgeon General  
Fort Sam Houston, TX  
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# EXECUTIVE SUMMARY

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“Dismounted Complex Blast Injury” (DCBI) is an explosion-induced battle injury (BI) sustained by a warfighter on foot patrol that produces a specific pattern of wounds. In particular, it involves traumatic amputation of at least one leg, a minimum of severe injury to another extremity, and pelvic, abdominal, or urogenital wounding.

The incidence of dismounted complex blast injuries has increased during the last 15 months of combat in the Afghanistan Theater of Operations (ATO). The number of Service Members with triple limb amputation has nearly doubled this past year from the sum of all those seen over the last eight years of combat. The number of genital injuries increased significantly from previous OIF rates.

The US Army Surgeon General (SG) appointed a task force to study the causation, prevention, protection, treatment, and long-term care options of this BI pattern. The Task Force was comprised of clinical and operational medical experts from the Departments of Defense (DoD) and Veterans Affairs (VA) and solicited input from subject matter experts in both Federal and civilian sectors.

This report will look at current candidates for “best practice” designation for prevention, mitigation, or treatment of dismounted complex blast injuries. It will address opportunities for intervention from the POI to long-term rehabilitation. The Task Force will address a systematic approach to this problem set from a medical perspective, using the Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities and Contracting (DOTMLPF-C) approach, followed by specific recommendations for the way forward.

This Task Force first undertook to describe what constitutes a complex injury. After nearly a decade of war in two theaters,

marked by severe burns, traumatic brain injury, and extremity injuries, what makes this pattern different? Both line and medical communities have noted the combination of high thigh amputations with genital injury associated with dismounted patrolling. In a significant subpopulation, the casualties sustained double and triple limb amputations.

The severity of these injuries presents new challenges to the medical and military communities to prevent, protect, mitigate and treat. This Task Force has an obligation to assess whether we are effectively managing the immediate-, near-, and long-term healthcare needs required by these Wounded Warriors, as well as those expected by his/her Family and loved ones.

Battle injuries (BIs) were at an all-time high in the Iraq Theater of Operations (ITO) during the troop surge and associated fighting in 2007. In 2008, the ATO monthly BIs exceeded that seen in the ITO, and the associated trend lines have continued to diverge.

The ATO BI severity scores have increased steadily since 2006. The number of extremity injuries, to include major amputations—the major focus of this Task Force—has exceeded that seen within the ITO at any point.

These trends reflect the tactical requirement for dismounted battle in the face of ground-emplaced improvised explosive devices (IEDs) and land mines.

Among those with lower extremity injuries we are seeing a significant proportion with associated genitourinary (GU) injuries—both internal and external—along with other pelvic, intra-abdominal, and spinal injuries. TBI co-morbidity adds yet another layer of complexity to some patients with DCBI. It is beyond the scope of this Task

Force to identify associated post-traumatic stress, although an increase is plausible.

The dismounted Warrior is at greater risk for severe injuries from IEDs, and the injury severity from the ATO since 2006 confirms this. The died of wounds (DOW) rate has been constant and we have seen a corresponding drop in the case fatality rate (CFR) and killed in action (KIA) rates over the eight years preceding 2010. (Definitions on Page 7).

Altogether, this suggests our warfighters at the point of injury (POI)—Marines, Corpsmen, Soldiers and Medics, alike—are better able to keep Warriors alive in spite of increasingly severe wounds. Current personal protective equipment (PPE) has mitigated head, eye and torso injuries drastically. Well-designed and heavily protected vehicles provide the mounted Warrior superior protection against roadside explosive devices. Extensive burn injuries among mounted Warriors, more common early in the wars, have nearly disappeared.

Extremities, therefore, are at greatest risk for complex blast injuries, especially among dismounted Warriors. To appreciate the burden of these injuries, for every major amputation (i.e., from the wrist or ankle and higher), we have encountered approximately four additional casualties with severe extremity injuries. For every seven of these individuals with mangled limbs and who undergo limb salvage efforts, one will ultimately undergo a late amputation (i.e., between 90 days and as late as five years following the initial injury).

Evidence from the US Army Institute of Surgical Research (ISR) suggests that these severely injured casualties survive due to the immediate application of extremity tourniquets by first responders.

The concept of Tactical Combat Casualty Care (TCCC) which emphasizes primary hemorrhage control in the tactical setting effectively replaced the resuscitation mantra of “A-B-C” for “Airway-Breathing-

Circulation.” Lives are saved when massive hemorrhage is controlled promptly.

Once a Wounded Warrior can get to a surgeon, his/her chances of survival increase significantly. DoD made significant advances in the field of resuscitation and trauma surgery in the current operations, many of which have been adopted by civilian medicine.

Of note, the advances were made with great attention to scientific rigor, so outcome measures could be tied to specific interventions. The Surgeons General of the Army, Navy, and Air Force have resourced the analysis of battlefield healthcare in order to allow documentation and measurement of our interventions throughout the wars.

Current evidence-based best practices include the development and implementation of a formal military trauma system; aggressive tourniquet use; early use of fresh whole blood and blood products; hypothermia prevention and management; damage control resuscitation and surgery; rapid strategic evacuation (STRATEVAC); comprehensive and multidisciplinary approaches to pain management, and rehabilitation.

Further refinement and implementation are required in: aggressive pain management at the POI; advanced-level medical staff aboard rotary wing (RW) evacuation platforms; consistent control of core body temperature; use of blood products—including plasma—within one hour of severe hemorrhage, oftentimes at the POI when delivered by RW assets; placement of a urologist at a Role III facility to address GU injuries; greater spiritual involvement in the healing process for both the Wounded Warrior and his/her loved ones once in CONUS; and widespread recognition within the Service Medical Departments and medical treatment facility (MTF) leadership of the extensive personnel, equipment, and operating room resources essential for definitive care of these severely injured Warriors.

With advances in rehabilitation, prosthetic care, robotics and assistive technology, most of our Warriors with major limb loss envision a future for themselves that can be full and rewarding. The Warrior with high-level lower extremity major limb loss will have greater rehabilitative challenges related to both the extremity and GU injuries spanning the physical, emotional, social, family, and spiritual domains.

Organizational alignment between agencies tasked to protect our Warriors in combat will be required. The medical community needs a proactive multi-disciplinary surveillance system that can generate the proper notifications and actions in response to early trends. Line unit liaison officers (LNOs) within the medical community will ease information and intelligence sharing, where appropriate to help facilitate improvements in Warrior tactics, techniques and procedures (TTPs) and PPE.

Finally, the Task Force applauds the aggressive medical advances made on behalf of the Warriors in harm's way. The envelope has been pushed, but within the constraints of medical science.

This latter point is important. Without scientific rigor, we are collecting anecdotes, Warriors are left with marked variability in their care, and questions from the American public as to the benefits provided would certainly arise.

The most important takeaway from this report is that our Warriors and their Families can trust our military medical community to provide absolutely everything possible to help them overcome any injury through a whole-person approach to healing. Our

goal is to address the cognitive, emotional, spiritual, and physical aspects to our wounded Warriors' sense of personhood, as well as on their social and environmental accessibility.

The Task Force wishes to thank The Surgeon General and Commanding General of the US Army Medical Command, LTG (Dr.) Eric Schoomaker, the Vice Chief of Staff of the Army, GEN Peter Chiarelli, and the Commandant of the US Marine Corps, Gen. James Amos, for their personal guidance that assisted me and my team through this process. These officers and senior leaders like them possess not only the vision, but the deep-seated compassion for our Warriors. I am also grateful for the valuable comments and recommendations for this report from our Sister Services' medical leadership, namely, Maj Gen Thomas Travis, the Air Force Deputy Surgeon General, and RDML Michael Anderson, the Medical Officer to the Marine Corps. I certainly appreciate that everyone is doing all within their power to keep our Warriors from being injured, but if they are injured, we want to ensure we expend every effort to help each and every one reach their maximum potential.

This report expresses the views of the author and the DCBI Task Force, alone. It does not necessarily reflect the views of the Army's Office of The Surgeon General, the United States Army Medical Command, the United States Army, Navy Medicine, the United States Navy, the United States Marine Corps, Air Force Medicine, the United States Air Force, or the Defense Department.

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# OVERVIEW

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In 2009-2010, the Joint Theater Trauma System (JTTS) identified the reversing BI trend between the two combat theaters. In 2010, BIs from the Iraq Theater of Operations (ITO) declined to near-zero, with a corresponding rise in BIs from the ATO.

Though still only a very small percentage of troops on the ground, and fewer than that seen during the ITO surge in 2007, the ATO experienced a significant relative rise in overall BI. Among these casualties, some were due to ground-emplaced IED blasts on dismounted patrols. Through the summer and fall of 2010, peaking in October, the JTTS identified a new trend of devastating injuries characterized primarily by high lower extremity amputations, pelvic and genital injuries, and spine injuries. While absolute numbers are low, the rates of these injuries in the last half of 2010 demonstrated a continuous rise.

With this apparent injury pattern change, The Army SG appointed a task force to further define and analyze the problem, with a charter to characterize the phenomenon, identify the cause, and recommend the medical way forward.

Injury from IEDs and land mines has been a realistic threat for these Warriors, and they took every measure they could to eliminate these risks. Units developed tactics, techniques and procedures (TTPs) to mitigate IED exposure, but the explosions could not be eliminated completely. Utilization of the current generation of mine-resistant armor-protected (MRAP) vehicles was constrained by terrain. The surge in the ATO addressed the need to hold terrain once cleared. In support of this need, newer, more mobile MRAP vehicles—the MATV (MRAP–All Terrain Vehicle)—adapted for the Afghanistan terrain are being introduced into the ATO to decrease the need for dismounted patrols. The Stryker program is introducing a new double-V hull

that should improve defeat of IEDs. Organizations such as Joint IED Defeat Organization (JIEDDO) are researching ways to eliminate the threat of IEDs in both theaters of operation. Dismounted patrols required TTP changes to minimize IED exposure.

Traumatic battlefield amputations were not uncommon, but Warriors knew of the prosthetic care and rehabilitation advances at facilities such as the Military Advanced Training Center in Washington, DC, the Center for the Intrepid (CFI) at Fort Sam Houston, TX, and the Comprehensive Combat Casualty Care Center (C5) at Balboa Naval Medical Center in San Diego, CA. However, the increased rate of double and triple amputees, coupled with pelvic and genital injuries, represented a new level of injury to overcome. Devastating injuries of the kind just described took their toll on unit morale. To some, the resultant burden on their Family and loved ones seemed too much to accept, and, anecdotally, some actually developed “do not resuscitate” pacts with their battle buddies in the event of this type of injury.

The Army SG took the step of creating a dedicated task force to address the following questions: Is there an actual or perceived increased incidence of these complex injury patterns? If actual, does it reflect an increase in the number of casualties generated? Alternatively, are a greater number of IED blast victims surviving these horrific wounds? Regardless of causation, can we improve medical and surgical management of these victims throughout their spectrum of care—from the POI to long-term rehabilitation and reintegration into the force or society?

What is the way forward to prevent, protect, or mitigate ground-emplaced IED blasts to dismounted patrols? Are we doing everything possible to manage, treat, and care for the whole Warrior and his/her

Family through the recovery, rehabilitation and long-term care following these devastating injuries? Are we addressing the physical, cognitive, emotional and spiritual domains fully?

Are there statutes, Departmental policies or regulations, directives or guidance that can better address unforeseen challenges to this population of Warriors? Finally, are our Warriors aware of the significant medical advances that may allow even these types of severe injuries to return to duty as a Service Member, or contribute as a fully integrated member of society? How can we demonstrate these capabilities to every Warrior and his/her Family before deployment? Following a brief overview, the first of four sections will characterize the injury we refer to as “dismounted complex blast

injury.” The second provides data and analysis. The third section presents current practices, highlighting the successes and challenges within the phases of evacuation and treatment. Also addressed is the “whole person” approach, focusing on multimodal pain management, urologic reconstruction, rehabilitation, neurological, psychological, and spiritual aspects of healing. The fourth section of recommendations lists each under the appropriate domain, using the Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities and Contracting (DOTMLPF-C) approach.

Following the conclusion, there are a number of appendices to support this report, including an action plan to facilitate tracking of recommendations approved for action.



Figure 1. Definitive reconstruction requires extensive resources: three surgical teams; multiple operating room events, and prolonged rehabilitation.

# DEFINING THE PROBLEM

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## HISTORICAL ARMY PERSPECTIVE

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As military battlefield technologies change and increase in complexity, so do the injuries they produce and the medical interventions employed to counter their impact.

The observational and reasoning skills of Ambroise Paré, a surgeon serving with the French Army near Turin in 1537, led him to conclude that gunshot wounds were not poisoned by gunpowder and, therefore, boiling oil need not be part of therapy. He also observed how these unburned tissues healed more readily and were more amenable to surgical sewing to stem blood loss, a technique he pioneered on the battlefield. Low velocity munitions, which tended to mangle the human body upon impact, provided military surgeons with ample opportunity for amputation. Whether to perform a primary amputation immediately after injury or wait until the patient had recovered from the initial shock of trauma (secondary amputation) was a point of contention for French, German, and British military surgeons through the 18<sup>th</sup> century.

The wars of the French Revolution and early Napoleonic Era convinced Dominique Jean Larrey, Surgeon to Napoleon's Imperial Guard, that primary amputation was imperative in the unsalvageable limb. Larrey also invented and employed the Flying Ambulance on the battlefield to bring the wounded and surgeons together more rapidly. By the time of our Civil War, ether and chloroform anesthesia and an efficient tourniquet had improved the surgical art somewhat. Surgeon General Hammond recognized the value of collecting and studying wartime injuries and diseases to improve future outcomes. He founded the Army Medical Museum to study war injuries and directed the publication of the

*Medical and Surgical History of the War of the Rebellion*. Hammond also assigned Major Jonathan Letterman as Medical Director to a medically-disorganized Army of the Potomac in summer 1862. Over the next six months, Letterman brought reorganization and efficiency to battlefield surgical care, tactical and strategic evacuation, distribution of supplies, and standards of practice which were instituted Army-wide by 1864.

By the late 1890s, higher velocity munitions combined with bacteriology, safer anesthetic control, the x-ray machine, and the advent of the modern combat medic to change the production and treatment of BIs. Surgeon General George Sternberg, founder of the Army Post-Graduate Medical School, where current standard of care was taught, told his medical officers this represented greater battlefield survival, and that the days of dying from surgical intervention were over. The modern era of battlefield care had arrived.

In WWI, British and US Army medical officers made inroads into the mysteries of shock, hypotension, volume replacement, and demonstrated that whole blood could be administered in forward areas. Surgical principles of wound excision, debridement and amputations emerged as life saving measures. Medical officers of the French Army recognized and treated battle-induced psychiatric injuries. Twenty years later, British and US medical officers would relearn these lessons of WWI in North Africa and Italy and adapt more advanced technologies to the battlefield environment. Captain Fred Hansen established forward treatment of what was soon called battle fatigue, returning 70% of those casualties to General Patton's Army fighting at El Guettar. Captain Lyman Brewer and his surgical team with the 2<sup>nd</sup> Auxiliary Surgical Group designed an intermittent positive

pressure breathing apparatus, thereby allowing chest wounds to be explored in the field. By the summer of 1944, enclosed ether anesthesia systems were developed, fluid resuscitation solved, and American ingenuity brought penicillin to the battlefield. In the Technical Bulletins issued by the Office of the Army Surgeon General (OTSG), consultants previewed current data which led to real-time improvements in military medicine.

In Korea and Vietnam, the US Army Medical Department pioneered helicopter evacuation and in the mid-1950s funded what would become one of the most famous aircraft in the world, the UH-1 *Iroquois* helicopter, as a battlefield ambulance. These aircraft allowed injuries to be addressed more rapidly by military surgeons like Major Carl Hughes, who developed forward repair of arterial injuries in Korea, and Captain Norman Rich who did the same for venous injury in Vietnam.

Today in Southwestern and Western Asia, advances in trauma management continue. Under the auspices of the US Army Institute of Surgical Research (USAISR) and the US Army Medical Research and Materiel Command (MRMC), hemorrhage control has become the primary treatment focus following injury. Use of blood products, maintaining normal body core temperature, and implementation of “damage-control resuscitation and surgery” have been the mainstays in improving BI survival rates beyond that seen in any prior war. Similarly, these conflicts have been marked with widespread use of external fracture fixation, delayed management of mangled limb injuries and low amputation rates that were comparable to Vietnam, but with more severe injuries.

Over the last several years, the US Army made tremendous advances in battlefield pain control with the use of multimodal opioid adjuncts and alternatives, new medication delivery systems, and comprehensive pain protocols. As a direct result, more

complete pain relief is provided sooner after injury than was previously possible. The Army Regional Anesthesia and Pain Management Initiative, started in 2000, led to advances such as the first continuous peripheral nerve block used early in Operation Iraqi Freedom (OIF) and the implementation of pain pumps for use on medical evacuations on Air Force military aircraft.

The SG chartered the Army Pain Management Task Force in August 2009 to make recommendations for a comprehensive pain management strategy. The resulting program is holistic, multidisciplinary, and multimodal in its approach, utilizing state of the art techniques and technologies.

With the SG’s oversight, Army Medicine has also made significant advances in the field of prosthetics and robotics, extremity injury rehabilitation and limb salvage techniques, and regenerative medicine.

Army medicine and the Army Medical Department have a long and rich heritage of real-time battlefield investigation and intervention to reduce BIs. The current wars are no different—new problem sets are identified against which significant gains are being made on the medical front.

## BACKGROUND

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In 2010, BIs in the ATO exceeded those in the ITO. The primary injury in the ATO often resulted from enemy contact with ground-emplaced IEDs and land mines. The injury of interest, DCBI, has increased significantly. A significant number of these injuries, but not all, were sustained by Warriors on dismounted patrols.

Because the observed injuries were occurring more frequently than previously seen, the Army SG appointed a task force to characterize the injury and determine how to better manage these Warriors and Families from POI through physical, emotional, in-

tellectual and spiritual recovery and rehabilitation.

The Joint Theater Trauma System was established in 2004 under US Central Command to effect trauma care performance improvement on the battlefield to provide a near-real time registry of combat-related casualties. In addition to deploying a trauma surgeon to lead this effort downrange, the JTTS maintains a team of nurses and other healthcare providers to collect hundreds of data points on each casualty evacuated from the battlefield. These efforts have proven invaluable not only in adjusting efforts among medics and providers on the battlefield, but also in improving medical and surgical techniques to optimize outcomes amongst our casualties.

Since its inception in 2006, the Blast Injury Research Program has made significant improvements in the way warfighters are protected from blast-related injuries, and in the way injured warfighters are treated and rehabilitated. Among many noteworthy contributions was the establishment of the Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) Program.

JTAPIC links the DoD medical, intelligence, operational, and materiel development communities with a common mission to collect, integrate, and analyze injury and operational data. Its goal is to improve the understanding of threat vulnerabilities and to enable the development of improved TTPs and materiel solutions to prevent or mitigate traumatic injuries.

To accomplish this, JTAPIC partners with the Army National Ground Intelligence Center; Office of the Armed Forces Medical Examiner (OAFME); Project Manager Protection and Individual Equipment; Army Research Laboratory; Army Aeromedical Research Laboratory; USAISR; Army Infantry Center, Naval Health Research Center; and the Marine Corps Systems Command.

Among casualties evacuated from POI to higher levels of care in 2009, there were 86 Warriors with major limb loss, of whom 23 had multiple amputations. By comparison, in 2010 there were 187 Warriors with major limb loss, with 72 casualties losing multiple limbs.

OAFME evaluated 111 Warriors who died in 2010 as a result of blast injuries. Of these, 68 had multiple amputations, 13 had sustained total body fragmentations, and 106 also had severe body injuries. This analysis demonstrated that death occurred among the Warriors with the more severe injuries, and nearly every case involved severe associated head or body injury.

During this same period there was a corresponding increase in the number of evacuated Warriors requiring massive transfusions (i.e., greater than 10 units of blood) from 91 to 165. By way of comparison, the 2007 surge in Iraq—the highest casualty-producing year in OIF—produced 216 amputees, of whom 60 had multiple limb amputations.

The ATO's most dramatic changes in 2010 were the increased numbers of bilateral thigh amputations, triple and quadruple amputations, and associated genital injuries.

The JTTS casualty data for the ATO shows 274 fatalities (KIA +DOW) and 2,108 WIAs in 2009. These numbers increased to 332 fatalities and 5095 WIAs in 2010. Additionally, the JTTS noted a large spike in multi-limb loss Warriors in the latter part of 2010. Associated with this was a large increase in the percentage of US casualties arriving at Landstuhl Regional Medical Center (LRMC) with amputations from October to December 2010.

IED explosions on dismounted patrols caused the large majority of these injuries, with traumatic amputation of at least one, and often both, lower extremities. It wasn't uncommon for these amputations to have accompanying GU injuries, penetrating

pelvic and abdominal trauma, and an upper extremity amputation or severe injury. Relative to a baseline incidence of 4.7%, the GU injury incidence among US casualties at LRMCC was 19% in October 2010, 10% in November 2010, and 13% in December 2010. When those who sustained major lower limb amputations were matched with those who also sustained genital injuries, the correlation approached 90%.

Post-traumatic stress (PTS) and TBI still play a significant role and add complexity and challenges to the rehabilitation and reintegration of these Warriors.

To better study this apparent change in injury pattern more effectively, we propose using the name “Dismounted Complex Blast Injury.” The definition of this injury is: An injury caused by an explosion, occurring to a Service Member while dismounted in a combat theater that results in amputation of at least one lower extremity at the knee or above, with either amputation or severe injury to the opposite lower limb, combined with pelvic, abdominal, or urogenital injury. This definition is intended only to clarify what injuries should be included in this report. It is not meant to define a subset of injuries for policy-making decisions.

# ANALYSIS

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## BURDEN OF INJURY

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### DEFINITIONS

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As a primer for the discussion of data on the topic of DCBI, it is necessary to understand key military injury terminology.

The Defense Manpower Data Center (DMDC) provides periodic updates for the number of Army WIA and either KIA or Died of Wounds Received in Action (DWRIA). The DMDC is the officially sanctioned source for DoD statistics related to Combat Operations.

The DMDC validated the mutually exclusive nature among the variables used in the Survivability Calculation Methodology, i.e., Warriors are only counted in either KIA number, DWRIA number, or WIA number.

### WOUNDED IN ACTION

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A critical term used to define combat-injured casualties is the number of wounded in action (WIA) and is the sum of three subgroups.

**Admitted to MTF:** These are BIs evacuated successfully to a Role II or III echelon of care. They are held for up to 72 hours or evacuated further toward more definitive and longer-stay facilities.

**Returned to Duty (RTD):** These are BIs whose injuries are mild enough to allow for a successful return to his/her unit within 72 hours, without need for further evacuation.

**Died of Wounds (DOW), or DOW Received in Action (DWRIA):** These are BIs who die from their wounds after having been successfully evacuated to the attention of a surgeon at a Role II/III echelon of care.

Conventionally, the subgroup of surviving WIAs who return to duty within 72 hours—the RTD—is excluded from denominators when proportional statistics are presented. This is significant because this group traditionally represents the majority of all wounded in action. The number and classification of combat wounded and dead is used traditionally to render insights into the lethality of the battle, the effectiveness of the systems of care and evacuation, and allows the investigator to focus attention on required areas of research. The following definitions standardize the numbers to allow a reasonable retrospective comparison among armed US conflicts.

### CASE FATALITY RATE (CFR)

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CFR refers to the combat deaths (i.e., KIA and DOW) as a percentage of total number of serious BIs (i.e., not counting those injured who are able to be returned to duty).

$$\text{CFR} = \frac{(\text{KIA} + \text{DOW})}{(\text{KIA} + \text{WIA} - \text{RTD})} \quad (100)$$

This summary statistic provides a measure of the battlefield's composite lethality for our BIs. Of note, the denominator for CFR includes the RTDs that are excluded in the denominator of DOW and killed in action (KIA) rates. However, this statistic has been used both with and without the RTD population, creating a major source of confusion when comparing data sets. Insufficient detail is provided by a CFR for detailed medical planning, since its assessment is not based on the population at risk. In this case, the CFR simply describes the mortality rate among Warriors who are actually wounded.

$$\text{Survivability} = (1 - \text{CFR}) \times 100$$

The metric of survivability is merely the converse of CFR and can also be described mathematically as a percentage.

### PERCENT KILLED IN ACTION (KIA)

KIA refers to the number of combat deaths that occur before reaching a military treatment facility (MTF, namely, a Role II or III echelon of care), and then expressed as a percent of the WIA minus the RTDs.

$$\%KIA = \frac{\text{(Deaths before MTF)}}{[KIA + (WIA - RTD)]} \quad (100)$$

This figure provides some measure of: 1) the lethality of weapons (>80% of KIAs die instantly from non-survivable injuries; 2) the effectiveness of pre-hospital care and 3) the efficiency of evacuation from the POI to higher echelons of care.

### PERCENT DIED OF WOUNDS (DOW)

DOW is the number of all combat deaths that occur after the casualty reaches an MTF, or Role II/III echelon of care. It is expressed as a percentage of total wounded minus the RTDs.

$$\%DOW = \frac{\text{(Deaths after MTF)}}{(WIA - RTD)} \quad (100)$$

This figure provides a measure of the effectiveness of the MTF care and perhaps also of the appropriateness of field triage, initial care, optimal evacuation routes and application of a coordinated trauma systems approach in mature combat settings. Deaths that occur at any time after evacuation to an MTF are included in this category.

It is important to note the above two figures, %KIA and %DOW, have different denominators. The latter does not include deaths before reaching a medical treatment facility or those who are dead on arrival at an MTF. This focuses %DOW as a measure of MTF care. However, both denominators

use the same definition of a battle injury—those injured severely enough that they will not return to duty within at least 72 hours. For practical purposes, these Warriors are generally evacuated out of theater.

The main difference between %KIA and %DOW is that the number of KIAs is excluded from DOW calculations. With that, it becomes clear the %KIA and %DOW cannot be summed to obtain the CFR.

## PREVENTABLE DEATHS

The JTTS conducts a weekly worldwide teleconference to review recent casualty data and injury outcomes. This has proven extremely beneficial in providing frontline medical personnel near-real time feedback on their care of the battle injured casualties. Concerning DCBI, the JTTS teleconference audience can readily identify early trends to optimize care from Role II and higher locations. It has been limited, however, in its ability to garner information from Warriors who do not survive before reaching a Role II. These cases are not routinely reviewed in the weekly trauma teleconferences.

Avoidance of preventable death is an important outcome measure in battlefield trauma care. Every friendly death in combat is a tragedy; every preventable friendly death is a call to action. Understanding the incidence of potentially preventable combat deaths requires autopsy data review from OAFME.

A review of OAFME records for the past 12 months revealed 111 dismounted Service Members killed by explosion with at least one major lower extremity amputation. Fifty of 111 (45%) were Soldiers, 55 of 111 (49.5%) were Marines; 2 were Sailors, and 4 were Airmen. Nearly half of these BIs had bilateral lower extremity amputations (38 of 81 casualties with more than one amputation). Additionally, 22 of 81 (27%) had three-extremity amputations, and 8 of 81 (10%) had segments of all four extremi-



ties amputated. (b) (7)(F)

A preventable death analysis has not been accomplished on this particular casualty subgroup to date, however, published reports in 2007 and 2008 indicate a potentially preventable death rate among US military fatalities in Iraq and Afghanistan to range between 15% and 50% in the DOW category, largely from hemorrhage. This area is extremely important and requires coordination between JTTS and OAFME.

The incidence of preventable deaths among 419 battle casualties sustained by one Army Ranger unit that trained all of its warfighters in TCCC since prior to the start of the war is 3%. Within this unit, the incidence of preventable deaths from failure to carry out required interventions in the pre-hospital phase of care was zero.

## INCIDENCE OF BATTLE INJURIES

Based on OIF composite casualty data, the casualty rates for %KIA, %DOW and CFR are 17%, 6.5%, and 11%, respectively, with a corresponding survivability rate of 89%. (See Figure 2).

These rates have remained relatively stable through the past three years. However, it is important to note the graph reflects cumulative rates over the course of many years, which tends to normalize day-to-day changes. This will tend to blunt or conceal any short-term trends. This report will compare the past 24 months in the ATO to identify any recent trends.

The JTTS implemented a military variation to the civilian trauma scoring system because our battle injuries are not seen within the civilian community. The resultant Military Injury Severity Score (mISS) takes into account markers of significant trauma relevant to the battlefield scenario. The ISR is studying the trauma severity scoring system

**OIF Cumulative Rolling Monthly Averages: %KIA, %DOW, CFR and mISS**  
November 2003 – September 2010

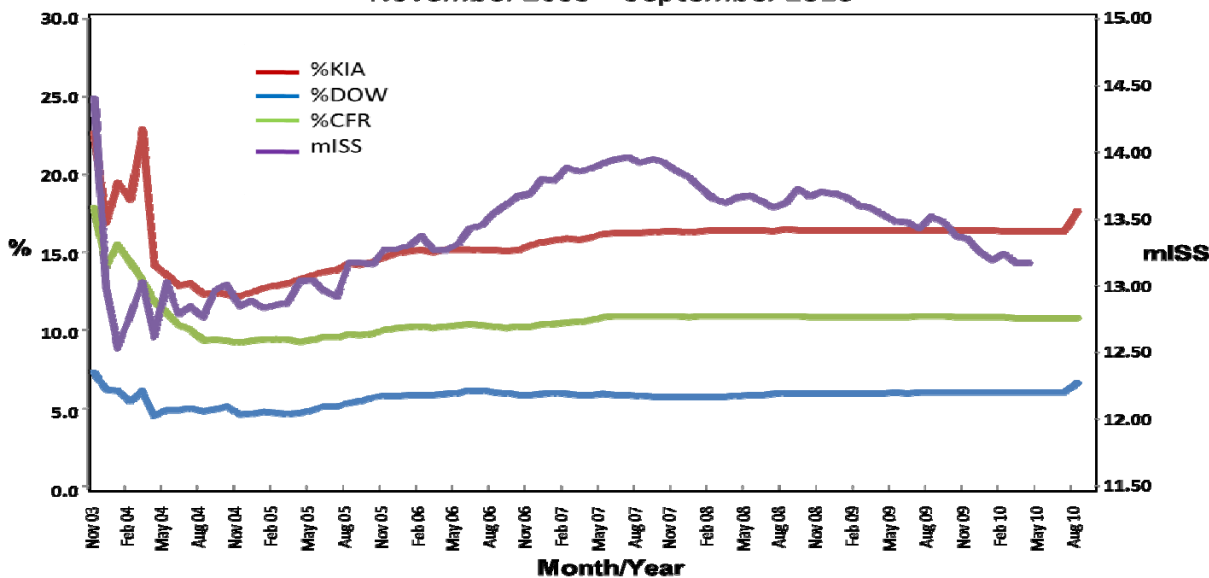


Figure 2. OIF Cumulative rolling monthly averages of % Killed in Action, % Died of Wounds, % Case Fatality Rate, and Military Injury Severity Score. Joint Theater Trauma Registry.

to optimize the predictive value for military operations.

Note the decreasing injury severity associated with the measured drawdown and advent of Operation New Dawn (OND) in the ITO. This suggests a decreased operational tempo, and less exposure to direct or indirect enemy contact compared to the 2007 troop surge.

The OEF composite casualty data shows corresponding %KIA, %DOW, and CFR of 15%, 5%, 12%, with a survivability rate of 88%. With respect to that seen in OIF/OND, this data demonstrates steady trends in three of the four measures, starting in 2006. (See Figure 3).

First, the injury severity has steadily increased. Secondly, both %KIA and CFR have decreased over this same period, with a more dramatic drop over the last twelve months. Of the four measures, %DOW has remained relatively stable during the past five years.

Again, the reader should bear in mind these data reflect cumulative rates over the course of many years. As such, small day-to-day changes become normalized over time.

The most striking takeaway from this graph is that KIA rates and CFR, when compared to the total Warriors exposed to risk, are declining at the same time injury severity is increasing.

The increased severity of injuries can reflect any number of events, either alone, or in combination, including, but not limited to, increased weapon lethality, TTP of either side, or an improved capability among Soldiers and Marines, Corpsmen and Medics, front line medical personnel, and evacuation assets to provide excellent pre-hospital care and efficient evacuation to sites that can provide acute resuscitation and damage control surgery.

The DoD is fully engaged in helping US-CENTCOM and ATO troops eliminate or

### OEF Cumulative Rolling Monthly Averages: %KIA, %DOW, CFR and mISS November 2003 – September 2010

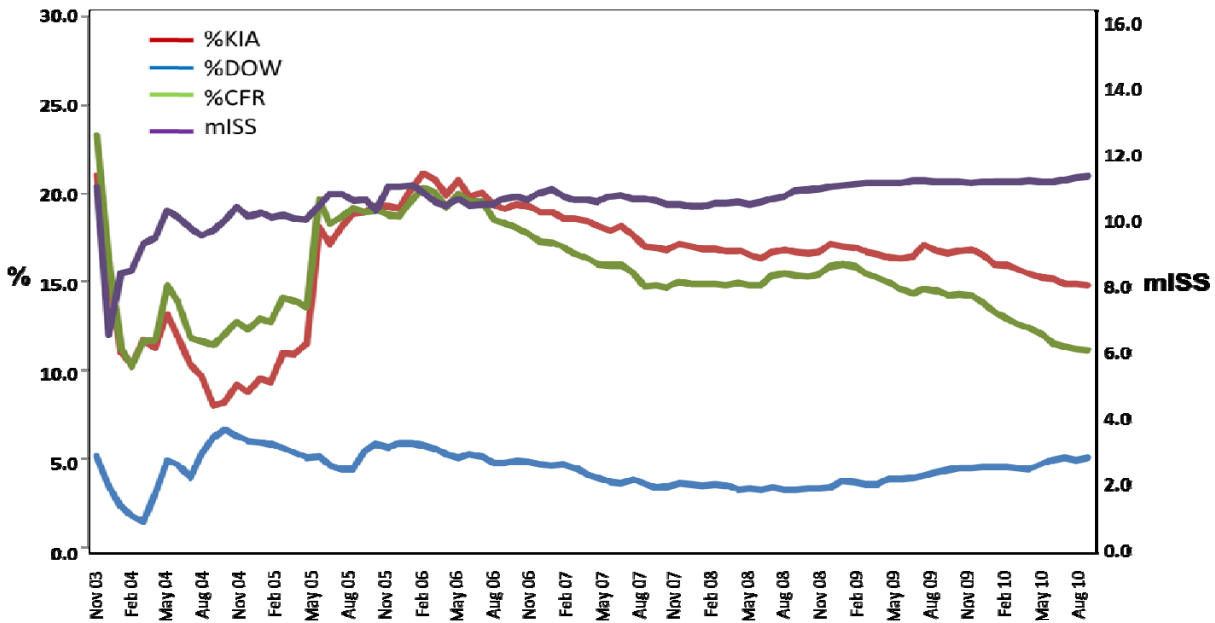


Figure 3. OEF Cumulative rolling monthly averages of % Killed in Action, % Died of Wounds, % Case Fatality Rate, and Military Injury Severity Score. Joint Theater Trauma Registry.

mitigate enemy threats across the battlefield. This Task Force believes a leading cause for these improved survival rates is due to a better trained and equipped warfighter force. Indeed, these findings portend a dynamic commitment to improving Warrior protection and combat casualty care.

Looking now at non-cumulative monthly casualty trends, the OIF/OND BIs have steadily decreased since 2008, following the troop surge and its intense fighting in 2007. (See Figure 4). With the sustained movement towards transitioning military responsibilities to the Government of Iraq (GoI), it appears this downward trend will continue unabated.

To the contrary, casualty numbers have steadily increased in the ATO, consistent with the increased number of troops at risk and the associated increased operational tempo. (See Figures 4 and 5). Throughout OEF, casualty numbers declined each winter. Despite this predictable variability, the casualty trends have steadily increased.

### Overseas Contingency Operations Casualty Data October 2001 – December 2010

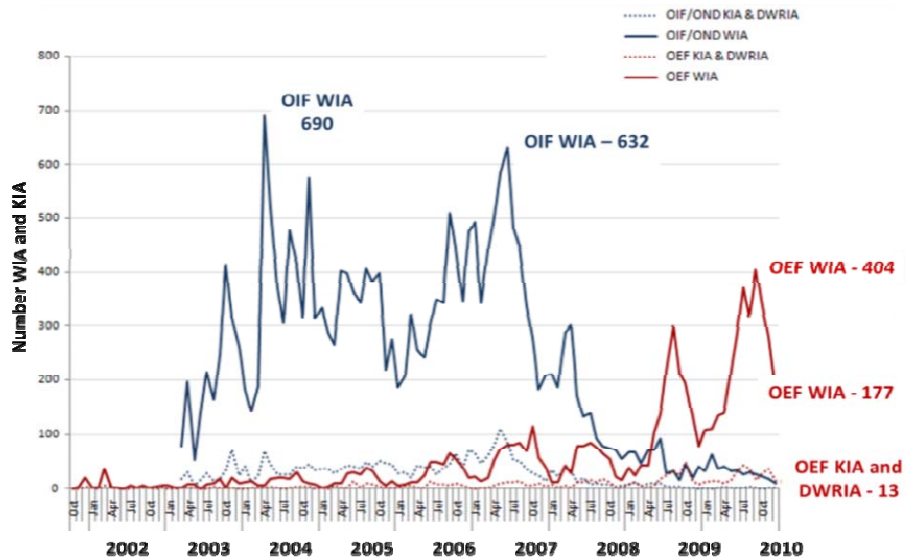


Figure 4. OCO monthly casualty data from OCT 01 to DEC 10.

Although we described a decreasing KIA rate on the previous slide, the actual numbers of KIAs and WIAs have both increased slightly this past year. Importantly, the

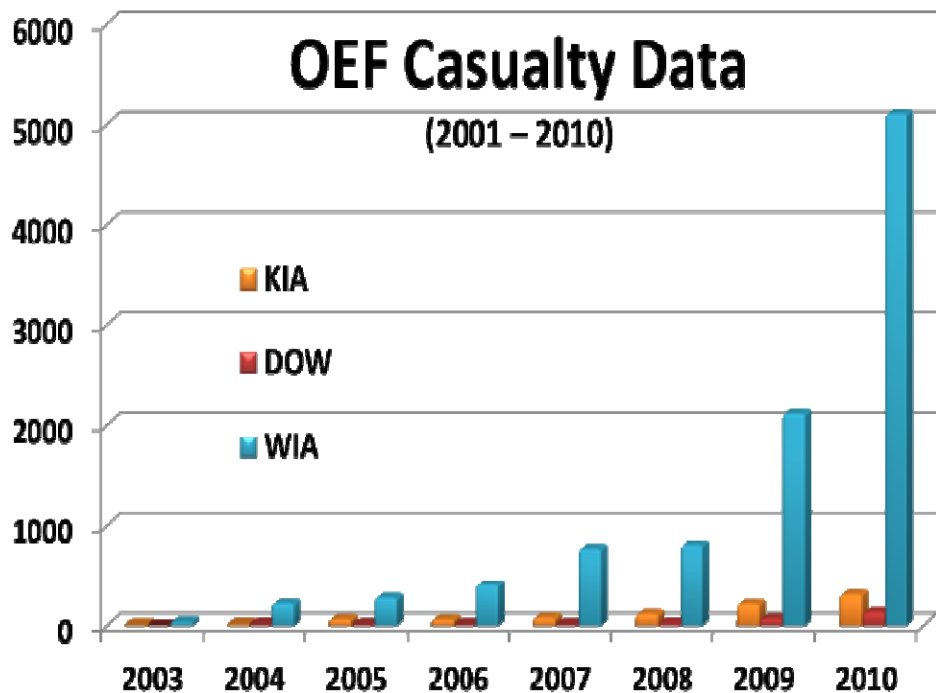


Figure 5. OEF Yearly Total Casualty Data (2003-2010).

KIA rate remained static during the period of increased troops at risk with the surge.

## IMPROVING SURVIVABILITY

Survival in battle is contingent upon a number of factors in addition to medical care, including equipment, training, maneuver techniques, tactics, and adaptability to the enemy threat. Attributable improvements in survival have come from lessons learned as a result of previous conflicts in American history. (See Figures 6 and 7).

Survival in World War II was improved by the novel utilization of blood transfusion and improvements in ground evacuation. With Korea and Vietnam, the advent of RW evacuation to expedite moving the combat casualty from POI to a medical facility markedly improved survival outcomes.

The current contingency operations have demonstrated unprecedented survival compared to previous conflicts in US military history.

Key components in the contemporary improvement in battle-field survival are improved PPE and mate-

riel, improvements in field provider training with the tenets of Tactical Combat Casualty Care (TCCC) and the implementation and evolution of a formal trauma system to effect performance improvement along the entire continuum of combat casualty care. These effects are emphasized by the progressive improvements in survival shown in Figure 7.

### Improving Casualty Survivability

OEF: 7 October 2001—31 December 2010

OIF: 19 March 2003—31 December 2010

(b) (6) OTSG 31 January 2011

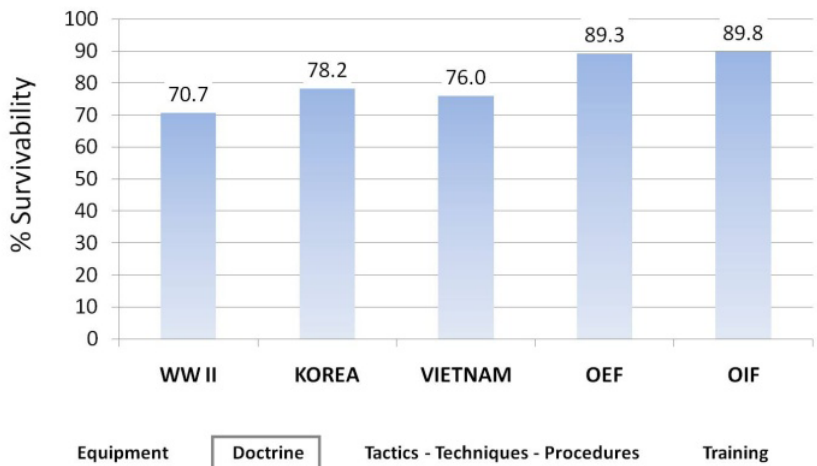


Figure 6. US military survival from battle injuries have increased with each major conflict since World War II.

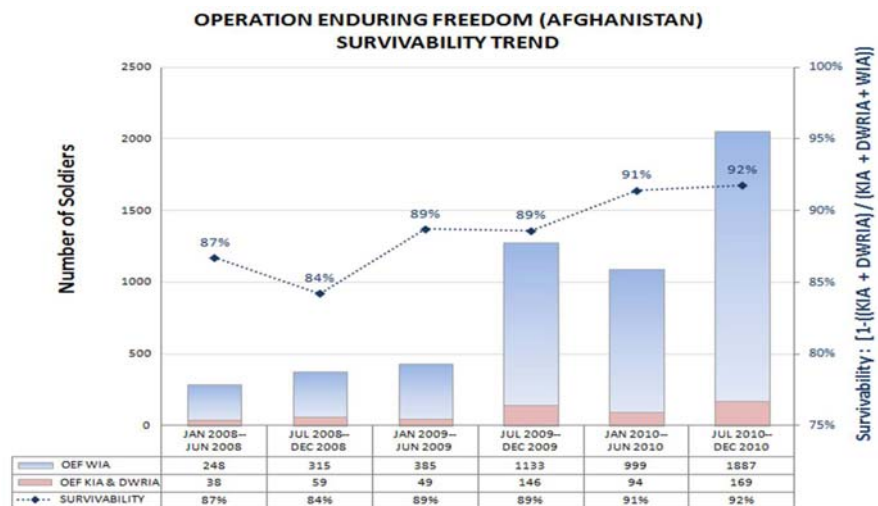


Figure 7. Six-month OEF Survivability trends (JAN 2008 – DEC 2010). DMDC, 03JAN11.

## MASSIVE TRANSFUSION

As a surrogate marker for injury severity and complexity, the number of massive transfusions has increased relative to the OEF casualty rates. (See Figures 8 and 9).

in the outcome improvement likely include improved training for Combat Medics and Corpsmen, tourniquet utilization, rapid casualty evacuation, and damage control surgery.

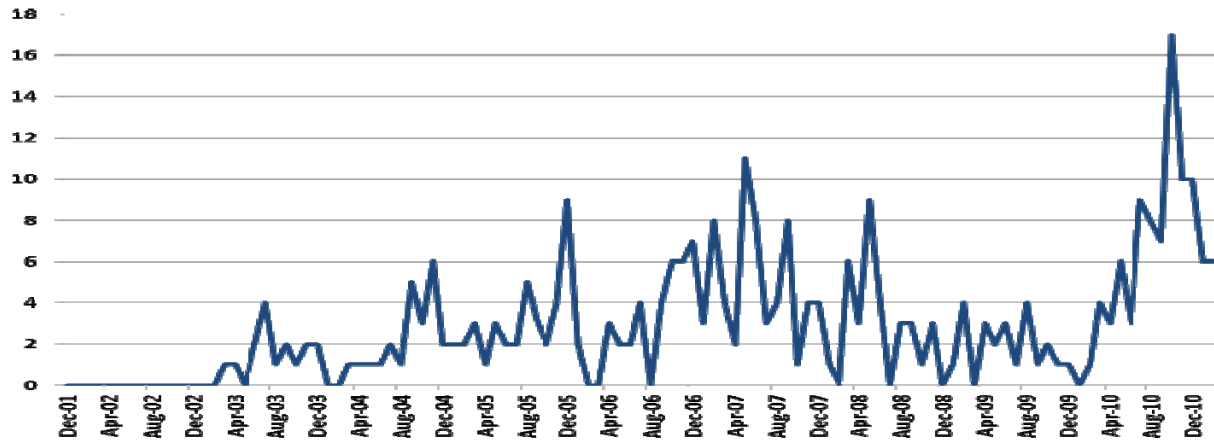


Figure 8. Monthly OEF massive transfusions. Left axis represents # units of blood. (DEC01 – DEC10)

Massive transfusion of blood is a marker of severe bleeding and hemorrhagic shock. The survival of combat casualties requiring massive transfusion has increased from 62% (before mid-2006) to greater than 80% (after mid-2006). The most significant component of this survival improvement is the change in resuscitation strategy focused upon

balanced transfusion of blood, plasma, and platelets, which approximates fresh whole blood. Other factors

## PRIMARY MECHANISMS OF AMPUTATION

Different phases of the current conflict have produced discrete injury patterns requiring adaptation for mitigation. Historically, the overwhelming number of US mil-

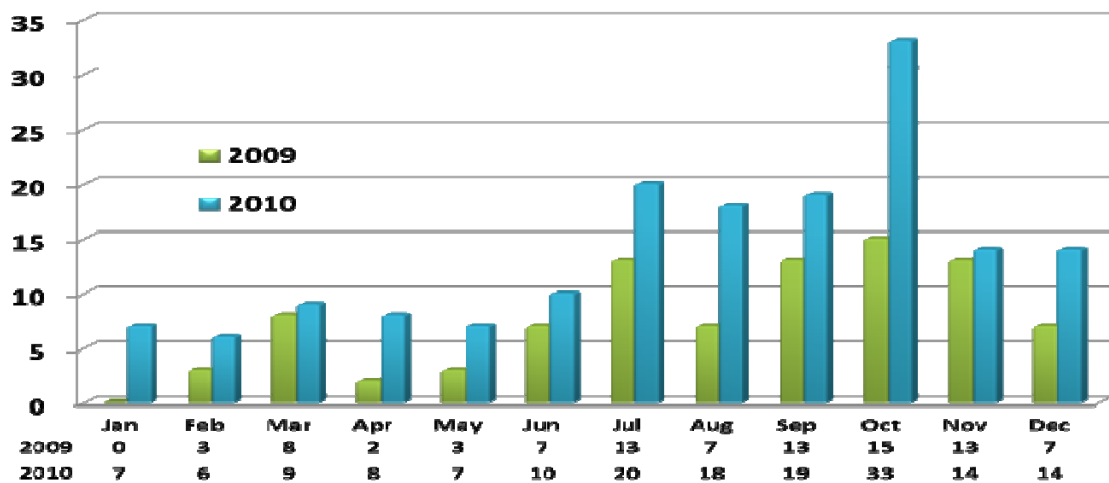


Figure 9. Recent monthly massive transfusions. Left axis represents # units of blood. (JAN09 – DEC10)

ARMY: BI and DNBI Amputee	19 MAR 2003--18 JAN 2011			7 OCT 2001--18 JAN 2011			OIF, OND, OEF Total	PERCENT OF ALL MECHANISM TYPE		
	Operation Iraqi Freedom & Operation New Dawn		OIF Total	Operation Enduring Freedom		OEF Total		OIF & OND	OEF	OIF, OND, & OEF
	MAJOR LIMB	MINOR LIMB	MAJOR + MINOR LIMB	MAJOR LIMB	MINOR LIMB	MAJOR + MINOR LIMB				
PRIMARY MECHANISM OF INJURY										
(b) (7)(F)										
column total	624	272	896	203	30	233	1129			
			79%			21%				

Table 1. Major and minor limb amputations from OIF/ OND and OEF. (b) (7)(F)

itary casualties was caused by explosions. The hallmark of the injury pattern in the contemporary context is the dismounted Warrior injured by a landmine or other improvised ground-based explosive (Table 1). The dismounted posture places the warfighter at risk for more significant orthopedic and soft tissue injury, including amputation, GU, pelvic and abdominal injury, as a result of the blast and energy and multiple projectile force.

The rate of major amputations has changed throughout the course of combat operations in the ATO. (See Figure 10). This rate of amputation in the context of personnel at risk suggests an increasing demand

on the continuum of the healthcare throughout the echelons of care, from the battlefield to long-term rehabilitation centers.

The graph shows the relative increase in OEF amputations over time, something lost when considering a single month or a single

### OEF, OIF, and OND Major Limb Amputee: BI Trend

October 2005—December 2010

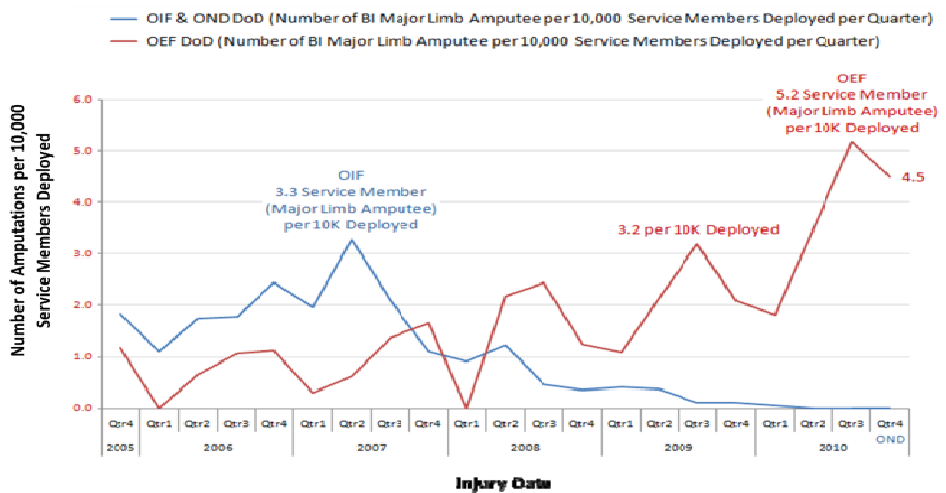


Figure 10. Major amputations for OIF/OND and OEF per 10,000 deployed troops (OCT05–DEC10).

year in isolation. Even though the numbers are less than that seen in the ITO during its peak casualty-producing months, it remains impressive by its relative increase. On the other hand, the absolute number of major amputations is a better reflection of the demand placed on the healthcare system throughout.

### Breakdown of Surviving Amputees

January 2010—March 2011

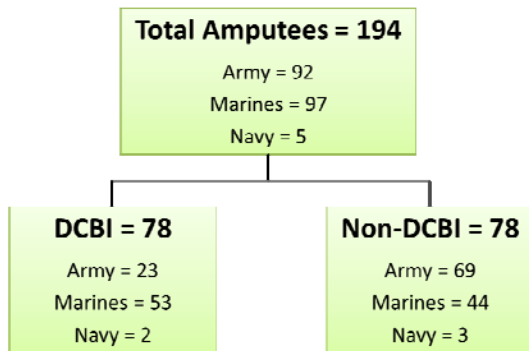


Figure 11. Service affiliation of surviving amputees from JAN 2010 through MAR 2011. 100% of these individuals were men. Naval Health Research Center.

These particular casualties not only require aggressive resuscitative and surgical support on the battlefield, but also encounter significant definitive and rehabilitative challenges as a result of their injuries. Advances in pre-hospital care, evacuation, and acute care are saving casualties with injuries that likely would not have survived in the past.

However, the significant explosive energy-producing event in the current scenario is associated with substantial destructive force, often leading to multiple amputations, the numbers of which have increased in OEF since mid-2010.

Navy Medicine studied 194 amputees in the ATO from January 1, 2010, through March 31, 2011. (See Figure 11). The first thing to note is that the USMC sustained the majority of these injuries. Among the BI am-

putees, there was a 50:50 distribution between the Army and USMC. Because of the smaller USMC footprint, the amputation rate among Marines was much higher than that of the Army: 1:206 USMC BOG vs. 1:641 Army BOG. Furthermore, of the 78 cases that met the DCBI definition, 68% (n=53) of the multiple-limb amputees were Marines (1 DCBI:377 USMC BOG). Additionally, the two Navy BIs were affiliated with USMC operations. Army Soldier BIs represented 29% (n=23) of the remaining DCBI cases during this 15-month period (1 DCBI:2565 Soldier BOG). (See Figure 12).

### DCBI by Service

January 2010—March 2011

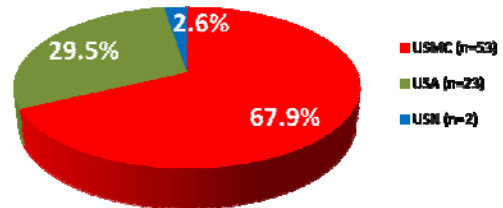


Figure 12. Service affiliation of surviving DCBI casualties from JAN 2010 through MAR 2011. Naval Health Research Center.

For the 15 month time period studied, 12% (n=23) of the 194 amputees were mounted and 88% (n=171) were dismounted. (b) (7)

(F) The average rate of DCBI per 1000 BIs was 6.69 for the Army and 28.45 for the Marines.

## ASSOCIATED GENITOURINARY INJURIES

Also associated with the ground-based explosive injury is an increase in the number and severity of GU injuries, particularly injury to the external genitalia (See Figure 13 and 14). As with amputations, the number of GU injuries has increased as a function of increased combat casualty number.

BI amputations have a significant association of perineal and GU injuries (Figure 15). The significance of the current pattern of GU injury is the potential impact on physical, reproductive, and behavioral health of these casualties. It is imperative, therefore, management of this complex pattern of GU injury requires attention paid towards surgical reconstruction and psychological health.

## ASSOCIATED TRAUMATIC BRAIN INJURY

Finally, available data suggests fewer cases of comorbid TBI among major amputation casualties from OEF compared to OIF/OND. Because this chart does not distinguish mounted from dismounted settings at the time of injury, the rate difference

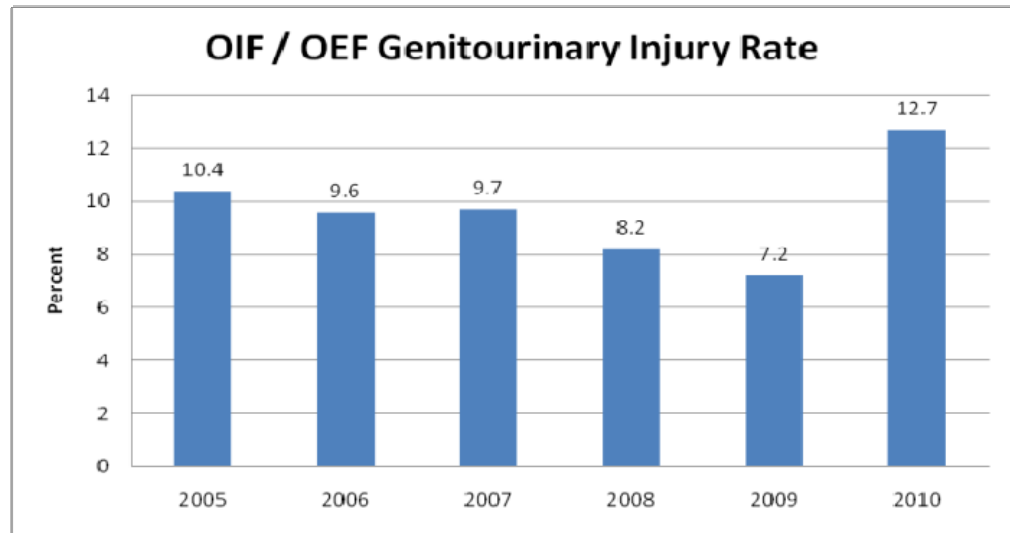


Figure 13. Rate of GU injury among all admissions from OIF/OEF from 2005 to 2010. Historical average is 2-5%. Source JTTR.

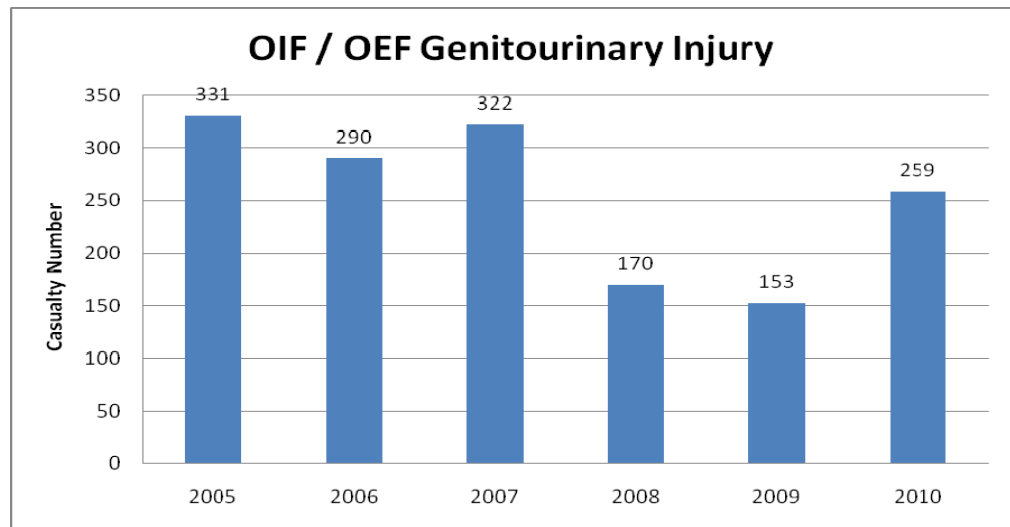


Figure 14. Total number of GU injuries among all admissions from OIF/OEF from 2005 to 2010. Source JTTR.



**OEF, OIF, OND Major Limb Amputee: Battle Injury (BI) Trend**

2009-2010

(b) (7)(F)



Figure 15. OCT09–DEC10 major amputations for OIF/OND and OEF with trends for associated GU injuries circled.

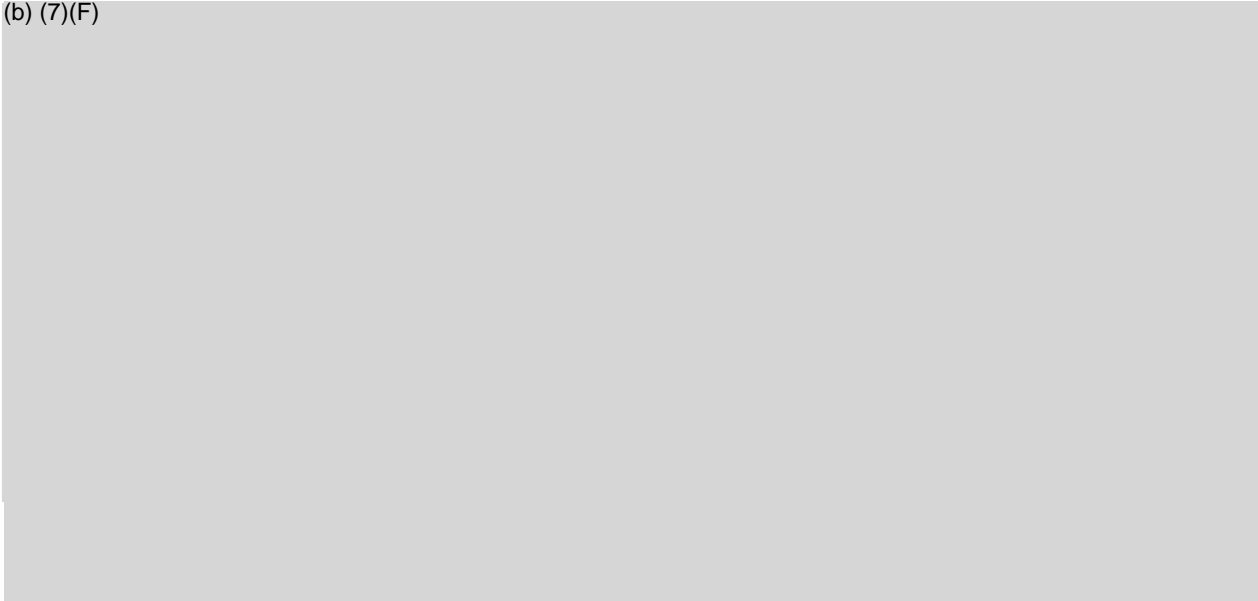
may simply reflect the greater number of dismounted cases in the ATO. (See Table 2). In turn, this may reflect the open space effects of explosive devices and vehicular crashes among dismounted troops.

Regardless, there remains a significant sub-population of traumatic amputation casualties with some degree of TBI secondary to

the inciting event. As will be discussed later, these comorbid injuries significantly increasingly challenge the patient's rehabilitation and recovery plan. In a whole-person approach to healing, these issues must be addressed comprehensively by the healthcare team and Family alike in support of the patient.

**BATTLE INURY: Amputation and Associated Traumatic Brain Injury (TBI)**

(b) (7)(F)



# CURRENT PRACTICE

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## PRE-HOSPITAL CARE

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The primary goal of pre-hospital care is to initiate actions that keep the casualty alive to reach a Role II/III medical treatment facility (MTF) with the capability to perform trauma resuscitation and surgical intervention if necessary. Pre-hospital's secondary goal is to optimize the battle casualty's potential for the best possible functional recovery and long-term good quality of life. This is best accomplished by mitigating risk factors for onset of the "lethal triad" of coagulopathy, hypothermia, and hypovolemia (i.e., the inability of the blood to clot, low body temperature, and low blood volume).

## BEST PRACTICES IN PRE-HOSPITAL CARE

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### TOURNIQUETS

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Exsanguination—lethal blood loss—from extremity wounds was the leading cause of preventable death among US military casualties in the Vietnam conflict. Published reports on causes of death in that conflict documented a 7.4% rate of preventable death from failure to use tourniquets.

As a result, TCCC began calling for the aggressive use of tourniquets for the initial control of life-threatening extremity hemorrhage five years before the onset of OEF. Tourniquet use is one of many areas in which TCCC recommends somewhat different pre-hospital trauma management strategies than those currently taught in civilian trauma courses.

A review of combat fatalities in OIF and OEF through 2006 reported a 7.8% death rate from extremity hemorrhage (77 deaths associated with lack of tourniquet use

among 982 fatality cohort). Of note, this rate mirrored that seen in the Vietnam War.

Contrast this experience with that of the 75th Ranger Regiment. The Rangers are one of only three US infantry units to have implemented TCCC throughout its force before the war, and the only group to have documented their experience. As such, they reported a 0% preventable death rate from extremity hemorrhage among 419 Ranger casualties throughout the entire decade of conflict in both OIF/OND and OEF.

When tourniquets are used in the pre-hospital setting, they have been shown to be remarkably effective at decreasing preventable deaths due to extremity hemorrhage without a corresponding threat to the treated limb. In addition, in a case series of 232 casualties with tourniquets placed in the field on 309 extremities, there were no limbs lost to ischemia (i.e., inadequate blood flow to tissues).

TCCC has gained increasing acceptance among US conventional forces since 2005. The Task Force expects future data will show improvement in preventable deaths.

## PREVENTION OF POST-TRAUMATIC COAGULOPATHY

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Coagulopathy, the inability for blood to clot normally, is common in combat casualties requiring transfusion (38%) upon arrival at the emergency department, and is associated with a six-fold increase in mortality. Additionally, coagulopathy increases mortality among trauma patients with severe TBI.

Acute traumatic coagulopathy, regardless of the underlying injury severity, resuscitative transfusion regimen, or other physiological markers for hemorrhage, was associated with early death in major trauma patients, with an odds ratio of 8.7 (i.e., the

patient is 8.7 times more likely to suffer early death than a patient without coagulopathy).

The hypovolemia associated with extremity trauma impairs the body's ability to maintain adequate temperatures. The resultant hypothermia—even at normal or hot ambient temperatures—results in coagulopathy, which, in turn, leads to further bleeding.

The best practices seen in this area are twofold: 1) TCCC course emphasis on eliminating the routine use of anti-platelet agents, namely aspirin- and nonsteroidal anti-inflammatory agents; and 2) relatively common post-traumatic use of specific warming blankets to maintain core body temperatures throughout the pre-hospital phase of care.

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## CHALLENGES AND ISSUES IN PRE-HOSPITAL CARE

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### CONTROL OF JUNCTIONAL BLEEDING

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DCBI casualties are often noted to have life-threatening bleeding in the groin or very proximal lower extremity regions, where a tourniquet cannot be applied effectively. Although hemostatic gauze has been reported to work well in some cases, a backup means of hemorrhage control is needed.

The ISR evaluated a Food and Drug Administration (FDA)-approved clamping device to address difficult-to-control junctional bleeding in the groin or axilla, with promising early results. Further development and evaluation of this technology is underway. Of note, at least two Special Operations Force (SOF) units have deployed this device into theater, although early data from Armed Forces Institute of Pathology (AFIP) is not yet available.

## BATTLEFIELD ANALGESIA

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Prompt relief of severe pain resulting from combat trauma has been shown to decrease the incidence of post-traumatic stress disorder in combat casualties.

The time from administration to onset of analgesia for intramuscular (IM) morphine can be as much as 30 minutes. In an attempt to gain rapid control of the pain, IM morphine's delayed response places the casualty at risk for inadvertent overdosing. For this reason, TCCC recommends that morphine and OTFC be administered intravenously for battlefield analgesia.

Oral transmucosal fentanyl (OTFC) was found to achieve rapid and effective battlefield analgesia. In addition to its rapid onset of pain control, OTFC had the advantage of obviating the need to obtain venous access in the battlefield. In 2003 TCCC added OTFC to the list of analgesia options. Unpublished data demonstrated 109 successive safe battlefield administrations of OTFC by Ranger Medics.

There is an FDA "black-box" warning for the administration of OTFC. However, there are multiple published reports in the civilian setting that document OTFC's safety with non-breakthrough cancer pain. The Committee on TCCC (CoTCCC) reviewed OTFC's adverse events reported to the FDA, which reflected problems in unmonitored clinical settings.

The TCCC recommends the one-time use of OTFC under the immediate supervision of a skilled combat medic. (CoTCCC Meeting Minutes, November 2010). Despite its event-free track record for prompt and effective battlefield analgesia, currently only SOF medics are equipped to provide pain relief with OTFC or intravenous (IV) morphine. This is an extremely important area to improve overall point of injury pain management through widespread adoption of CoTCCC recommendations. Additional medic training would further improve this

valuable adjunct and safety in its application.

## HYPOTHERMIA

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Hypothermia-induced coagulopathy is a well-described complication of decreased platelet function, slowing of coagulation cascade enzyme activity, and alterations of the fibrinolytic system. Of note, post-traumatic hypovolemic shock impairs one's ability to generate heat to maintain normal body temperature. This predisposes large-volume hemorrhagic casualties to a vicious cycle of hypothermia that leads to a coagulopathy and worsening hemorrhage.

Preliminary data from an ongoing ISR study on battlefield trauma care noted that 83 of 192 casualties had only a wool blanket for hypothermia prevention. Its studies also show that wool blankets are ineffective at preventing heat loss.

TCCC has long recommended specific and aggressive strategies (the Hypothermia Prevention and Management Kit) to combat hypothermia in combat casualties. Reporting this through Unit Status Reports (USR) will improve the opportunities for its use with combat casualties.

## FLUID RESUSCITATION

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There is no evidence from human trials that aggressive pre-hospital administration of crystalloid fluids improves survival among trauma patients. On the contrary, there is some evidence it decreases survival. Large-volume crystalloid fluid resuscitation is not used in TCCC. Of note, even civilian trauma centers stopped advocating large-volume crystalloid resuscitations.

The use of hypotensive colloid fluid resuscitation was reported in a large, non-randomized study at Ryder Trauma Center in Miami that showed a trend towards improved survival, without impairing coagulation status. Hypotensive resuscitation with Hextend® was approved by the CoTCCC in

2003. Both the limited use of IV access recommended in the 1996 TCCC paper and the hypotensive resuscitation strategy are now being reflected in some civilian trauma organizations.

Despite the above, the ongoing ISR's pre-hospital trauma interventions study found crystalloids used for fluid resuscitation in 87% of casualties who received pre-hospital fluids. There is as yet no requirement for unit-level reporting of fluids used in resuscitations, despite TCCC recommendations.

## TCCC TRAINING

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TCCC is now used by all Services in the US military and by many coalition partners as the standard for training medics to manage combat trauma on the battlefield. It is taught to new Soldiers by the Army Training and Doctrine Command (TRADOC) as part of its Combat Lifesaver training program. On the other hand, US military physicians and nurses do not routinely receive formal TCCC training. This disparity between medics and medical officers can lead to incongruous approaches to the DCBI casualty regarding hemorrhage control or resuscitation regimen.

TCCC is also not taught routinely to combat leaders or to all deploying warfighters during their pre-deployment preparation for combat operations. This eliminates the possibility of these individuals being taught TCCC's latest developments and lessons learned.

Pre-deployment provider training requirements should be the same for providers assigned to either Army or Marine Role II facilities. Familiarization with CENTCOM CPGs and TCCC principles should be a pre-deployment training prerequisite.

## **FREEZE-DRIED PLASMA**

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Data indicates a significant advantage to administering packed red blood cells (PRBCs) and plasma in a 1:1 delivery ratio. Within the MTF, plasma is stored as fresh frozen plasma (FFP), and then thawed prior to administration. To administer blood products in the pre-hospital phase, one needs a means to get plasma into the battlefield reliably.

As such, freeze-dried, or lyophilized, plasma has gained interest recently. Although available overseas, these products, lack FDA approval presently.

Gaining this approval or accelerated fielding through the FDA process has become a top priority among the military science community. In fact, it was identified as a top priority research area in pre-hospital fluid resuscitation by the ISR-MRMC sponsored fluid resuscitation conference held in Dallas in January 2010.

## **PRE-HOSPITAL DOCUMENTATION**

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Pre-hospital care is key to mitigating worsening morbidity following an explosion injury. Systematic improvement requires a means to document care rendered at the POI

Only 14% of casualties have pre-hospital care documented upon arrival at a Role II/III facility. The lack of consistent pre-hospital documentation of care continues to be a requirement gap across the Services.

Unit-based pre-hospital trauma registries (PHTRs) have proven beneficial for the healthcare team at successively higher echelons of care. Unfortunately, use of such registries, such as that seen in standard NATO documentation forms, has not been embraced across the force. Implementation of its use is being developed currently. At a minimum, documenting the date-time group of tourniquet placement on the card and on the patient is the most important information for decision making at the

next level of care. Medications and intravenous fluids are next most important.

## **ROTARY WING EVACUATION**

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Almost every casualty is evacuated to Role II or III care via RW platforms. This has been through combat RW, which is called casualty evacuation (CASEVAC), or by dedicated, medically equipped RW MEDEVAC platforms. This has been due to theater-wide air superiority and the relatively high risk of ground evacuations due to roadside bombs. It is important to note Marine Corps doctrine differs from the other Services in that evacuation platforms are designated, not dedicated. Additionally, CASEVAC from the POI to Role II/III echelons of care is not restricted to RW platforms. In this regard, Marine RW CASEVAC involves lifts of opportunity.

The Marine Corps employs an En Route Care System (ERCS) that provides essential follow-on support for the Forward Resuscitative Surgical System (FRSS). The ERCS has the mission of transporting stabilized post-operative patients from Role II sites to the next echelon of care. As such, it is capable of providing two hours of in-flight medical care for two critical, stabilized, patients. The ERC team consists of one critical care nurse and one 8404 ERC Corpsman (b) (3) [10 USC 130(b)]

supported by Army and Air Force RW platforms.

## **ROTARY WING PLATFORMS AND ORGANIZATION**

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In both theaters of operation we have been able to evacuate BIs from the POI to a surgeon within one-hour of request. This has proven more difficult in the ATO due to its rugged terrain, high altitudes, and long

distances between Role II/IIIs and the operating force engaged with the enemy.

The cost has been high on these low-density, highly specialized air ambulance units. To meet the one-hour evacuation standard within both theaters of operation, mission requirements have produced significant wear on both airframes and personnel, with only slight relief from the drawdown of troops in OND.

Accelerated implementation of the Army's decisions to increase MEDEVAC units' complement of organic aircraft from 12 to 15, along with the growth of nine additional MEDEVAC companies within the force structure, will provide much greater flexibility in the operational employment of these strategically vital assets.

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## **BEST PRACTICES IN ROTARY WING EVACUATION**

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In 2007, a RW evacuation database was implemented to track timelines for each phase of every RW MEDEVAC mission. This allowed senior leaders and commanders to understand and control performance at each step to maintain or enhance evacuation times and standards.

Although well-postured for shorter evacuation missions, Army aircraft are not the best suited for the longer distances in place in the ATO. The Army should consider other airframes with better speed, range and lift.

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## **CHALLENGES AND ISSUES WITHIN ROTARY WING EVACUATION**

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The DCBI patients routinely overfly Role II sites in their evacuation to Role III echelons of care. This occurs because: 1) The Role II site may not have the requisite resource capability to handle these very se-

verely wounded casualties; 2) the Role II facility is not located between the casualty pickup location and the next higher echelon of care; 3) the casualty is directed to a Role III echelon by the MRO; and/or 4) the aircrew determines the patient's condition warrants overflight to a Role III echelon of care.

Although survivability has increased and KIA/DOW rates remain fairly constant, we do not know the rates of KIAs with the DCBI pattern in relationship to Role II locations. The questions that merit further study include:

Are those patients with a DCBI occurring closer to Role II dying prior to receiving definitive care?

If RW evacuations of DCBI patients routinely bypass Role II echelons of care, does it result in a higher mortality?

Greater speeds and payloads substantially enhance aerial medical evacuation operations by facilitating timely evacuation to the appropriate Role of care, over greater distances, and with more efficient use of forces.

With greater ranges, vertical lift aircraft could operate from more secure locations, with less logistical support lines, less of a footprint on the ground, and provide evacuation to better care facilities for injured Warriors.

Platforms with cabin space sufficient to allow medical providers to stand, with appropriate equipment and interior lighting, could facilitate limited en-route emergency surgical procedures.

However, it has been shown that delay of transport to definitive care has resulted in an increased mortality. This begs the question of whether mid-level providers should staff these platforms, similar to that done by the United Kingdom (UK) and its Medical Emergency Response Team (MERT) system utilizing physicians, not medics, or physician assistants. The ISR is working to

obtain the UK MERT data for review. In the meantime, the US Army is using critical care nurses for the transport of complex patients between Role II and Role III facilities, and is completing a study to increase the flight medic skill set to that of a paramedic. Other Services may address this gap utilizing different manning options. Ultimately a Joint solution should be explored, maximizing all of the different Service strengths.

The issue of patient regulation and when to overfly Role II needs further evaluation. Clinical decision-making needs to be part of the process, whether at the time of pick-up and/or as part of the Patient Evacuation Coordination Cell (PECC).

## ON-BOARD TACTICAL EVACUATION CAPABILITY

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Medical expertise aboard evacuation platforms is not presently standardized in the ATO. The level of medical expertise on board ranges from Basic Emergency Medical Technician (EMT-B) flight medics to paramedics and critical care nurses, while others, namely the UK, utilize MERTs staffed with highly trained trauma providers.

Currently in Regional Command-Southwest [RC(SW)], the UK MERT is used preferentially to evacuate the most severely wounded casualties. The MERT is the only unit that has a physician-led RW medical team onboard. As such, it routinely administers pre-hospital blood products (four units of packed red blood cells and four units of fresh frozen plasma), provides advanced airway interventions, and treats with vasopressor agents, tranexamic acid, and IV analgesia with ketamine or fentanyl.

The UK's approach is promising in that it brings resuscitative concepts far forward, potentially extending the reach of RW evacuation hubs. Air Force Special Operations Command (AFSOC) deploys Special Operations Surgical Teams (SOST) and

Critical Care Evacuation Teams (SOCSET) that operate in a fashion similar to the UK's MERTs.

USSOCOM has long had a surgical capability on evacuation platforms.

Army flight medics do not generally receive advanced trauma training beyond what their 68W ground combat medic counterparts receive. As they are trained currently, US flight medics lack the complete skill set to manage all patient categories through the full spectrum of military operations. The Task Force believes the new Army flight medics should have the capability to provide enroute specialized advanced trauma management at or near the point of injury.

Unpublished data demonstrates an increased 48-hour survival rate among casualties transported by critical care flight paramedics (CCFP) relative to those monitored by EMT-B flight medics (92.1% vs. 84.9% survival). The AMEDDCS CG approved a recommendation recently to train all 68W Flight Medics to qualify as Critical Care Flight Paramedic Certified (CCFMT-P/FP-C). Having paramedic-certified flight medics will bring the Army in line with the US civilian medical standard.

Based on their experience, the Navy contends transport of stabilizing casualties from Roles II to III facilities must be performed by at least a critical care nurse with flight training (i.e., ERC RN) who is capable of monitoring hemodynamic parameters, administering vasoactive medications and blood products, and performing immediate life-saving interventions. For unstable casualties, the Navy further contends a physician should lead the critical transport team.

## **ROLE II/III: ACUTE RESUSCITATION**

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Acute resuscitation involves the pre-hospital phase and the hospital phase of combat care. The focus of this section is initial definitive surgical care provided on arrival to the combat treatment facility.

Mitigating the severe ischemia and irreversible shock cascade these patients face requires skills and resources not available from a Medic/Corpsman at the POI, or routinely available on Army or Air Force RW aircraft.

### **BEST PRACTICES IN ACUTE RESUSCITATION**

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#### **STAFFING**

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There is significant variability in personnel composition and capability of the Services' forward surgical units. The various Role II sites share a common core mission, however, which is to control non-compressible hemorrhage and mitigate the effects of the lethal triad of acidosis, coagulopathy and hypothermia.

Data from I MEF's experience in RC(SW) during 2010 support placing a forward resuscitative team (FRT) in close proximity to areas of active engagement. Physician judgment, clinical decision making, and resuscitative skills proved beneficial to both the patients' short- and long-term clinical outcome.

The FRTs provided enroute resuscitative care, and consisted of an emergency medicine physician and nurse, physician assistant (PA), and three-to-six Corpsman. Typically they were attached to an isolated (geographical or tactical) battalion aid station (BAS) or to the UK MERT transport crew.

## **FACILITIES**

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Combat medical facilities include the US Military Role II and the Role III echelons of care. The Army Role II echelon is the forward surgical team (FST). The FST is a 24-person unit which includes three general surgeons, one orthopedic surgeon and two anesthesia providers. The ability to hold critically injured patients after surgery at the FST is limited to 12-to-24 hours due to manpower and supplies.

The Marines' Role II is filled by the shock trauma platoon (STP) and the forward resuscitative surgical system (FRSS). The eight-person team includes two general surgeons and an anesthesiologist.

The FRSS can manage five patients simultaneously (two pre-operative, one intra-operative, and two post-operative). It can provide for a maximum of 18 surgical patients over 48 hours before relief and re-supply.

Doctrinal USMC Role II facilities (FRSS) are similar in capability to an Army split-FST (two surgeons; one anesthesiologist; one OR table). Alternatively, an Army FST (four surgeons; two anesthetists; two OR tables) is similar in capability to a surgical shock trauma platoon (SSTP = 2 FRSS and an STP). The Marines deployed SSTPs successfully during OIF.

In the ATO, the Marines reorganized their Role II facilities. With a minimum of 20 personnel, these enhanced units included two general surgeons, an orthopedic surgeon, and an anesthesiologist, emergency medicine physician, PA, emergency medicine nurse, CRNA and two critical care nurses.

The Role III echelon of care is the combat support hospital (CSH). The CSH consist of over 200+ personnel supporting multiple general/trauma surgeons, orthopedic surgeons, as well as vascular surgery, thoracic surgery, neurosurgery, gynecologic surgery and intensive care providers. Urologic



surgeons are not presently a requirement at the CSH, but are frequently assigned as an alternative to the general surgeon. These specialty-trained surgeons can make a direct impact on salvage at the time of initial resuscitative surgery.

The CSH has an extended holding capability with a fully staffed intensive care unit. Both the FST and the CSH may be split in different locations as needed. Presently, FSTs and CSHs are strategically placed to provide initial surgical care to all US Warriors within one hour of injury. All US patients with DCBIs are transferred to Landstuhl Regional Medical Center via Critical Care Aeromedical Transport (CCAT) Teams. Transport is generally within 12-24 hours of initial surgical treatment.

Despite the ATO's steady increase in injury severity over the past four years, the percentage of KIAs relative to significant BIs has declined slightly over the same period, and the percentage of DOWs for the same population has remained steady. However, this Task Force is focused on a specific injury pattern that significantly increased in occurrence over the last six months. Put together, we see a long-term increase in survivability among BIs in the ATO, with a peak of 91.6% in 2010. Of note, the DOW rate is equivalent among the FST, split-FST and the CSH.

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## CLINICAL PRACTICE GUIDELINES

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Over the course of OIF, OEF and OND, the JTTS has developed and refined many advances in acute resuscitation and care of the trauma patient to include massive transfusion protocols, traumatic amputation protocols, theater transfer protocols, pain protocols, TBI protocols and many others. The advances in combat care have set new standards in civilian trauma centers for transfusion practices. These Clinical Practice Guidelines (CPGs) are the backbone of the standards of practice in combat trauma

care. The CPGs are taught to Army surgeons currently in graduate medical education programs and to deploying staff surgeons during their preparatory training. However, there is no standardized mandatory pre-deployment trauma training for all medical providers. The CPGs are also available on the ISR website:

[www.usaisr.amedd.army.mil/cpgs.html](http://www.usaisr.amedd.army.mil/cpgs.html)

Upon arrival at the CSH, the DCBI patient receives rapid care by a multidisciplinary group of surgeons and support providers. Massive transfusion protocols are instituted using 1:1:1 PRBC:plasma:platelets ratios. Tourniquets are confirmed or applied to injured extremities and standard guidelines of trauma care are followed. Patients are rapidly transferred to the operating rooms and multiple surgeons address the various injuries simultaneously.

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## CHALLENGES AND ISSUES WITHIN ACUTE RESUSCITATION

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### ROLE III STAFFING

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Minimum staffing requirements for a Role III hospital site should include general/trauma surgeons with vascular surgical capability, orthopedic surgeons, critical care physician and appropriate intensive care unit (ICU) and support staff, to include an Acute Pain Service (APS) with a medical officer trained in pain management. Presently, urologists are assigned only as alternatives in general surgeon slots. Their presence in the ATO would provide a specialist focused on salvage or repair procedures in the setting of GU injuries.

It is not clear if a surgeon's combat experience is a factor in survival among DCBI patients, but it would appear not to be so. As opposed to the medical officers at the POI, surgeons have been exposed to trauma

management during their respective residencies.

That stated, staff providers not currently assigned to high-volume, trauma-heavy MTFs, such as Brooke or Walter Reed Army Medical Centers, should undergo pre-deployment trauma refresher training. These training programs are currently available in Miami, Fort Sam Houston, and other sites.

## ROLE II STAFFING

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Role II [Army Forward Surgical Team (FST)] is much smaller in size and capability than its Role III counterpart. As an example, FSTs do not have platelets or cryoprecipitate, and the pool for whole blood is typically more limited.

Generally speaking, FSTs are being split throughout the ATO. These smaller Role IIs have one general surgeon and one orthopedic surgeon, or two general surgeons and no orthopedic surgeon. This also means they only have one anesthesia provider.

In general, most split-FSTs hold 30-to-50 units of PRBCs and similar amounts of FFP. A split-FST could stabilize a DCBI patient and then send the casualty to the next echelon of care. Many FSTs have taken care of local national patients with this injury pattern and have maintained high survival rates. However, given the limited resources of the split FST, should they have multiple patients, they would be quickly overwhelmed.

Within the ATO Roles II are routinely overflowed when evacuating DCBI patients. This is more a reflection of the MTF's capabilities than on the specific training of its assigned personnel. Published data based on survival reports indicate the FST and the split-FST have the similar survival rates, stratified for ISS, as the CSH. However, this data must be interpreted carefully—

most of these patients are currently evacuated directly to Role III facilities.

Therefore, if bypassing an FST to reach a Role III site will add more than 30 minutes to the evacuation for a single patient, the current recommendation would be an initial stop at the FST for stabilization, and then continue transport. KIA data must be studied to determine any relationship between DCBI KIA and proximity to Role II care.

The Role II echelon of care remains valuable to the warfighter. Mobility is its greatest advantage and Role IIs should be moved throughout the battlefield to best support likely high intensity operations.

The Navy's experience is that combat trauma experience is critical to the clinical decision-making that occurs at its Role II facilities.

They see provider rotations between the Marines' Role II and III sites as integral to their skill development and maintenance. Finally, placement and utilization of Role II assets must be done on the basis of at least a regional trauma system plan.

## PAIN MANAGEMENT

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The JTTS does not track pain control through the Role II and III facilities. There is a CPG addressing pain management and the implementation of the Joint Regional Anesthesia and Analgesia Tracking System (JRAATS) just released that will now allow the Theater Medical Data Store (TMDS) a tool to collect data on how well pain is treated at the Roles II/III. An Acute Pain Service in Level III facilities would not only treat pain effectively, but it would also heighten the awareness of commanders to make treating (and tracking) pain control a parameter of success for the DCBI patient.

## **ROLE IV/V: DEFINITIVE CARE AND REHABILITATION**

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Over the decade, DoD and VA established definitive care programs, and developed and refined many advances in medical, surgical, psychological, and rehabilitative care for Warriors who sustain severe combat injuries, particularly those with complex limb trauma and amputation. Most of these lessons learned and advanced techniques are described in the Textbooks of Military Medicine' Care of the Combat Amputee, published by the Borden Institute in 2009. Additionally, several joint DoD and VA CPGs have been developed to promote standardized optimal care for combat casualties with TBI, spinal cord injury (SCI), hearing and/or vision loss, polytrauma, and limb loss.

### **BEST PRACTICES IN DEFINITIVE CARE AND REHABILITATION**

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#### **SURGICAL PRACTICES**

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The basic tenets of war surgery apply to all combat wounds. These include: 1) Aggressive and frequent debridement of all contaminated wounds; 2) preserving as much viable tissue as possible; and 3) leaving the wound open until ready for definitive closure. The timing of definitive closure is often based on the surgeon's direct observation of the wound. Recent research suggests that laboratory analysis of wound effluent may offer a more scientific method to making this decision.

Despite the advances in prosthetic technology, when patients present with severe bilateral lower limb injury, it is still preferable to attempt salvage by whatever means available (circular frames, free tissue transfer, etc.) if the casualty will physiologically

tolerate the procedure. If function of the lower limb is not satisfactory after reconstruction and rehabilitative efforts, an elective amputation may be considered.

For the lower limb amputee with severe upper extremity injury, all efforts should be made to preserve as much function of the upper limb. In these circumstances, stability and optimum upper limb function become even more important because the upper limb will be required for transfers and wheelchair use. Therefore deliberate or permissive fusion of the wrist, elbow or shoulder may be preferred to an unstable or painful limb that is more mobile.

Providing adequate soft tissue coverage for individuals with multiple limb loss and extensive soft tissue wounds can be extremely challenging because of the lack of adequate donor sites. Furthermore, great care must be taken to not disturb remaining limb or trunk function by harvesting nerve, bone, or soft tissue. The use of vacuum dressings helps to improve wound healing and skin graft acceptance.

With multi-limb amputations, it is better to have different surgical teams simultaneously working on their respective limb, rather than performing sequential surgeries. This approach reduces operative and anesthesia time, enhances surgical communication, and helps to reduce longer lapses of deep venous thrombosis (DVT) prophylaxis and nutritional support.

#### **CENTERS OF EXCELLENCE**

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To provide care optimally for Service Members who sustain DCBI, specialized centers are needed that have both the experience and subspecialists necessary to provide comprehensive medical, surgical, behavioral health and rehabilitative care. It is well recognized that advanced skills are developed through a combination of education and experience.

By seeing a high volume of patients at a few selective facilities, the medical system will maintain and build expertise. In addition, having a large concentration of individuals with similar combat injury patterns creates a better therapeutic milieu for recovery. Not only is the patient able to share experiences and help motivate each other, but his/her Family is able to build relationships with other Families who are going through the same process.

Other advantages of focusing care of these individuals at select treatment facilities, include: access to advanced equipment and technology; ability to build and refine specialized treatment and support services; optimization of patient and Family education; and the ability to form partnerships with outside organizations, such as the VA, industry manufacturers, academic institutions, leaders in science and technology, and civilian and governmental support groups, including Veteran Service Organizations.

Data reported to the Limb Loss Panel of the Defense Health Board indicate rehabilitating Warriors do better when working together with other Wounded Warriors. Dr. Messinger documented clear emotional and physical healing benefits when peers and peer Families interact. He also demonstrated rehabilitation from traumatic injury has to move along multiple dimensions, taking into account both the physical body and the social world the patients have inhabited and will inhabit. This supports the strong interdisciplinary team processes currently in place.

### **AGGRESSIVE AND COMPREHENSIVE PAIN MANAGEMENT**

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Optimal pain control should be the goal in treating all DCBI Warriors. This should occur at all echelons of care. During the definitive care period, the use of multiple peripheral nerve blocks is often helpful in

managing multiple limb trauma and/or amputation. Intravenous use of opioids and/or NMDA receptor agonists, such as ketamine can also be effective, but should be managed by a physician with pain experience.

The use of multimodal medications, including membrane stabilizers, antidepressants, and topical preparations, may be effective in treating neuropathic and phantom limb pain. This approach along with access to Complementary and Alternative Medicine (CAM) interventions, such as acupuncture and meditation can be very helpful at improving pain and reducing the need for excessive opioids. Although no studies have reported on the incidence of persistent phantom limb pain among multiple limb amputees, anecdotal reports do not suggest a significant increase in this patient population. It is more likely that one, rather than all, limbs will be problematic, and also more likely the affected limb will be an upper extremity.

As in all patients, the use of opioids should be monitored closely. It is imperative to teach people to adjust to some level of chronic pain. There are significant side-effects to many current treatments for pain. Sports, recreation, meditation, and other activities may help. Young patients will often develop an early tolerance to opioids, which can be treated best with opioid rotation, adjuvant medications and modalities. Furthermore, all members of the treatment team must be sensitive to the fact that opioids with or without alcohol may often be used to self-treat conditions such as depression, anxiety and sleep disturbances. Pain and Behavioral Health Specialists should be readily available for this patient population. In addition, provide the Warrior access to CAM.

### **HOLISTIC CARE**

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The focus of care must be directed to the individual patient and his/her Family rather than a specific limb, surgical wound, or

medical issue. Additionally, community leaders, employers and municipal planners, as well as DoD leadership, must enhance, educate, and manage expectations, as these individuals reintegrate into functioning and productive members. This requires comprehensive interdisciplinary care with frequent meetings to facilitate communication and creative thinking to help overcome significant obstacles to care.

## FAMILY PARTICIPATION

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Providing Families and non-medical attendants (NMA) opportunities to participate in the care of the DCBI patient represents a significant advancement in the approach to healthcare. This fosters Family support, patient motivation for recovery, and the promotion of independence. Family members are often the first to note morale changes and risky behavior. They need training, and will benefit from healthcare, particularly behavioral health training, during their displacement. For casualties with severe injuries requiring extensive assistance for independent activities, the military should have the ability to provide NMA orders to more than one person.

## EARLY REHABILITATION

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Rehabilitation has been viewed traditionally along the continuum of care after all acute medical and surgical issues are treated. In addition, many individuals believe that “rehabilitation” is the role of the Veterans Health Administration (VHA), rather than the DoD. This has been demonstrated to be outdated. In fact, improved function results ultimately from earlier rehabilitation implementation.

It has been proven that early rehabilitation throughout the acute medical and surgical period is essential for success. By preventing secondary complications that are often associated with immobility such as muscle atrophy, decreased cardiovascular and pulmonary reserve, joint contractures, venous

clot formation, etc., better short- and long-term outcomes may be achieved. Furthermore, building independence in activities of daily living, such as grooming, bathing, toileting, and feeding helps build confidence, motivation, and independent mobility, and it reduces depression and anxiety.

## REHABILITATION LESSONS LEARNED

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In the field of rehabilitative medicine, best practices and lessons learned include the following:

Optimal TBI and SCI care are best achieved in partnership with specialized VA facilities. Currently, traumatic amputee care is most highly developed within the DoD.

Rehabilitation plans should be goal-directed in a step-wise fashion to set challenging goals appropriate for each stage of recovery.

Early introduction to wheelchairs and wheelchair skill training can help multi-limb amputees begin the reintegration process sooner. These Warriors require proper wheelchair selection, fit, and training.

Multi-limb amputees require specialized therapy treatment protocols, to include a patient-focused, higher therapist-patient ratio.

Highly skilled and experienced prosthetists are necessary to fabricate and fit advanced technology prostheses.

Socket comfort and suspension for individuals with hemi-pelvectomy, hip disarticulation, and high transfemoral amputation is very challenging. Novel solutions to this have been developed within the DoD by partnering with industry.

Upper limb prosthetics remain inadequate for transhumeral and shoulder amputees. Continued effort needs to be made on the Defense Advanced Research Products Agency (DARPA) project.

Return to vocation is influenced by multiple factors, requiring the need for access to highly skilled Vocational Rehabilitation specialists.

The use of Assistive Technology (AT) is often needed to improve functional independence. Partnering between the DoD and VA has increased injured Service Members' access to AT specialists

## ADAPTIVE SPORTS

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Programs that encourage, promote, and support a return to sports and recreational activities often have a profound positive effect on individuals recovering from DCBI. These programs enhance confidence, community integration, and motivation, as well as skill development and perception of self.

## GOAL SETTING PROGRAMS

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The Army Center for Enhanced Performance (ACEP) originated at the United States Military Academy (USMA) as a systematic educational and developmental process to enhance adaptive thinking, mental agility, and self-regulation skills essential to the pursuit of overall personal strength, professional excellence, and the Warrior Ethos.

Grounded in cutting edge performance psychology and academic strategies, the ACEP utilizes realistic and engaging virtual environments to reinforce its principles. The mental skills training develops the Warriors and their Families' full potential of personal strength, professional excellence, and the Warrior Ethos.

The ACEP has migrated across Army installations, including WRAMC for use with its Wounded Warriors.

Within ACEP, the Comprehensive Soldier Fitness-Performance and Resilience Enhancement Program (CSF-PREP) provides a systematic way to build mental and emo-

tional strength using scientifically tested, evaluated, and validated education methods from the fields of sport and performance psychology. The CSF-PREP goal setting training for WRAMC's Wounded Warriors and their Families includes a comprehensive goal setting plan. The Wounded Warriors' personal outcome goals are broken down progressively into priority goals, plans of action and attitude statements for goal accomplishment. This increases focus, purpose, motivation, direction, self-confidence, persistence and creative strategies to increase the chances of success. The physical plan provides the Warrior with a guide that can be monitored and applied for continued success.

Examples of outcome goals for Wounded Warriors in the WRAMC CSF-PREP:

"I am in the World Class Athlete Program."

"I return to duty focused on all of the things that I can do."

"I am an ultimate Warrior who is an excellent father, husband and Soldier."

"I complete an Olympic distance triathlon."

"I become a cadre member in the Warrior Transition Command."

"I successfully transition into a productive career in the Department of Homeland Security."

"I graduate from college in the Class of 2012."

Examples of outcome goal priorities:

"I attend all of my appointments and give 100%."

"I research materials provided by my medical providers."

"I make use of the educational opportunities provided to me as a WT."

"I go to the park with my daughter three times each week."

"My wife and I have a date night one time each week."

"I work out four times per week for 45 minutes."

"I meet with financial services to create a budget."

"I celebrate my success to keep me motivated."

"I manage my time and study for one hour each night, giving myself one night off each week."

Examples of attitude statements:

"I am all that I want to be."

"I go further every day."

"I have no regrets."

"If he can, I can."

"I've still got it."

"My Family and friends are here for me."

"I'm stronger now than I ever was."

"Through tragedy comes strength."

The benefits of goal setting and that of its aggressive and relentless pursuit appear to be long-lasting in the realm of emotional and physical healing.

## INTEGRATED CASE MANAGEMENT SYSTEM

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Skilled and experienced case managers are critical for the care of DCBI Warriors. They promote healthcare coordination, medical appointments deconfliction, and enhanced communication between the treatment team and patient. These individuals maintain up-to-date information on available support services from numerous government and nongovernmental organizations. They also facilitate better communication between the clinical team and the

Warrior Transition Unit (WTU) staff and/or the patient's unit liaison representative.

## DOD-VA PARTNERSHIP

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To provide optimal short- and long-term care for DCBI patients, the DoD and VA treatment and support programs must complement each other. VA facilities, primarily those designated as Levels 1 or 2 Polytrauma Centers, are well staffed and equipped to provide expert care to severely injured Service Members. Many of these facilities may also offer geographic advantages to a Service Member's home or social support system. Early dialogue should take place between the DoD and VA facilities for each patient to establish the most effective comprehensive care plan maximizing available expert services.

Continuity of care between the DoD and VA is greatly enhanced by establishing team video teleconferencing prior to transferring care from one facility to another. Enhanced communication also allows for the sharing of best practices, development of clinical practice guidelines (CPGs), and clarifying patient and Family expectations. The VA has recently established a number of Transition Rehabilitation Programs to help better support individuals with disabilities return to their communities and vocation. Additionally, community-based support organizations provide assistance.

## PROXIMITY OF OUTPATIENT SUPPORT SYSTEMS

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Many DCBI Warriors will require extended acute and sub-acute rehabilitation given the number of injuries and impairments they must overcome. This often involves the fitting and training of more than one prosthetic limb; additional challenges with achieving comfortable prosthetic socket fittings given the often proximal limb amputation and extensive soft tissue scars and wounds; the frequent need of ongoing reconstructive surgeries; co management of

other injuries such as sensory loss (vision, hearing), balance difficulties, pain syndromes, and behavioral health problems. Access to accessible post housing and transportation are critical for this care.

## **EDUCATION AND RESEARCH PROGRAMS**

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Ongoing educational programs, especially graduate medical education (GME) programs, are critical to provide optimal definitive care for DCBI Warriors. Military-unique curricula ensure the house staff develop the skill set needed to treat complex injury patterns seen in this patient population.

In addition, an active research program is essential to discover novel interventions to improve the quality of life of DCBI Warriors.

## **CHALLENGES AND ISSUES WITHIN DEFINITIVE CARE AND REHABILITATION**

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While a unique pattern of injury has been observed in Service Members who sustain DCBI, previously published reports offer some insight to many problems these individuals will face during their recovery and rehabilitation. A recent survey conducted on Vietnam and OIF/OEF casualties with limb loss provides important data that the military should consider when developing comprehensive definitive care programs.

Overall supplementary wheelchair use averaged 32% for Vietnam veterans and 53% for OIF/OEF veterans. Among OIF/OEF members, 83.3% of bilateral lower-limb loss and 77% of multiple limb loss (including arm and leg) reported supplementary wheelchair use compared to 46% and 56% respectively in Vietnam Veterans.

Approximately 25% of OIF/OEF amputees are already reporting arthritis. Vietnam veterans report a frequency of 64.4%.

Reported problems with persistent pain (chronic back pain > 36%; phantom pain > 72%; and residual limb pain > 48%) are excessive.

Over 50% of individuals with limb loss report frequent skin problems on the residual limb (51% Vietnam veterans and 58% of OIF/OEF veterans).

Mental health problems, such as depression, anxiety and PTSD occur commonly after military deployment, ranging from 15 to 17%, as compared to the 9.3% observed prior to deployment. Recent evidence suggests this number is much higher for individuals who sustain a combat related amputation. Reports suggest nearly 66% of combat amputees have at least one behavioral health diagnosis, much greater than the 20-30% rate commonly reported in the general traumatic amputee population. In addition, the likely higher incidence of depression in combination with PTSD for individuals who sustain DCBI increases their risk of a slower recovery, distress, and suicidal behavior.

Hearing loss is present in 47% of Service Members and veterans with traumatic limb loss.

Anecdotal observations note more of a psychological burden for young males who sustain severe genital injuries. This needs additional investigation and research.

While the rates of return to vocation and meaningful community participation are unknown for Service Members who sustain DCBI, the overall national statistics for returning to work after a severe disabling injury remain low.

## **PROSTHETIC ABANDONMENT**

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Among war veterans with multiple-limb loss, 68% of Vietnam veterans and 92% of OIF/OEF veterans use at least one prosthet-



ic device. With regards to those who sustain bilateral upper limb loss, between 55 to 60% of Vietnam veterans and 40 to 45% of the OIF/OEF veterans do not use prostheses at all. This data suggests a relatively high dissatisfaction with upper limb prostheses in both groups, as well as a higher rejection rate for the Vietnam group.

In fact, 30% of Vietnam amputee group and 22% of the OIF/OEF group reported total prosthesis abandonment. This difference was even more significant for individuals with multiple limb amputation. Over 29% of Vietnam veterans with multiple limb loss abandoned the use of any prosthetic support.

The most frequent reason for prosthetic abandonment among the OIF/OEF group was that their residual limb was too short (30%), whereas the Vietnam group reported that the prosthesis was “too much fuss” (57%).

Interestingly, in both the Vietnam and OIF/OEF group, those who were more likely to abandon the use of their prosthesis had undergone a hip disarticulation amputation, illustrating the additional challenges posed with using a prosthetic device at a higher amputation level. It was shown previously the energy cost of ambulation is much higher in an individual with an above knee amputation (AKA) than a below knee amputation (BKA). This increase in energy demand is even more pronounced for individuals with a hip disarticulation or bilateral above knee amputations, patterns of injury commonly seen in the DCBI population.

It is not surprising that Vietnam veterans, particularly those with a high-level or bilateral lower extremity loss, report a greater rate of prosthetic abandonment than OIF/OEF veterans. As veterans age, they typically experience a generalized decrease in overall strength and endurance, making it more difficult for them to use a prosthesis. Aging also makes it more difficult for them to continue to compensate for other comor-

bid battle injuries, such as fracture, soft tissue loss, TBI and post-traumatic stress disorder (PTSD).

Additionally, it is likely long-term secondary complications of limb loss, such as arthritis, pain, diabetes and cardiovascular disease also contribute to prosthetic abandonment over time. The Task Force feels confident newer prosthetic technology, advances in medical, surgical and rehabilitative care, and a greater emphasis on fitness and a healthy lifestyle will help mitigate this abandonment rate in the future.

### QUALITY OF LIFE

Upper limb prosthetics continue to be inadequate for those with transhumeral and shoulder amputations. Advances in upper limb prosthetic technology is on the horizon, although, more effort must be made to translate this technology to the clinic.

Of particular interest to the DCBI Task Force, survey results indicate individuals with multiple limb amputation report a better overall quality of life (QOL) than those with single limb amputation. This effect was observed among both Vietnam and OIF/OEF veterans. In the Vietnam group, among participants with unilateral lower-limb loss, 26.4% reported a better QOL, 44.9% reported a good QOL, and 28.7% reported a worse QOL. In the Vietnam vet group with multiple limb loss, 47.2% reported a better QOL.

In the OIF/OEF group with unilateral lower-limb loss, 50.3% reported a better QOL, 38.0% reported a good QOL, and 11.7% reported a worse QOL. Among multiple limb loss amputees, over 50% of responders reported an overall better QOL.

The authors of this study speculate that individuals who sustain multiple limb loss from war often experience more injuries and as a result are grateful to be alive and have a more dramatic change in life priorities. For example, in one survey of people

with limb loss, participants with bilateral limb loss more frequently reported they considered something good had happened to their life (character building, more appreciation for life, developing coping abilities) because of the amputations. The Vietnam vets could show a stronger effect because the vets have had nearly 38 years to develop coping mechanisms. In contrast, OIF/OEF veterans had only had an average of 3 years to adjust to their injuries.

### **HIP DISARTICULATION AND HEMI-PELVECTOMY**

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Very proximal lower limb amputations occur at a higher rate for DCBI casualties. Hemi-pelvectomy had been traditionally rarely seen in the trauma patient, because most patients with injuries at this level did not survive. Now, with the advances in combat casualty care and expeditious use of tourniquets, many of these Warriors are now surviving on the battlefield. Definitive closure of this level of injury requires specialty trained surgeons. These cases are often associated with higher wound complication rates, such as pressure ulcer formation, cardiopulmonary dysfunction, limb contractures, and generalized deconditioning.

### **HAND TRANSPLANTATION**

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Individuals with bilateral upper limb loss, severe unilateral upper limb loss and visual deficits, bilateral lower extremity limb loss requiring prostheses or transfer independence may benefit from hand transplant surgery. Currently within the United States, several medical centers have ongoing research protocols to perform this procedure. Post-transplant rehabilitation is critical for success. The Army SG chartered a specialty advisory board to ensure patients and their Families receive adequate screening and education about this procedure. Notably among these risks is the post-transplant requirement for lifelong

immunosuppressive therapy. Navy Medicine's Executive Research Advisory Board (ERAB) and Emerging Therapeutics Validation Panel (ETVP) advises Navy/Marine Corps leadership on cutting edge medical treatments and technologies in response to requests for information (RFI) from patients, patient care providers, and Service Line and Staff leadership.

### **TRAUMATIC BRAIN INJURY**

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Unpublished data obtained from the Department of Orthopedics & Rehabilitation at Walter Reed suggest the co-existence of traumatic brain injury (TBI) is essentially the same for single limb loss (40%) compared with multiple limb loss (41%).

Because of the high rate of TBI in combat casualties, including those with DCBI, access to TBI rehabilitation services are needed during the acute, subacute, and chronic care of this patient population. Highly skilled neuropsychologists, case managers, behavioral health specialists, rehabilitation counselors, speech language pathologists, occupational and physical therapists, as well as TBI physicians, are needed to co-manage these patients. Typical co-existing symptoms include: headache, cognitive impairment, balance difficulty, and behavioral changes. Novel treatment strategies include supervised self-paced computer learning activities, and cognitive behavioral therapy principles applied to more traditional physical and occupational therapy.

### **AGGRESSIVE INFECTION SURVEILLANCE**

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Although definitive data does not exist, military providers report that DCBI wounds are particularly susceptible to infection, and that the risk of infection (especially fungal infection) is even greater when multiple limbs are involved. Therefore this patient population will likely require a more prolonged antibiotic use and a higher

risk of wound failure, necessitating additional trips to the operating room.

Given this increased infection risk, aggressive institutional infection control policies must be established and enforced to help reduce the added risk of nosocomial infections. Institutions providing definitive care to this patient population should have skilled and experienced Infection Disease Specialists and Infection Control experts.

## PREVENTION AND TREATMENT OF SECONDARY COMPLICATIONS

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While the risk of venous thrombus formation—DVT and its complication, pulmonary thromboembolism (PTE)—are higher in the combat amputee population (30%), data is currently not available on the incidence of DVT or PTE for individuals with DCBI. Special consideration should be made as to the timing of DVT prophylaxis in the setting of multiple surgical interventions.

## GENITOURINARY (GU) RECONSTRUCTION

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GU interventions must be performed in multiple stages. If extensive soft tissue is lost, finding adequate tissue to cover these wounds or perform reconstruction is more challenging. Individuals with DCBI and genital injury will often require a protracted inpatient/outpatient stay. It is best if these injuries are managed by the same surgical team over time rather than transferring care elsewhere.

Because of this, provisions must be made to have adequate staffing, housing, administrative, and medical support at Role V facilities to provide protracted care for these individuals. Currently, there are a limited number of providers (civilian and military) who perform phallic reconstruction surgery—thus indicating the need to train more military urologists and plastic surgeons in these techniques.

## GENITAL LOSS AND HORMONAL CONCERNS

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While GU injuries present complex surgical and behavioral health challenges, other medical issues must be addressed. Low testosterone levels have been reported after trauma, serum testosterone levels are significantly reduced. Therefore testicular loss will only complicate further hormone deprivation.

The role of hormone replacement to promote soft tissue and nervous tissue healing has not yet been determined. It is also unknown when the optimal timing for replacement should begin. Given the long-term needs of hormonal replacement and monitoring, systems should be established to provide life-long care by medical specialists in this area. Related problems of infertility also require needed attention. All Service Members who sustain DCBI (with or without genital injuries) should have access to fertility expert consultation as needed.

## THE ROLE OF THE PRESS

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By increasing public awareness of the sacrifices and challenges Service Members and their Families confront, there appears to be a better acceptance to disability, improved access to community participation, and decreased negative stigma to body disfigurement and the scars of war.

## IMPACT TO CARE TEAM WITH LONG TERM MANAGEMENT OF PATIENTS WITH THIS INJURY

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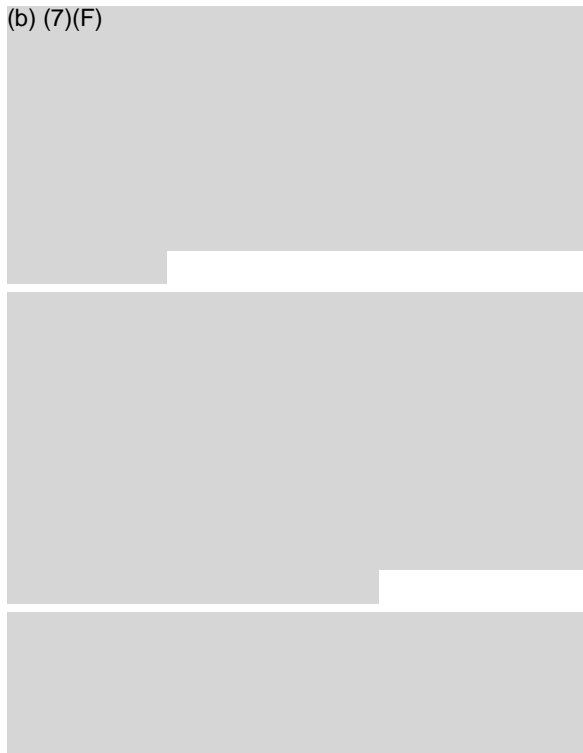
Individuals caring for these patients—the physicians, nurses and medics—expend a great deal of personal resources to maintain a positive attitude throughout their provider-patient relationship with these wounded Warriors. Provider resiliency is a key component for the well-being of the team. This important aspect cannot be overlooked.

# WHOLE-PERSON APPROACH TO HEALING

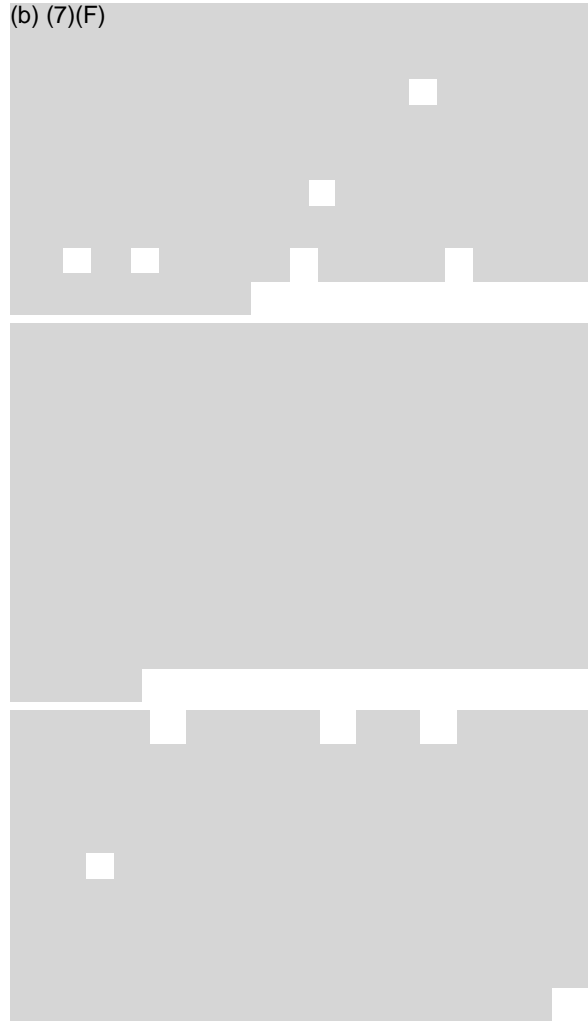
## PROTECTION

Project Manager Soldier Protection and Individual Equipment (PM-SPIE) is leading a consortium of organizations in researching ballistic undergarments. The objectives are to define the threat, characterize capabilities and limitations of commercially available products, and recommend a path forward (development through production and fielding). The consortium membership includes representatives from the United States Army Product Manager Soldier Protective Equipment (PM-SPE), the United States Marine Corps (USMC) Program Manager for Infantry Combat Equipment (PM-ICE), Army Research Laboratory (ARL), Navy Research Laboratory (NRL), Natick Soldier Research Development & Engineering Center (NSRDEC), and the Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) Program.

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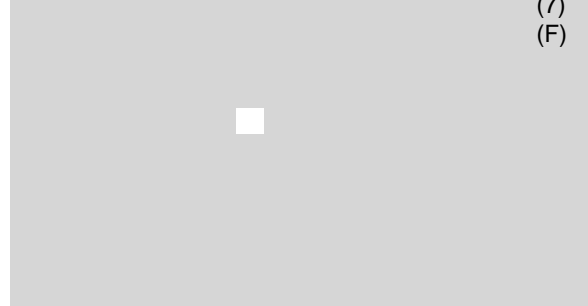


(b) (7)(F)



The Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) partnership has conducted an analysis of GU injuries for relevant incidents. While it conveys the statistics related to GU injuries, it does not contain any information regarding the blast threat mechanism (e.g., blast effects: penetration, overpressure, blunt trauma) of the wounds and whether they could be countered by a low level of protection.

(b)  
(7)  
(F)



(b) (7)(F)

MEDCOM can provide the consortium specific information on wound data to assist with protective garment design. Up to 40% of pelvic and groin injuries may be mitigated through additional protection.

What is of critical importance to the material developer is an understanding of the size and quantity (distribution) of fragments causing GU injuries and to what depth they are embedded in the tissue. This data would allow reverse engineering of kinetic threats and provide a basis for requirement and product specification development. A MEDCOM perspective on the amount of, and complications from, dust and debris in the wound area would provide valuable insight on the benefit of a specific undergarment as a countermeasure.

(b) (7)(F)

The ARL is working to produce a means of propelling sand at high velocity so that a repeatable measure of resistance to penetration can be made of various candidate materials and systems. In addition, they hope to correlate this to known threat mines so a meaningful description of the threat can be defined.

While the test fixture and methodology are nearly complete, the characterization of this threat and material screening is expected to continue into 3QFY11. ARL is also correlating the probability of injury through from modeling and simulation. These models, compared to actual injury data, would

provide useful tools to understand the area of coverage required and would help confirm the threats needed.

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## UROLOGIC CONSIDERATIONS, ISSUES AND INTERVENTIONS

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In the most recent few years of overseas contingency operations there has been a sharp increase in the number and severity of injuries to the external genitalia and lower urinary tract primarily in dismounted troops. The reasons for this are multifactorial and addressed in other portions of this report.

There are several areas where military urology can provide their expertise in providing state of the art care for these complex injuries.

The first area is in the area of improving protection for the external genitalia, groin and perineum. (b) (7)(F)

Urology is involved with the Natick Soldier Research, Development, and Engineering Center to look at innovative ways to provide protection for our Warriors.

Providing individual protection is about striking the right balance among many competing factors, including level of protection; weight and bulk of materials; mission and environment; hygiene, etc.). Having Warriors and medical experts provide input helps achieve that balance, as we work to provide improved Warrior protection capabilities with our PM partners.

After receiving initial resuscitative and life-saving treatments at Roles I and II echelons, patients often obtain their comprehensive surgical care at level III facilities by general surgeons. Historically, the

care provided has often relied on the experience and training of the on-site surgeon.

Previous reports from OIF show that having a deployed urologist available in the CSH may result in a better rate of testicular salvage. While it would be difficult to determine if the current testicular injuries are salvageable, it is likely that having a specialty-trained urologist available in theater would be a positive factor in addressing these often-complex injuries. Additionally, urologists likely have a broader knowledge of the future reconstruction strategies anticipated for major penile, scrotal and urethral injuries that should be taken into consideration during acute resuscitation. Having a urologist available in theater might provide additional training for other providers and allow for more seamless consultation among the medical areas that are initially receiving these injuries.

There are fewer concerns once Warriors with complex urological injuries reach higher echelons of care that have fellowship-trained urologists. Military urology has incorporated complex GU reconstructive techniques among its residency training programs.

The JTTR has been a valuable resource in identifying certain injury patterns and demonstrating at-risk populations, but it lacks the ability to provide longer term outcome data. Army urology is involved in designing research to follow these injuries in a longitudinal manner to track long-term urological disabilities (e.g., voiding dysfunction, erectile dysfunction, and infertility) and to correlate these complications with initial management. It also would be helpful to partner with Behavioral Health to study the long-term psychological effects of complex genital injuries.

Opportunities also exist for military urology to partner with civilian organizations and institutions to further study and provide quality care for wounded Warriors with complex GU injuries. The American Urological Association has appointed a special

task force to study and make recommendations regarding genitourinary trauma. The Military will play an important role on this project.

Having urology specialists in the ATO makes a difference in providing expert care during acute resuscitation. Waxman published his experience in theater, noting an excellent testicular salvage rate following exploration. To this end, the Army SG directed that the ATO's Role III have a staff urologist assigned at all times.

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## **NEUROLOGICAL CONSIDERATIONS, ISSUES AND INTERVENTIONS**

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Explosive mechanisms are the leading cause of TBI for active duty military personnel in war zones. In the DBCI setting, with substantial blast force as the primary mechanism of injury, it is especially crucial to perform TBI screening, as it can be under-recognized, given the gravity and enormity of other life threatening injuries.

DoD has implemented a brief (four-question) TBI screening (BTBIS) tool that can be followed by more formal cognitive assessments if TBI is suspected clinically. Blast force produces multiple mechanisms for TBI, including direct structural brain injury and secondary injury from hypoxia, hypoglycemia, or hypotonic fluid resuscitation of severe polytrauma. In this setting, the specific challenges of TBI include, but are not limited to, increased seizure risk, adverse effects of over-medication, and an ongoing barrier to rehabilitation programs that require intact attention, memory and learning skills for maximum recovery.

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## PSYCHOLOGICAL CONSIDERATIONS, ISSUES AND INTERVENTIONS

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Due to continuing advances in the trauma care and management, an increasing number of casualties are surviving severe battlefield trauma. As these Warriors survive their severe injuries, they face significant challenges in the emotional, cognitive, spiritual and physical aspects of recovery. Recent trauma literature suggests a high propensity for post-injury depression and post-traumatic stress disorder (PTSD) among severely injured individuals. These studies demonstrate prolonged and profound dysfunction (physical and emotional) that is oftentimes underestimated by health-care providers.

With this in mind, behavioral health (BH) specialists' goal for these patients is to maximize their potential for emotional, mental, spiritual and physical recovery. BH care focuses on improving the Warrior's quality of life, increasing his/her functional abilities, and addressing residual psychological issues or complications.

Regarding the question of genital loss/damage early on the injured might find it overwhelming to talk about it. However, timing will be important and it might be best for a patient with a prolonged hospital course, or especially after the patient's transition to an outpatient setting.

Probing too deeply or "encouraging," the patient to talk about it before they are ready would be intrusive and potentially undermine the patient's ego defenses which they need to continue to function. Making them aware that physical intimacy is a topic that we can address and treating it in a normalized manner could be productive. Specialized sex instructions with marital or intimate counseling can be beneficial.

This issue might be more germane after the acute phases of intervention are completed and could be initiated upon the transition

from inpatient to outpatient. Having a trained sex therapist within either BH or Physical Medicine and Rehabilitation (PMR) Services could provide consultation to not only the Psychiatry Consultation Liaison Service (PCLS), but to other services, as well.

Specific BH tasks during the definitive care and rehabilitative phases of recovery include: 1) Appropriately assessing the injured Warrior's emotional status and needs; 2) establishing a comprehensive treatment plan to address assessed issues/needs; 3) recognizing expected emotional responses and complications which require intervention; 4) providing comprehensive psychiatric support to the Warrior and his/her Family through his/her transition from inpatient to outpatient status, and then as he/she adjusts to community interactions; 5) providing individual, group and medical management treatment; and 6) facilitating all BH needs through the Warrior's nurse case manager.

The Marines receive behavioral health support specifically from Navy Medicine, although, they may receive trauma care from the other Services. The Marine Corps Operational Stress Control and Readiness (OSCAR) program embeds behavioral health personnel with ground combat elements at the regimental level to provide primary prevention, early detection, intervention, and command consultation. These providers are augmented by trained primary care providers and religious personnel (OSCAR Extenders), and junior leaders and Marines (OSCAR Mentors). Beyond the POI, OSCAR personnel play a minimal role in the injured Marine's medical care, but have a significant task in helping to provide psychological first aid to both the affected Marines and their unit. Any comprehensive BH plan must recognize that military BH personnel typically have limited experience dealing with DCBI Warriors. To handle these patients appropriately, the BH specialist will need additional specialized training to

manage the unique challenges these Warriors place on the system. It must also recognize that multiple amputees are at increased risk for BH challenges, and that the critical nature to providing a seamless provision of care from Active Duty to Veteran/Retiree status, which requires dedicated case management.

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## **REHABILITATION CONSIDERATIONS, ISSUES AND INTERVENTIONS**

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### **CENTER SELECTION**

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DCBI casualties should be evaluated by rehabilitation specialists within 72 hours of admission to the definitive care hospital. Based on the degree of injury, impairment, and likely course of recovery, early discussion should be initiated between the rehabilitation specialists, treating team, patient, and Family. Issues of critical importance to discuss include: 1) The presence of a SCI; 2) significant TBI; 3) presence or likelihood of major limb loss; and 4) geographic location of the patient's support structure.

Every effort should be focused on getting the injured patient to the facility that best meets his/her medical, surgical, rehabilitative, psychological, and social needs. Therefore it is essential for DoD practitioners to have current understanding of the DoD and VA capabilities at each of their major medical centers.

A fundamental principle is that rehabilitation requires both a re-learning of old skills as well as the acquisitions of new skills. This becomes most difficult for a TBI patient impaired by severe cognitive deficits. Therefore, these patients are best treated at a facility with expertise in inpatient TBI rehabilitation, particularly one of the designated VA polytrauma centers.

Similarly, it is widely recognized that SCI patients are best treated at a center special-

izing in SCI care and rehabilitation. The VA currently has 23 SCI Centers throughout the United States. While many DoD providers and facilities offer expertise in various components of inpatient TBI and SCI care, the designated VA specialty facilities have more experience in providing comprehensive interdisciplinary care for individuals with these injuries.

In addition to providing expert care, these VA sites also have several advantages over other civilian sites, to include expertise in initiation and educating patients about the VA disability benefits, entrance into vocational rehabilitation programs, access to assistive technology (e.g., cognitive aids, wheelchairs, orthotics), home modifications, continuity of long-term care, and military liaisons to link the Warrior with his home unit.

The majority of the Amputee Programs within the VA system have focused care primarily on older patients with acquired amputations from disease (e.g., diabetes, vascular disease, etc.), which represent a different population than multi-limb DCBI amputees. In response, the military has developed three Amputee Centers of Excellence (Walter Reed and Brooke Army Medical Centers and Balboa Naval Medical Center that provide state-of-the art inpatient and outpatient rehabilitation).

Coordination of rehabilitative care between the DoD and VA systems is significantly enhanced by the use of Video Teleconferencing (VTC). On a weekly basis providers within both systems are able to exchange ideas, share learning experiences, and better transfer care from one facility to another. In addition, having the patient and Family attend the VTC allows them to have a face-to-face introduction and conversation to the receiving treatment team, which helps to alleviate transfer concerns. There is currently very little cross-communication between the various electronic medical records, increasing risk of documentation



loss between the DoD MTFs and VA system.

Multi-limb loss creates significant challenges to independence in one's activities of daily living (ADLs) and mobility (e.g., sitting, transferring, standing, and walking). Experienced therapists and prosthetists should be embedded with the treatment and rehabilitation team to establish realistic goals with each patient in a manner that promotes success.

For example, an individual with bilateral AKAs should first learn to stand independently on short prostheses, prior to initiating walking or lengthening the prosthesis. They also need early and advanced wheelchair skills. Achieving success at each stage of recovery with small milestones will result in better outcomes than attempting to push rehabilitation too fast.

To help support this rehabilitation paradigm, the Amputee Care Program at Walter Reed has developed rehabilitation treatment protocols from consensus opinion among experienced providers. These are available among the DoD, VA, and civilian medical communities.

### ACCESS TO ADVANCED TECHNOLOGY

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Over the past decade significant advances have been made in prosthetics, orthotics, wheelchairs and other ATs. Given the significant challenges to regaining independence for the severely injured Warriors, access to these technologies is essential. Early introduction to a power or manual wheelchair typically results in a dramatic improvement in a Warrior's mood as independent mobility is achieved.

It is more common to require repeated prosthetic trials through the first year—before achieving the basic goals of independence with ADLs and ambulation. Experienced orthotists, prosthetists, and AT specialists are required to optimize the fit and function

of these technologies. Novel suspension systems, upper limb prostheses that support crutch ambulation, and motorized wheelchairs with customized user controls and power seat functions represent some of the common needs of this unique patient population.

Technological advances have also been made in rehabilitation devices. The use of simulators (e.g., Fire Arms Training System (FATS)), virtual reality environments (e.g., Computer Assisted Rehabilitation Environment, or CAREN), and mobility training aids (e.g., Solo-Step®) have all helped in providing comprehensive rehabilitation for DCBI patients.

### SPECIALIZED AND EXPERIENCED STAFF

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While much attention has been given to the advances in technology, the technology is useless without experienced therapists who can teach patients how to make the best use of that technology. A humanistic quality is essential to promote recovery and rehabilitation.

Setting realistic goals, monitoring and assessing barriers to advancement, and application of therapeutic exercise promote maximum outcomes. A therapeutic and trusting relationship between the provider and the patient helps to promote motivation, enhances behavioral health, and improves compliance with treatment.

Optimal staffing ratios have yet to be determined for the DCBI patient. The Task Force's consensus is the level of care for an individual with multiple limb injuries increases substantially with every severely impaired limb.

One therapist may be able to supervise two to three patients with non-complicated trauma simultaneously, whereas the DCBI patient may require continued direct two-on-one physical therapy. This is also true for prosthetists, who must spend a signifi-

cantly greater amount of time to fit and adjust a prosthesis for multi-limb or proximal amputations.

Evidence demonstrates that Service Members with combat injuries, particularly limb loss, greatly benefit from peer visitors. Peer training programs exist at the DoD rehabilitation sites, as peer visitors are more effective once trained.

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## VOCATIONAL REHABILITATION

Return to vocation is influenced by multiple factors and is especially challenging for DCBI Warriors. Early instruction and continual follow up by vocational rehabilitation specialists can greatly improve return to work, education, and career development.

Currently these services are provided by the VA but integrated within the DoD treatment sites. Providing vocational assessments and counseling, as well as coordinating efforts in an interdisciplinary fashion, will help alleviate patient and Family concerns and facilitate community reintegration.

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## EMBEDDED BEHAVIORAL HEALTH SPECIALISTS

Given the significant challenges to rehabilitation and recovery and the high incidence of secondary psychological problems among DCBI Warriors, Behavioral Health experts should be embedded within the acute, sub-acute, and chronic care treatment teams. At Walter Reed, experience has shown the implementation of Preventative Psychiatric Consultative Services has helped educate patients and Family, normalize alterations in mood, affect, and expectations, quickly identify problems for immediate treatment, and help remove the stigma associated with behavioral health diagnoses and treatment.

Easy access to behavioral health experts in the therapy areas helps identify mood problems as they develop, promote early inter-

vention, and facilitate interdisciplinary communication. It is not uncommon for DCBI Warriors to manifest psychological problems once they have completed their early phase of rehabilitation, sometimes years later, as they struggle with relationships, sense of self, and difficulties with obtaining and sustaining a fulfilling vocation.

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## DRIVING REHABILITATION

Independent driving is essential for individuals to successfully integrate back into the community. Driving Rehabilitation Specialists provide much needed support to ensure proper patient evaluation, training, assistive equipment modifications to a car or truck. They can also conduct certified road testing to meet independent driving and motor vehicle insurance requirements.

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## PAIN MANAGEMENT CONSIDERATIONS, ISSUES AND INTERVENTIONS

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There have been significant advances in the treatment and tracking of battlefield pain. New technology, training, medications, and the US Army Pain Task Force's progressive multimodal approach to pain treatment have begun to methodically transition pain treatment from an opioid-centric treatment to a multimodal comprehensive solution. SOF Medics are trained currently to perform peripheral nerve blocks at the POI with local anesthetics. This is proving to be of great benefit, as it: 1) improves the speed and quality of pain control; 2) increases the chance that the injured Warrior can shoot, move and communicate with the tactical unit, if needed; 3) mitigates the need for high doses of narcotics later in the course of treatment; and 4) decreases the likelihood of pain-driven post-traumatic stress.

Pain adjuncts such as IV acetaminophen, recently FDA-approved for US use, have proven useful in our Wounded Warriors during definitive surgery at Level IV facilities. This has a clear potential for battlefield use as a quick-acting pain adjunct. Intranasal ketamine, recently shown to have neuroprotective properties—and newer types of narcotics and methods of administration, such as patient-activated fentanyl transdermal systems and sublingual sufentanil tabs—may complement and, in certain situations, replace morphine as the drug of choice.

The US Army's Pain Task Force's team approach to pain management is crucial in optimizing the Wounded Warriors' immediate, acute, and definitive rehabilitation and recovery. Access to the full spectrum of pain control is necessary throughout the Warrior's lifetime.

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## **SPIRITUAL CONSIDERATIONS, ISSUES AND INTERVENTIONS**

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As a standard of care, all patients are assessed spiritually with the Spiritual Attitude Inventory (SAI). This is an evi-

denced-based instrument designed to assess the patient's spirituality. In general terms, it allows the ministry team to follow the patient over time. It also nests well with the post-hospitalization comprehensive transition planning.

The hospital ministry team works closely with behavioral health experts, particularly shortly after admission, to collaborate on a mutually supportive approach to the Wounded Warrior. The hospital chaplain community recognizes the unique challenges facing the DCBI Warrior, and more frequent spiritual assessments would be the norm.

Anecdotally, we have seen our female chaplains excel at connecting with these DCBI and other Wounded Warriors. It is possible they represent a non-threatening, yet compassionate, fellow Warrior who can wade directly into the raw issues of perception and reality with these male DCBI patients and take on a similar role with the WWs' spouses and fiancées. This requires further study, but it would be prudent to ensure the major Role IV sites for definitive care have at least one female chaplain on staff.

# RECOMMENDATIONS

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## GENERAL

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This report's recurring themes can inform our leadership of current best practices and additional opportunities to more fully care for severely injured Warriors. The particular injuries described have severe, global effects on the Warrior, of course, but also affect their fellow Warriors, their Families, and their healthcare providers.

The recommendations that follow are based on the DOTMLPF-C domain format (namely, Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Contracting). These recommendations are ordered from the most urgent and near-term imperatives to lower, but still important, priorities.

While the majority of these recommendations address gaps in Army Operational medicine, they may not be supportable by all the Services. A multi-Service working group needs to formulate Joint solutions for the present ATO and future Joint medical missions.

## DOTMLPFC DOMAINS

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### DOCTRINE

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1. Initiate a 'pilot' solution to the POI-to-Role II/III evacuation capability:

a. Evacuate urgent polytrauma casualties on RW platforms staffed with paramedics and flight nurses to include minimum of two attendees per critical (alpha) casualty.

b. Provide PRBCs and plasma on POI-to-Role II/III evacuation platforms routinely for critical casualties; administer at 1:1 ratio during flight.

c. Update system based on documented outcomes.

2. Overfly Role II echelons of care when evacuating an urgent polytrauma patient, if Role III site is less than 30 minutes away.

3. Mandate CoTCCC hypothermia prevention measures be followed and tracked.

4. Provide multimodal treatment and tracking of pain starting from the POI through stabilization, transport, and definitive treatment phases.

5. Elevate coordination of the Patient Evacuation Coordination Cells throughout the RCs within the ATO to IJC level.

6. Facilitate electronic medical information exchange between all echelons of care, including the VA and agencies involved with prevention, protection, and mitigation (beyond treatment).

7. Formalize relationship between MRMC (JTAPIC, OAFME, and JTTS), US Army Public Health Command, intelligence, operational, materiel communities and JIEDDO to optimize situational awareness, coordination and surveillance among all elements.

8. Direct and resource OAFME to conduct comprehensive, multi-disciplinary reviews of all combat deaths, with a focus on potentially survivable deaths. Every death must be reviewed, with information regarding preventability and cause of death entered into a searchable database within 30 days of death.

9. Offer fertility medical services to any Service Member and spouse with combat injury-related infertility.

10. Enlist command attention to completion of TCCC card, and entering TCCC card information into the JTTR and electronic medical record (EMR) for all casualties; make this a USR item.

11. Clarify shared responsibility between DoD Health Affairs and VA for the short- and long-term medical, surgical and rehabilitative care for Service Members who sustain DCBI.

12. Develop a military injury functional disability score

13. Consider employment of more capable MH-47, CV-22, or MH-53 RW evacuation platforms; engage in DoD efforts in articulating future vertical lift requirements and incorporate requisite MEDEVAC components.

14. Study optimal airway management and fluid resuscitation for polytrauma casualties.

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## ORGANIZATION

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1. Institutionalize the JTTS, and resource it and the Public Health Command to optimize their collective ability to track all phases of evacuation through proactive surveillance.

2. Develop appropriate medical surveillance systems that track severe injury and alert leaders when trends vary from historical/acceptable ranges.

3. Relook organization of Roles II and III echelons of care to best facilitate management of DCBI.

4. Enlist command emphasis on capturing pre-hospital casualty data.

5. Establish programs to prevent and mitigate DCBI complications, such as arthritis, chronic pain, heart disease, hypertension, obesity, diabetes and behavioral health disease.

6. Improve coordinating efforts among federal agencies to implement effective vocational rehabilitation for DCBI Warriors.

7. Establish Assistive Technology programs between MTFs and sister VA centers that address DCBI Warrior requirements.

8. Direct and resource the JTTS to provide case summaries and focused reviews for all DCBI casualties.

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## TRAINING

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1. Increase Air Ambulance medic/nurse training to Paramedic level.

2. Mandate pre-deployment combat casualty clinical trauma refresher, evidence-based clinical practice guideline review, TCCC familiarization and EMR familiarization for all providers and nurses.

3. Provide for better training in TCCC concepts to all combat leaders and all deploying warfighters and require USR reporting to measure commanders' use of guidelines.

4. Ensure IED and C-IED training remain embedded in collective training.

5. Provide additional specialized training to military rehabilitation providers who care for DCBI patients. Incorporate cognitive behavioral therapy, rehabilitation counseling, psycho-social sensitivity, regenerative medicine exposure, and the basics of assistive technology.

6. Ensure a more robust pre-deployment trauma experience for POI-to-Role II/III evacuation providers assigned to air evacuation units.

7. Provide additional specialized training for BH specialists caring for DCBI patients. Focus on coping and thriving with multiple limb loss, sensory loss, and genitalia injury; incorporate Family counseling and support skills.

8. Develop optimized training modalities for sustainment training on pre-hospital surgical airways.

9. Ensure adequate number of urologists and plastic surgeons are trained and skilled in genitalia reconstruction.

10. Assess validity and relevance of the Army Trauma Training Center as the FST's pre-deployment culminating training event.

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## **MATERIEL**

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1. Facilitate accelerated fielding of an FDA-approved freeze-dried plasma product for use by US Medics.

2. Pending an FDA-approved freeze-dried plasma product becoming available for fielding, pursue steps needed to field the French or the German freeze-dried plasma products for resuscitation of DCBI casualties in shock until blood and plasma can be used on evacuation.

3. Conduct studies to assess the safety and efficacy of FDA-approved truncal tourniquet systems to control non-compressible pelvic-area bleeding.

4. Conduct expedited studies on the value of plasma as the sole resuscitation fluid for pre-hospital resuscitation of shock.

5. Assess the risk-benefit ratio for the early use of tranexamic acid for casualties with non-compressible bleeding.

6. Conduct studies to compare the safety and efficacy of current and future hemostatic agents.

7. Conduct studies to compare the safety and efficacy of current and future commercially available tourniquets.

8. Ensure all TCCC-recommended equipment is provided in the Army individual first aid kits (IFAKs) and combat medical sets; make this reportable in the USR.

9. Emphasize high-priority research for clinical validation studies and comparative effectiveness of surgical methods, rehabilitation paradigms, regenerative medicine applications, including large peripheral and spinal nerve function for individuals with DCBI.

10. Acquire DoD funding and oversight for prosthesis and mobility device development for DCBI Warriors, particularly those with mangled limbs undergoing limb salvage, multiple limb loss, and very proximal upper and lower limb loss.

11. Continue aggressive research in tissue regeneration.

12. Establish systems to expedite specialized DCBI-related healthcare equipment and supply acquisition.

13. Continue to improve upon prosthetic, robotic and regenerative options to include user interfaces, cognitive Assistive Technology, and smart home technology.

14. Continue to improve dismounted IED detection devices.

15. Assess current and future patient movement items for enroute RW care.

16. Develop optimized electronic physiological monitors to better manage pre-hospital fluid resuscitation.

17. Compare current and future PPE to protect against GU and perineal injuries.

18. Equip US Combat Medics to achieve more effective narcotic analgesia using IV morphine or OTFC during Tactical Field Care.

19. Improve prosthetic socket interfaces to prevent commonly occurring acute and chronic skin problems.

20. Assess helmet-mounted sensors to measure blast exposure to the head.

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## **LEADERSHIP**

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1. Develop venues by which pre-deployment command teams can visit extremity injury centers of excellence, and WWs can visit units preparing to deploy.

2. Establish JIEDDO and JTAPIC LNOs to weekly JTTS teleconferences.

5. Place priority of effort on Combat Casualty Care within Role V MTFs; require tracking of “first starts” in the operating rooms.

4. Clarify responsibility of the clinical oversight of flight medic protocols within the ATO. Raise onboard medical care standards to that of civilians.

5. Synchronize injury data gathering and presentation.

6. Tri-Service strategic communication about the definitive care and long-term needs and expectations of DCBI Warriors should be incorporated into the leadership training of officers and non-commissioned officers at all levels.

7. Keep senior leadership apprised of trends on severely wounded Warriors’ treatment and long-term functional recovery.

8. Conduct research on the impact genitalia injury has on psychological health, quality of life and short- and long-term outcomes.

9. Direct future research to address long-term complications, such as post-traumatic arthritis and overuse injuries to intact limbs.

10. Provide recurring updates to all active duty trauma surgeons outlining the DCBI pattern and specific CPGs related to their care.

11. Improve surgical interventions to help restore peripheral and central nerve function after traumatic injury.

12. Implement existing CPG to manage pain.

13. Establish a Pre-Hospital Consultant to the Army SG.

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## **PERSONNEL**

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1. Deploy urologist to Role III MTF with every rotation

2. Relook manning and staffing of air ambulance companies, Area Support Medical Companies, Forward Surgical Teams

3. Staff definitive care facilities with adequate personnel to support multiple operating room teams on multiple returns for surgery, specifically to include first starts in the operating room and dedicated surgical teams, nursing teams, rooms and equipment.

4. Establish appropriate staffing ratios to care for DCBI patients at all echelons of care to maintain flexibility to adjust to increased casualty flow, humanitarian missions, and individual deployments. This not only optimizes DCBI patient care, but it helps maintain long-term provider resiliency.

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## **FACILITIES**

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1. Competing interests within MTFs must be clarified, with existing trauma facilities taking on the main effort in definitive reconstruction and return to function.

2. Update Medical Simulation Training Centers and Combined Training Centers to include the ATO’s most current lessons learned.

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## **CONTRACTING**

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1. Ensure appropriate resourcing for DCBI Warriors’ long-term rehabilitative care within both DoD and VA healthcare systems.

2. Develop improved and more flexible healthcare support contracts to acquire specialized providers to meet the DCBI patients’ dynamic clinical requirements.

3. Have urologic specialty panel review all GU injuries.

# CONCLUSION

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DCBI is a devastating injury. Tactical imperatives drive the need for dismounted patrols. Many organizations and agencies are working to eliminate the current threat of ground-emplaced IEDs and land mines. Advances in tactical combat casualty care and technical expertise of everyone in the chain of survival has decreased what were certainly fatal injuries just a few years ago.

Our focus is to minimize morbidity associated with the initial explosive injury, and to present the patient in an optimal physiological state for long-term rehabilitation and functional recovery. Also important for this injury pattern, as with many others, is the medical community's concerted effort at healing the whole person—physically, cognitively, emotionally, psychologically and spiritually. Included with-

in this healing arc are the Warriors' Families and loved ones and those providing care.

Many of the issues and gaps addressed in this paper cross Service, Interagency and DoD/Civilian lines, thus comprehensive solutions should be determined by diverse stakeholder working groups.

Finally, it is reassuring to note we have yet to recognize an injury pattern or volume of cases that has overwhelmed our medical capabilities or led to increased fatalities. Nonetheless, we continue to reevaluate clinical practices and outcomes and refine diagnosis and treatment with evidence in order to maintain the highest survivability and functionality possible.



# APPENDIX A

## CHARTER



REPLY TO  
ATTENTION OF

MCCG

DEPARTMENT OF THE ARMY  
HEADQUARTERS, UNITED STATES ARMY MEDICAL COMMAND  
2748 WORTH ROAD  
FORT SAM HOUSTON, TEXAS 78234-6000

### Complex Battle Injury Task Force Charter

#### I. Establishment, Purpose and Scope

##### a. Establishment

The Surgeon General (TSG) establishes the Complex Battle Injury Task Force (CBI TF). The charter delineates the CBI TF's purpose, scope, and organization. This charter is in effect until revoked.

##### b. Purpose

The CBI TF serves as an advisor to TSG on matters related to complex battle injuries.

##### c. Scope

The CBI TF shall:

- (1) Meet to compile a list of questions surrounding complex battle injuries and determine a timeline to answer those questions; then make recommendations.
- (2) Conduct a thorough analysis of the method of wounding in complex cases by cross-walking with Joint Theater Trauma System (JTTS).
- (3) Provide a full laydown of wounding, management at point of injury, killed in action/died of wounds rates, evacuation chain management and impact on care and ultimate clinical "burden" on the system and outcome for the patient with these complex wounds.
- (4) Provide a fuller or more complete "life cycle or injury management" view and review.
- (5) Establish a system which sets upper and lower limits of these injuries given the battle OPTEMPO and troops at risk and pushes information proactively.
- (6) Recommend complex battle injury policy and procedures to TSG and oversee policy execution.

*Attachment 3*

(7) Provide TSG with summaries of all meetings.

II. Organization

a. The CBI TF Chairman is responsible for oversight and coordination of all CBI TF activities and required deliverables.

b. At a minimum, the CBI TF will consist of representatives from Orthopaedics, General Surgery, Neurosurgery, Neurology, Physiatry, Behavioral Health, Rehabilitation, Program Analysis and Evaluation, Medical Operations, Veterans Affairs, Warrior Transition Command, Nursing, US Army Medical Research and Materiel (to include Joint Trauma Analysis and Prevention of Injury in Combat), U.S. Army Institute of Surgical Research (to include JTTS and Tactical Combat Casualty Care), Defense & Veterans Pain Management Initiative, U.S. Army Forces Command, U.S. Army Medical Department Center and School, Public Health Command, and Air Ambulance.

III. Authority

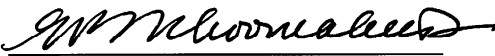
The Commander, US Army Medical Command, hereby establishes the CBI TF.

IV. Approval Authority

31 JAN 2011

Date

*There is a compelling need to  
pursue this charter with a  
sense of urgency and rapid &  
reasoned recommendations  
for actions to be taken.*



ERIC B. SCHOOMAKER  
Lieutenant General  
The Surgeon General and  
Commanding General, USAMEDCOM

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Total number:

- a. Rehab and Amputee: COL (b) (6)
- b. WTC: COL (b) (6)
- c. JTAPIC: COL (b) (6)
- d. ISR: COL (b) (6)
- e. JTTR/S: COL (b) (6)  
(b) (6)
- f. Pain: Lt Col (b) (6)  
(b) (6)
- g. Air Ambulance: COL (b) (6)
- h. PA&E: (b) (6)
- i. MED OPS: MAJ ( P) (b) (6)
- j. Psychiatrv Consultant: COL (b) (6)  
(b) (6)
- k. SOCOM: COL (b) (6)
- l. FORSCOM: COL (b) (6)
- m. AMEDD C&S: Ms (b) (6)  
LTC (b) (6)
- n. PHC: Dr. (b) (6)
- o. TCCC: CAPT (ret) (b) (6)
- p. Physiatry Consultant: COL (b) (6)
- q. General Surgery Consultant: COL (b) (6)
- r. ICU Nursing Consultant: COL (b) (6)
- s. Neurosurgical Consultant: (b) (6)
- t. Neurology Consultant: (b) (6)
- u. Ortho Consultant: LTC(P) (b) (6)
- a. Chief Ortho Trauma SAMMC: LTC (b) (6)
- b. Ortho Consultant: COL (b) (6)
- c. VA: (b) (6)
- d.
- e. TRADOC: (b) (6)
- f. Civilian partners/Rehab: (b) (6)

TSG's email:

1. We need a more thorough analysis of the method of wounding in these cases by cross-walking with JTTS, as he says. It's also not an "uptick"--it's a potentially major increase which is not at a time in the year when we expect these casualties.
2. We need a full laydown of wounding, management at POI, KIA/DOW rates, evac chain management and impact on care and ultimate clinical "burden" on the system and outcome for the patient in these complex wounds. We need a fuller or more complete "life cycle or injury management" view and review.
3. We need a system which sets upper and lower limits of these injuries given the battle OPTEMPO and troops at risk and pushes information proactively. We shouldn't have to rely on me or others to ask or "pull". It ought to be "push".

ATTACHMENT 2

# INFORMATION PAPER TO VCSA

(UNCLASSIFIED)

## INFORMATION PAPER

DASG-HSZ  
30 January 2011

**SUBJECT:** Complex Battle Injury Task Force

1. **Purpose:** To inform the VCSA on the establishment of the Army Surgeon's General Complex Battle Injury Task Force to deal with increasing numbers of multiple amputations and complex injuries.

2. **Facts:**

a. Multiple amputations due to battle injury jumped significantly in 2010. Eight U.S. military Service Members lost three or more limbs from the start of OEF (2003) through 31 December 2009. In comparison, 17 Service Members suffered three or more limb losses in 2010. (Source: amputee database (b) (6))

b. The OTSG Health Policy and Services Directorate (HP&S) briefed LTG Schoomaker about this drastic increase on 7 January 2011 (Attachment 1). This brief predominately contained statistical data and trend analysis with minimal clinical or operational root cause examination.

c. Upon reviewing the 2010 statistics and identifying numerous associated questions, LTG Schoomaker directed HP&S to establish a Complex Battle Injury Task Force (CBI TF) to holistically study these complex wounds and specifically:

(1) Conduct a thorough analysis of the method of wounding in complex cases in coordination with the Joint Theater Trauma System.

(2) Provide a full review of complex wound management from the point of injury thorough the full spectrum of care including killed in action/died of wounds rates, evacuation, impact on care and ultimate clinical "burden" on the system, and outcomes for the patient with these complex wounds.

d. HP&S has completed the following actions as of 29 January 2011:

(1) Identified multi-disciplinary SMEs to serve as CBI TF members (Attachment 2) consisting of representatives from Orthopedics, General Surgery, Neurosurgery, Nursing, Neurology, Physiatry, Behavioral Health, Rehabilitation, Aviation Medicine, Program Analysis and Evaluation, Healthcare Operations, the Warrior Transition Command, US Army Institute of Surgical Research (to include Joint Trauma Tracking System and Tactical Combat Casualty Care), US Army Medical Research and Materiel Command (to include Joint Trauma Analysis and Prevention of Injury in Combat), US Army Medical Department Center and School, the Public Health Command (Provisional), the Defense & Veterans Pain Management Initiative, US Army Forces Command, US Special Operations Command, and the Veterans Health Administration.

(2) Developed and initiated staffing of the CBI TF charter (Attachment 3).

(3) Prepared and initiated staffing on a decision paper (Attachment 4) for TSG to select a General Officer as CBI TF Chairman.

(b) (6)

Approved by: COL (b) (6)

# APPENDIX B

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## KEY REFERENCES (ALPHABETICAL ORDER):

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Allen PB, Salyer SW, Dubick MA, et al. Preventing hypothermia: comparison of current devices used by the US Army in an in-vitro warmed fluid model. *J Trauma* 2010; 69:S154-S161.

Amor SP. ABCA Armies' Program Chief of Staff ltr dtd 22 Feb11.

Bickell WH, Wall MJ, Pepe PE, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. *N Engl J Med* 331:1105, 1994.

Blackbourne L, Czarnik J, Mabry R, et al. Decreasing killed in action (KIA) and died of wounds (DOW) rates in combat wounded. *J Trauma* 2010 Jul; 69 Suppl 1:S1-4.

Borgman MA, Spinella PC, Perkins JG, et al. The ratio of blood products transfused in patients receiving massive transfusions at a combat support hospital. *J Trauma* 2007; 63:805-813.

Butler FK, Giebner SD, McSwain N, et al, eds. Pre-hospital trauma life support manual; seventh edition—military version. November 2010.

Butler FK, Hagmann J, Butler EG. Tactical combat casualty care in special operations. *Mil Med* 161; Supplement; August 1996.

Butler FK. Tactical combat casualty care: update 2009; *J Trauma* 2010;69:S10-S13.

Calderbank P, Woolley T, Mercer S, et al. Doctor on board? What is the optimal skill-mix in military pre-hospital care? *Emerg Med* 2010 (Epub ahead of print).

Champion HR, Holcomb JB, Lawnick MM, et al. Improved characterization of combat injury. *J Trauma* 2010 May; 68(5):1139-50.

Clarke JE, Davis PR. Medical evacuation and triage of combat casualties in Helmand, Afghanistan. (Submitted).

Committee on Tactical Combat Casualty Care (CoTCCC) meeting minutes; November 2010.

Cotton BA, Jerome R, Collier BR, et al. Eastern Association for the Surgery of Trauma Practice Parameter Workgroup for Pre-hospital Fluid Resuscitation guidelines for pre-hospital fluid resuscitation in the injured patient. *J Trauma*. 2009 Aug; 67(2):389-402.

CRASH-2 Collaborators. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASH-2 randomised controlled trial. *Lancet* 2011; 377:1096-1101.

Deal V. USSOCOM TCCC Issues; CoTCCC meeting minutes; November 2010.

Dempsey ME. Improvements to tactical combat casualty care (TCCC) and the combat lifesaver course; TRADOC Ltr; 8 April 2010.

Dougherty et al. *J Rehabil Res Dev.* 2010; 47(4):333-48.

Doughtery PJ, McFarland LV, Smith DG, et al. Multiple traumatic limb loss: a comparison of Vietnam veterans to OIF/OEF servicemembers. *J Rehabil Res Dev* 2010; 47(4):333-48.

DuBose JJ, Barmparas G, Inaba K, et al. Isolated severe traumatic brain injuries sustained during combat operations: demographics, mortality outcomes, and lessons to be learned from contrasts to civilian counterparts. *J Trauma.* 2011 Jan; 70(1):11-8.

Eastridge B, Costanzo G, Spott M, et al. Implementation and dissemination of a military trauma system: utilizing medical lessons learned from the battlefield. *Proceedings of the NATO Human Factors in Medicine Conference, 2010.*

Eastridge B, Butler F, Wade C, et al. Field triage score (FTS) in battlefield casualties: validation of a novel triage technique in a combat environment. *Am J Surg.* 2010 Dec; 200(6):724-7.

Eastridge BJ, Stansbury LG, Stinger H, et al. Forward surgical teams provide comparable outcomes to combat support hospitals during support and stabilization operations on the battlefield. (In review).

Eastridge B. Key graphs, charts and trends for the final DCBI Task Force report; 28 March 2011.

Eastridge BJ, Mabry R, Blackbourne LH, et al. We don't know what we don't know: point of injury data from combat casualty care. (Submitted to the *Journal of the Army Medical Department*, 2011).

Epstein RA, Heinemann AW, McFarland LV. Quality of life for veterans and servicemembers with major traumatic limb loss from Vietnam and OIF/OEF conflicts. *J Rehabil Res Dev.* 2010; 47(4):373-85.

Fabbri A, Servadei F, Marchesini G, et al. Predicting intracranial lesions by antiplatelet agents in subjects with mild head injury. *J Neurol Neurosurg Psychiatry* 2010; 81:1275-1279.

Gailey R, McFarland LV, Cooper RA, et al. Unilateral lower-limb loss: prosthetic device use and functional outcomes in servicemembers from Vietnam war and OIF/OEF conflicts. *J Rehabil Res Dev.* 2010; 47(4):317-332.

Galarneau M, Martin M, Oh J, et al. An analysis of in-hospital deaths at a modern combat support hospital. *J Trauma* 2009; 66:S51-S61.

Haut ER, Kalish BT, Cotton BA, et al. Pre-hospital intravenous fluid administration is associated with higher mortality in trauma patients: a national trauma data bank analysis; *Ann Surg* 2011. (In press).

Hoge CW, Castro CA, Messer SC, et al. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N Engl J Med* 2004; 351:13-22.

Holbrook TL, Galarneau MR, Dye JL, et al. Morphine use after combat injury in Iraq and incidence of post-traumatic stress disorder. *NEJM* 2010; 362:110-117.

Holcomb JB, Wade CE, Michalek JE, et al. Increased plasma and platelet to red blood cell ratios improves outcome in 466 massively transfused civilian trauma patients. *Ann Surg* 2008; 248:447-458.

Holcomb J. Devastating dismounted IED injuries in OEF; Defense Health Board presentation; 8 March 2011.

Holcomb J. Fluid resuscitation in modern combat casualty care: lessons learned in Somalia. *J Trauma* 2009; 54:S46-51.

Holcomb JB, McMullen NR, Pearse L, et al. Causes of death in special operations forces in the global war on terror. *Annals of Surgery* 2007; 245:986-991.

Institute of Surgical Research, Joint Theater Trauma System CPGs.  
<http://www.usaisr.amedd.army.mil/cpgs.html>.

Institute of Surgical Research, Joint Theater Trauma System, amputation CPG.  
<http://www.usaisr.amedd.army.mil/cpgs/Amputation%2016%20Feb%2010.pdf>.

Institute of Surgical Research, Joint Theater Trauma System, management of pain, anxiety and delirium CPG.  
<http://www.usaisr.amedd.army.mil/cpgs/Mgmt%20of%20Pain%20Anxiety%20and%20Delirium%2023%20Nov%2010.pdf>.

Institute of Surgical Research, Joint Theater Trauma System, urologic trauma CPG.  
<http://www.usaisr.amedd.army.mil/cpgs/Urologic%20Trauma%20Management%2030%20Jun%2010.pdf>.

Joint Publication 4-02.2, Tactics, techniques, and procedures for patient movement and joint operations.

Kelly JF, Ritenhour AE, McLaughlin DF, et al. Injury severity and causes of death from Operation Iraqi Freedom and Operation Enduring Freedom: 2003-2004 versus 2006. *J Trauma* 2008; 64:S21-S27.

Kinzle R. Development of a field packable junctional tourniquet. *ISR Mil Tech report*; 21 Jan 2011.

Kotwal RS, Montgomery HR, Kotwal BM, et al. Eliminating preventable death on the battlefield, *Arch Surg*. (In press).

Kotwal RS, O'Connor KC, Johnson TR, et al. A novel pain management strategy for combat casualty care, *Ann Emerg Med* 44(2):121, 2004.

Kragh JF Jr, Walters TJ, Baer DG, et al. Survival with emergency tourniquet use to stop bleeding in major limb trauma. *Ann Surg* 2009; 249:1-7.

Kragh JF, Walters TJ, Baer DG, et al. Practical use of emergency tourniquets to stop bleeding in major limb trauma. *J Trauma* 2008; 64:S38-S50.

Kulkarni et al. Association between amputation, arthritis and osteopenia in British male war veterans with major lower limb amputations. *Clin Rehabil* 1998; 12(4): 348.

Laferrier JZ, McFarland LV, Boninger ML, et al. Wheeled mobility: factors influencing mobility and assistive technology in veterans and servicemembers with major traumatic limb loss from Vietnam war and OIF/OEF conflicts. *J Rehabil Res Dev* 2010; 47(4):349-60.

Laird J. ISR Pre-hospital Trauma interventions study; CoTCCC meeting minutes; November 2010.

Ley EJ, Clond MA, Sprour MK, et al. Emergency department crystalloid resuscitation of 1.5 L or more is associated with increased mortality in elderly and non-elderly trauma patients. *J Trauma* 2011; 70:398-400.

Mabry R, Apodaca A, Penrod J, et al. Impact of critical care trained flight paramedics on casualty survival during helicopter evacuation in the current war in Afghanistan; Manuscript submitted to NEJM.

Mabry R: OEF MEDEVAC and enroute care director after-action report dtd 7 Feb 2011.

Mace J, Mabry R, Bolenbaucher R, et al. Died of wounds (DOW): cause of death after battlefield injury. (Submitted to *J Trauma*, 2011)

MacGregor A, Clouser M, Mayo J, Jackson C. Dismounted complex blast injury—the current experience. Naval Health Research Center, San Diego, CA. 2011.

Maughon JS. An inquiry into the nature of wounds resulting in killed in action in Vietnam. *Mil Med* 1970.

Mazuchowski E. AFME data review; email message, 7 March 2011.

McFarland LV, Hubbard Winkler SL, Heinemann AW, et al. Unilateral upper-limb loss: satisfaction and prosthetic-device use in veterans and servicemembers from Vietnam and OIF/OEF conflicts. *J Rehabil Res Dev*. 2010; 47(4):299-316.

McSwain, N, Champion, H, Fabian, T, et al. State of the art of fluid resuscitation 2010 prehospital and immediate transition to the emergency department (ED). (Submitted to the *J Army Med Dept*, 2011.)

Melcer T, Walker J, Galarneau M. et al. Midterm health and personnel outcomes of recent combat amputees. *Mil Med* 2010; 175:147-54.

Messinger S. Getting past the accident: IEDs, limb-loss and refashioning a life in a military medical center. *Med Anthropol Q* 2010; Sep; 24(3):281-303.



- Mitra B, Cameron P, Mori A, et al. Acute coagulopathy and early deaths post major trauma. *Injury* 2010.
- Nesbitt, M, Allen, P, Beekley, A, et al. Current practice of thermoregulation during the transport of combat wounded. *J Trauma* 2010 Jul;69 Suppl 1:S162-7.
- Nessen SC, Cronk DR, Edens J, et al. US Army two-surgeon teams operating in remote Afghanistan—an evaluation of split-based forward surgical team operations. *J Trauma* 2009; 66:S37-S47.
- Niles SE, McGlaughlin DF, Perkins JG, et al. Increased mortality associated with early coagulopathy of trauma in combat casualties. *J Trauma* 2008; 64:1459-1465.
- Ogilvie M, Perira B, McKenney M, et al. First report on safety and efficacy of hetastarch solution for initial fluid resuscitation at a level 1 trauma center. *J Am Coll Surg* 2010; 210:870-880.
- Pasquina PF, Cooper RA. Care of the combat amputee. Office of the Surgeon General , Borden Institute. Washington, DC. 2009.
- Reiber GE, McFarland LV, Hubbard S, et al. Servicemembers and veterans with major traumatic limb loss from Vietnam war and OIF/OEF conflicts: Survey methods, participants, and summary findings. *J Rehabil Res Dev*. 2010; 47(4):275-97.
- Salehpour F, Bazzazi AM, Porhomayon J, et al. Correlation between coagulopathy and outcome in severe head trauma in neurointensive care and trauma units. *J Crit Care*. 2011; In press.
- Schopp LH, Clark M, Mazurek MO, et al. Testosterone levels among men with spinal cord injury admitted to inpatient rehabilitation. *Am J Phys Med Rehabil*. 2006; 85:678-84.
- Serkin FB, Soderdahl DW, Peterson M, et al. Combat urologic trauma in US military overseas contingency operations. *J Trauma*. 69 Suppl 1:S175-8, 2010 Jul.
- Simmons JW, White CE, Eastridge BJ, et al. Impact of policy change on US Army combat transfusion practices. *J Trauma*. 2010 Jul;69 Suppl 1:S75-80.
- Sperry JL, Ochoa JB, Gunn SR, et al. An FFP:PRBC transfusion ratio >1:1.5 is associated with a lower risk of mortality after massive transfusion. *J Trauma*. 2008;65:986-993.
- Stansbury LG, Lalliss SJ, Branstetter JG, et al. Amputations in U.S. military personnel in the current conflicts in Afghanistan and Iraq. *J Orthop Trauma*. 2008 Jan;22(1):43-6.
- Wade, C, Salinas, J, Eastridge, B, et al. Admission hypo- or hyperthermia adversely affect survival after trauma: A comparison of civilian and military environments. (Submitted to the *Intl J Emerg Med*, 2011).
- Waxman S, Beekley A, Morey A, et al. Penetrating trauma to the external genitalia in Operation Iraqi Freedom. *Intl J Impot Res* 21(2):145-8, 2009.

Waxman S, Beekley A, Morey A, et al. Penetrating trauma to the external genitalia in Operation Iraqi Freedom. International Journal of Impotence Research 21(2):145-8, 2009.

White, JM, Stannard, A, Burkhardt, GE, et al. The Epidemiology of vascular injury in the wars in Iraq and Afghanistan. Ann Surg. 2011 Jan 6.

<http://www.healthquality.va.gov/>

<http://www.pva.org/site/apps/ka/ec/catalog.asp?c=ajIRK9NJLcJ2E&b=6423003&en=atLJJXODK9LSJ7PGL8IPJ4PRKnKUJ3MIKhLVePYJxG&CategoryID=322146>

[http://www.dvbic.org/Providers/TBI-Clinical-Tools-\(1\).aspx](http://www.dvbic.org/Providers/TBI-Clinical-Tools-(1).aspx)

# APPENDIX C

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## DEFINITIONS

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**Dismounted Complex Blast Injury:** IED-or land mine-related blast injury to a dismounted Warrior that includes at least one lower extremity amputation and also includes severe injuries to other limbs, GU system, pelvis, and/or abdomen. This description is based more on the inclusion of several severe injuries compounding complexity, and not intended to be exclusive of injuries of similar severity, sustained from other mechanisms.

**Polytrauma:** Two or more injuries sustained in the same incident that affect multiple body parts or organ systems and result in physical, cognitive, psychological, or psychosocial impairments and functional disabilities. TBI frequently occurs as part of the polytrauma spectrum in combination with other disabling conditions, such as amputations, burns, pain, fractures, auditory and visual impairments, post-traumatic stress disorder (PTSD), and other mental health conditions. When present, injury to the brain is often the impairment that dictates the course of rehabilitation due to the nature of the cognitive, emotional, and behavioral deficits related to TBI.

**Major Limb Amputation:** Any loss at or above the ankle or wrist.

# APPENDIX D

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## COTCCC RESEARCH PRIORITIES (NOVEMBER 2011)

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Follow-Up Tranexamic Acid Studies: As a follow-on effort to the CRASH-2 study, trials should be performed to determine the benefits and risks of using tranexamic acid for the subset of trauma patients who have non-compressible hemorrhage.

German Freeze-Dried Plasma Experience: Documentation of the German experience with this agent in both the pre-hospital and hospital settings would help to define the potential benefits that might be obtained by the use of this agent in the pre-hospital setting by US Forces.

Prospective Study Using FDA-Approved Plasma Alone for Pre-hospital Resuscitation Fluid in Patients with Non-Compressible Hemorrhage: This study would provide a basis for judging the benefit to be gained from fielding a freeze-dried plasma product when one becomes available in the US.

MERT Team Experience with 1:1 PRBC: Plasma Experience: With British MERT teams routinely giving PRBCs and plasma in a 1:1 ratio during POINT OF INJURY TO ROLE 2/3 MTF EVACUATION, the outcomes from their experience should be studied and compared to outcomes using Hextend® alone during evacuation.

Improved Battlefield Analgesia – Ketamine: Additional case series detailing the benefits and risks of using ketamine for pre-hospital analgesia in trauma patients are needed.

Pre-Hospital Care Documentation and Databasing: Research and transition efforts are needed to aid in the capture of battlefield trauma care rendered and the transfer of this information to both unit-based pre-hospital trauma registries.

Truncal Tourniquet: A prototype truncal tourniquet designed to assist in controlling external junctional hemorrhage in the tactical environment has recently been approved by the FDA. Studies documenting the efficacy of this device in eliminating distal pulses on extremities as well as the ability of users to apply it effectively are needed.

Use and Outcomes Data for Individual Elements of TCCC: Studies such as those performed on tourniquet use are essential to assessing recommended TCCC interventions and identifying areas for improvement.

Monitor-Driven Pre-hospital Fluid Resuscitation: Pre-hospital fluid resuscitation has the potential to do harm as well as good and the data to support specific fluid resuscitation protocols needs to be stronger.

Comparison Testing of Celox Gauze, Combat Gauze, and ChitoGauze: It would be useful to compare newer hemostatic agents to Combat Gauze in the consensus bleeding model developed at ISR to gain an understanding of their relative efficacy.

Comparison Testing of New Tourniquets: Although there have been good reports from both pre-hospital and in-hospital use of the CAT, SOFT-T, and EMT tourniquets, it would be useful to compare the new tourniquets to these currently-fielded devices.

Surgical Airway Training Methods: Surgical airways have been shown to be the most technically difficult pre-hospital trauma skill to train and sustain. Comparison studies of different training modalities used to teach this skill are needed.

Clinicopathological Review of Every US Fatality in Iraq and Afghanistan: Using a multidisciplinary team approach, OAFME autopsy records from the current conflicts should be reviewed to determine the causes of death and which deaths were potentially preventable.

Optimal Management of Traumatic Brain Injury in TCCC: Studies that better define optimal airway and fluid resuscitation management for casualties who often have polytrauma in addition to their TBI offer the potential to enhance both survival and the clinical outcomes in survivors.

The Impact of point of injury to Role 2/3 MTF Evacuation Provider Level and Skill Sets on Survival: There are at least three models of evacuation platform staffing in use in the CENTCOM area of operations at present: Determination of the optimal model for point of injury to Role 2/3 MTF Evacuation platform staffing requires an analysis of the outcomes obtained to date using these different options.

Hypothermia Prevention Equipment Comparative Studies: New and improved technologies to prevent hypothermia are being developed and there should be an ongoing program to evaluate these technologies as they evolve.

Combat Medic/Corpsman/PJ Equipment Evaluations: Equipment after-action evaluations would allow for quantitative evaluations and specific comments about the merits of currently fielded combat medical equipment.

Focused Analysis of JTTR Data Regarding Specific TCCC Interventions: Analysis of the information contained in the trauma system trauma registry may yield valuable insights about the success or deficiencies of the current TCCC Guidelines.

Enhanced Pelvic Protection in Personal Protective Equipment: Deployed forces currently sustain injuries to the pelvic, GU, and perineal areas from dismounted IED explosions. Research is needed to identify options to protect this region while minimizing additional weight and discomfort to the warfighter.

# APPENDIX E

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## ACTION PLAN

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This report's recurring themes provide the military with opportunities to more fully care for the severely injured Warriors discussed herein. Not only are these casualties injured on many fronts, but so too are their fellow Warriors, Families, and healthcare providers.

There are four focus areas of strategic importance for all battle injuries: 1) Comprehensive pain management at the POI; 2) complex behavioral health challenges facing DCBI Warriors and their Families, especially when there are concomitant GU injuries; 3) the incorporation of a rehabilitation mindset and philosophy throughout the spectrum of care; and 4) spiritual considerations for long-term care and rehabilitation for Warriors, Families, and units.

The recommendations that follow are based on the DOTMLPFC domains (namely, Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Contracting). The main body of this report contains detailed and more specific recommendations, ranked in the Task Force's collective order of priority. This action plan addresses the major operational goals for improved care of the Warrior with severe complex blast injuries.

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## CASUALTY EVACUATION

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There is wide training level variability among evacuation staff. The UK's MERT employs a physician to accompany the most severely injured casualties, whereas US evacuation providers are typically flight medics trained to the EMT-B level. Nurse Corps Officers augment Air Ambulance companies currently to assist in transporting severely wounded casualties. (D,T,M,P)

Recommendation: Define minimum standards of certification for air evacuation providers as EMT-P for evacuation of critically injured Warriors. AMEDDCS should ensure the current RW evacuation equipment sets meet current and future challenges. Finally, the Medical and Aviation communities should consider a trial of small numbers of MERT-like specialized RW platforms with surgical capability.

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## JOINT THEATER TRAUMA SYSTEM

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The Army SG implemented the JTTS to document trauma presentations, interventions and outcomes through a centralized database. Over the years, its registry, the JTTR has become one of the nation's largest trauma registries, with 10 years of longitudinal data from Echelons I to V care. This organization, similar to its predecessor from Vietnam, the Wound Data & Munitions Effectiveness Team (WDMET), plays an absolutely critical role in establishing long-term commitment to military trauma care and research. The overarching and large scope nature of JTTR requires augmentation through modules with enhanced specificity for more detailed tracking of data and trends with injuries. Specifically, the Military Orthopaedic Trauma Registry is required to identify and track these complex injury patterns. (D,O,L,P,F)

Recommendation: Develop and codify the JTTS as a Joint Service Requirement for continuous long-term funding, staffing, and facility support with additional development or support for region specific modules.

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## **INJURY SEVERITY SCORES**

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Current military doctrine pulls definitions, grading scores, and disease criteria from civilian trauma literature. The use of Injury Severity Scores allows comparisons to current medical literature and outcomes data. The use of standardized definitions also allows better correlation with existing literature. However, the definitions and scores do not take into account functional and long-term challenges that specific battlefield injuries face. Military-specific definitions are needed to facilitate thorough research and comparison of long-term outcomes. (D,T,P)

Recommendation: The USAISR should develop military-specific trauma scoring criteria for DoD that address the complexities of battlefield injuries.

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## **PRE-DEPLOYMENT TRAINING**

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Six levels of trained personnel provide battlefield medical care. Since 2007, every Army Recruit received initial medical training, which provides them adequate tools to render “Buddy Aid,” when needed. Non-medical Soldiers who receive additional training are identified as a Combat Lifesaver (CLS). Current doctrine places one CLS per squad/vehicle/formation. However, most deploying units exceed this requirement, often training everyone in the unit to the CLS-level.

Combat medics (68W Military Occupational Skill, or MOS) undergo extensive initial entry training, including EMT-B, Pre-Hospital Tactical Lifesaver, etc. Additionally, medics typically receive training in TCCC prior to deployment. Currently, there is no advanced training for 68Ws assigned to ground or air ambulance units.

Battalion physicians and physician assistants are prevalent on the battlefield in combat formations. However, the level of medical care in functional and multifunctional formations can be quite variable from unit to unit, depending on the type of unit and level of individual provider training. Specialists at the Role II/III echelons possess have undergone more extensive graduate medical education, in general, but not necessarily so in the fields of emergency medicine or trauma surgery. This can lead to wide variability in the field.

The Army SG mandated that all FSTs conduct pre-deployment training at the Army Trauma Training Center (ATTC), a civilian trauma center in Miami, FL. This training event helps to build teams that will later deploy, but its benefit appears directed primarily to the non-surgical members. The main reason is this training does not replicate the severity of trauma currently seen in the ATO. Additionally, this civilian setting lacks training venues on other warfighting functions, with which the deploying staff must be facile. (T,M,L,P)

Recommendation: AMEDDCS and CALL should collaborate to develop programs of instruction based on specific theaters of operation, echelons of care, and anticipated skill requirements. This must include specialty specific individual and team skills. Requirement for each surgeon prior to first deployment to spend an additional week of training at LRMC, where they will encounter the types of casualties he/she will likely see during deployment. Ensure pre-deploying officer, NCO and spouse leadership visit the Warrior with major limb loss and ex-

tremity injury centers of excellence. As a corollary, ensure volunteer WVs visit units before deployment.

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## **MEDICAL ORGANIZATION AND CONFIGURATION**

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Current doctrine calls for echelons of care, with progressively robust capabilities with each successive level. Wounded, Ill, and Injured warfighters are to sequentially traverse these care echelons. This report highlights areas for improvement, from the POI through definitive care, to better address current and future requirements. There has not been a comprehensive joint analysis of battlefield care since before OEF. Multiple compartmental looks at specific areas and echelons of care have been undertaken by individual Services. However no systematic comprehensive review of the entire theater healthcare system has been performed in the past ten years. (D,O,P,F)

Recommendation: ASD(HA) should establish a tri-Service team to reexamine and validate or remodel joint medical combat casualty care doctrine throughout every level of care.

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## **MEDICAL EQUIPMENT**

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Continuous research and development are needed for equipment such as truncal or junctional tourniquets, upper and lower extremity prostheses, and robotics. The field of regenerative medicine also holds great promise for these injured Warriors. (D,T,M,P,F,C)

Recommendation: Develop a tri-Service research forum to discuss and develop new DCBI strategies, with DoD and FDA commitment to test, approve and rapidly field potentially life-saving equipment or validate best practices and technology rapidly.

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## **MEDICAL DOCUMENTATION**

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Care on the battlefield is complex, and requires timely input of critical medical information to make expedient decisions on prioritization and delivery of finite resources on the battlefield. Documentation has significantly improved during OIF and OEF with the fielding of Medical Communications for Combat Casualty Care, the development of The Joint Theater Trauma Registry, the use of AHLTA-T, Theater Medical Data Store, and many other systems. However, the current system is often stove-piped, paper-based and difficult to manage. This impacts our ability to address pre-hospital care, the most fertile area for targeted improvement. (T,M,L,P,F,C)

Recommendation: Rapidly develop user-friendly, reliable, digital system to capture POI pre-hospital care from the POI. Consolidate documentation systems into one electronic health record that fully captures healthcare delivery across the enterprise of care, from the battlefield to the VA.



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## **CLINICAL RESEARCH**

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Battlefield care has improved significantly over the recent years due to research-driven advances. New and ongoing research must continue to allow for optimal care of the wounded. (D,O,T,L,P,F,C)

Recommendation: Form inter-Service and inter-agency relationships to facilitate aggressive, innovative and relevant translational and outcomes-based clinical research.

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## **PAIN MANAGEMENT**

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Throughout this report, from POI through definitive care, each section discussed the significant opportunities to improve upon pain management from the POI forward. The current battlefield focus is almost exclusively based on opioid pain control. A Comprehensive Pain Management Care Strategy has been developed that will mitigate most of the shortfalls in training and pain management. (D,O,T,M,L,P,F,C)

Recommendation: Fully support the Comprehensive Pain Management Strategy. Ensure rapid fielding of all appropriate resources. Prioritize training on the next deploying units and those involved in immediate care to these Warriors and Families.

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## **SPIRITUAL CARE**

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DCBI casualties with concomitant GU injuries require special spiritual considerations not made with other wounded Warriors—including those with major amputations. The ability to be intimate in a way that involves the genitalia is a significant identifier of self. At a minimum, more frequent spiritual assessments would be indicated for these types of casualties. (D,O,L)

Recommendations: Couple with civilian organizations and VA to rapidly gain expertise in this area. Develop an Ethics Panel with civilian and military leaders to discuss and gain options on DCBI-related issues. Additionally, a strategic communication effort must be rapidly initiated to emphasize quality of life, continued self-efficacy and significance/ value for the injured Warrior living with these injuries, to be managed at Unit, Service, and Public levels.

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## **BEHAVIORAL HEALTH**

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The behavioral health needs of these Warriors and their Families are not fully understood. These severe injuries, coupled with the possible loss of reproductive organs or function, will pose long-term challenges for everyone involved. Behavioral Health providers are often poorly equipped to cope with the challenges these patients face. (T,L,P)

Recommendation: Consider utilizing the National Intrepid Center of Excellence (NICoE) or similar behavioral health resource as a referral and training site for this subset of Warriors. Train providers specifically on the care of these Warriors and Families. Develop virtual and other remote access processes to allow these Warriors and Families to receive care while home and in long term rehabilitation. Lifelong monitoring of these Warriors and Families will be critical to long-term outcome management.

# APPENDIX F

## JOINT THEATER TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE: MANAGEMENT OF HIGH BILATERAL AMPUTATIONS

Original Release/Approval:			Note: This CPG requires an annual review
Reviewed:		Approved:	
Supersedes:	<b>Initial management of high bilateral lower extremity amputations with associated pelvic/perineal injuries</b>		
<input type="checkbox"/> Minor Changes	(or)	<input checked="" type="checkbox"/> Changes are substantial and require a thorough reading of this CPG	(or)
<input type="checkbox"/> Significant Changes	POC: (b) (6)		

1. Goal. To review indications for and the procedures associated with the initial management of bilateral lower extremity amputations with associated pelvic/perineal injuries.

2. Background. Bilateral lower extremity amputations with associated pelvic/perineal injuries represent one of the most challenging cohorts of surgical patients from management of the initial injury through final reconstruction. These injuries are associated with an increased incidence of morbidity and mortality. Survival is initially dependent upon hemorrhage control and massive resuscitation protocols. Later risks for mortality include sepsis and multisystem organ dysfunction. These injuries can broadly be divided into two categories; those with a perineal/pelvic floor injury and those without. There are few counterparts in civilian trauma. An organized aggressive continuum of surgical care by general surgeons and orthopaedists is critical to optimize outcomes.

3. Evaluation and Treatment.

a. Initial Resuscitation. These patients typically arrive in extremis shortly after injury. Tourniquets are often in place on all injured extremities. Due to profound shock and associated upper extremity amputations, IV access may not be obtained in the field. Rapid placement of IO (intra-osseous) lines is sometimes a useful adjunct to begin resuscitation prior to venous access. This injury pattern mandates immediate activation of massive transfusion protocols, the preferential use of fresh blood (< 21 days old), minimal use of crystalloid products, and early consideration for the use of fresh whole blood (FWB), if blood resources are limited. (Refer to Damage Control Resuscitation CPG).

b. Role of Resuscitative Thoracotomy. Occasionally these patients arrive with CPR in progress. When signs of life are present, consideration of resuscitative thoracotomy should be given according to established clinical practice guidelines. Outcome data from OIF suggest a reasonable survival rate in properly selected patients. Another alternative described with exsanguination in civilian extremity injuries is the use of a brief period of CPR with concomitant massive blood product resuscitation before resorting to a resuscitative thoracotomy.

c. Triage considerations. These patients consume massive amounts of blood products and utilize multiple surgical assets to include operative teams, equipment and operative hours. In the multiple casualty scenario, consideration of a balance between resources and surgical assets should be considered prior to proceeding with resuscitative thoracotomy.

d. Preoperative studies. Useful preoperative studies may include CXR, AP Pelvis, FAST, and DPL. Expedient CT of the head may be considered in patients displaying lateralizing signs consistent with severe TBI requiring operative intervention, but should not degrade resuscitation or delay surgical hemorrhage control.

#### 4. Operative Approach.

a. Prioritization and surgical teams. The initial operative goal is hemorrhage control and control of contamination. Due to the nature of these injuries, this is best achieved using a team of general surgeons and orthopaedists working concurrently on the patient (if available). For example, two surgeons can achieve proximal control and address intra-abdominal injuries while a second team focuses on the amputations. A third team can be utilized to address upper extremity injuries, if present. This approach maximizes efficiency and limits prolonged physiologic insult to a severely injured patient. Prior to operation, the most critical procedures (i.e., proximal hemorrhage control, control of contamination, completion amputations, bladder repair and potential colonic diversion) should be listed, keeping in mind reasonable parameters to terminate surgery.

b. Proximal vascular control. The level of proximal vascular control is dictated by several clinical variables: previous resuscitative thoracotomy, associated pelvic disruption, level of tourniquet placement and level of amputation(s). Typically vascular control should be achieved at the most distal level possible, including control via a retroperitoneal approach or in the groin. A strategy of walking the clamps down in patients with massive pelvic injuries is prudent. This involves laparotomy, infra-renal aortic control, and movement of control distal to the internal and external iliacs. In the case of pelvic floor injuries with open pelvic wounds and active posterior bleeding, temporary control of the internal iliacs is prudent. This can be achieved with vascular clamps, vessel loops, Rommel tourniquets, or vascular clips. The benefit of achieving hemorrhage control must be balanced against the risk of ischemic tissue at the site of injury and subsequent infection and diminished wound healing. An attempt to reperfuse the internal iliacs should be made at the index or subsequent procedure.

c. Role of proximal diversion. In patients with an obvious need to divert the fecal stream due to pelvic disruption or an open pelvic fracture, stapled interruption of the sigmoid colon at the pelvic brim should be performed early to facilitate pelvic exposure and vascular control.

d. Orthopedic considerations. It is common for these patients to present with traumatic bilateral lower extremity amputations at various levels from transtibial amputations to very high transfemoral amputations, often with extremely complex soft tissue blast wounds up to and including the perineal and gluteal region. Associated traumatic amputation of the non-dominant upper extremity is also common. The most challenging cases involve open pelvic ring and peri-acetabular fractures and dislocations. Initial orthopaedic resuscitative involvement entails assuring that extremity hemorrhage control is sufficient with tourniquets. Often after the onset of the massive transfusion protocol, patients can bleed through in-place field tourniquets. In this case, they require placement of additional field tourniquets or pneumatic ones (if available) to control bleeding until optimized in the operating theater. Quick examination of the pelvic ring should be performed to address stability. Pelvic fractures can be stabilized with the use of clamped sheets or commercial pelvic binders centered over the trochanters.

Index operative procedures should be prioritized with surgical team leader. Hemorrhage control of traumatic amputated limbs and peri-pelvic sources is the priority. Pelvic and perineal packing is helpful for tiny vessel hemorrhage control and cases with continued coagulopathic oozing. In the multilevel amputee, limb length is inversely proportional to later energy expenditure. Revision amputations should occur at the most distal viable level with double ligation of all named vessels in an open, length-preserving fashion. Atypical rotational flaps are greatly preferred over guillotine-style or open circular amputations. Care should be given to salvaging healthy tissue for flap coverage, even if it is an atypical anterior rotational flap in the face of destroyed posterior tissue. When necessary, pelvic ring stabilization with external fixation is preferable to binders due to proximity of wounds and serial debridements that will be required. ASIS or AIIS pins are both appropriate, with the latter offering the greatest reduction control but which demands fluoroscopy and surgeon experience. Consideration should be given for later orthopaedic pelvic incisions so as to appropriately divert the location of colonic and urinary streams. External fixation of long bone fractures should be accomplished during the index procedure when possible. Smaller bone and joint fractures can be addressed if the patient remains stable, otherwise they are cared for after the initial resuscitation.

e. Soft tissue debridement. Adequate initial surgical debridement is critically important. These blast wounds are typically complex and extensive. They may be grossly contaminated with dirt, fragment debris, clothing and foliage. Wounds should be incised with well-planned incisions to extend the zone of injury to healthy tissue. Systematic debridement of nonviable skin, subcutaneous tissue, fascia, muscle, periosteum and bone is critical to reduce the bio-burden and later risk of sepsis. With subsequent debridements, these blast wounds tend to evolve; if tissue is questionable and not contaminated it should be maintained and addressed at later surgical interventions. However, since the timing of the next operation (at the next echelon of care) is unpredictable, avoid leaving marginally viable tissue behind, as many of these complex wounds will develop progressive necrosis. When present, pelvic/perineal and pelvic wounds need to be similarly addressed.

f. Associated vascular injuries. This injury pattern appears to be associated with iliac vein injury. When possible these injuries should be shunted or repaired rather than ligated. Unless easily repairable, arterial injuries in these critically injured patients should be managed initially with shunting followed by formal repair at subsequent operation. Care should be taken to avoid exclusion of the profunda femoris during shunting or repair, in order to perfuse the soft tissue and muscle.

g. Associated GU injuries. Injuries to the ureters, urethra, bladder, scrotum, penis, and prostate are common. These should be addressed if feasible with a focus on hemorrhage control, urinary control or diversion, and preservation of tissue for later reconstruction. See urologic trauma management CPG for specific recommendations.

h. Consideration of prone positioning. In most patients, the posterior soft tissue injuries can be addressed with elevation of the amputated stumps, or with the patient in a lateral position after the supine portion of the case has been completed. However certain injury patterns have a large posterior element. In these cases it is sometimes necessary to prone the patient during the index procedure for either hemorrhage control or debridement of deep blast wounds in the gluteal and low back region. This decision should not be made lightly and can often be deferred to secondary procedures. When undertaken, the use of a Jackson table can facilitate a safe transition to the prone position. Unstable pelvic ring injuries should be stabilized prior to placing a patient prone, as this position can exacerbate pelvic volume widening and hemorrhage.

i. Temporary abdominal closure. Liberal use of temporary abdominal closure with delayed stoma maturation is advised.

j. Wound dressings. Traumatic wounds should not be definitively closed until multiple adequate debridements have been performed. By nature, the extensive soft tissue destruction and degree of contamination in these wounds make them infected until proven otherwise and a continuum of surgical debridements is necessary to prepare wounds for closure or coverage. If necessary and in the face of clean viable tissue, incisions made to extend the zone of wounds to healthy levels can be loosely approximated to prevent massive skin retraction. The preferred initial wound dressings include wet-to-dry, Dakin's soaked gauze, antibiotic bead pouches or wound vacs.

## 5. Perioperative management.

a. Need for Radiologic Imaging. These injuries are associated with a significant transfer of energy to the casualty resulting in high risk for associated injuries of a blunt and penetrating nature. Once the patient is physiologically stabilized, complete imaging, including "Pan Scan" CT and plain film examination, should be obtained to evaluate for occult injury.

b. Need for repeated debridements. It is important to appreciate the phenomenon of wound evolution and the expectation that the soft tissue will evolve with respect to extent and tissue viability over the course of several days. In the acute phase (<72 hours from injury) wounds should be frequently inspected in the operation room (every 24 hours). In the later, sub-acute phase (3-7 days from injury) wounds may require less frequent treatment based on the presence of viable tissue and absence of ongoing contamination. Multiple debridements are routinely required and the massively injured, physiologically deranged patient should not undergo excessive surgical procedures during the initial operation other than those required to control hemorrhage and gross contamination. See the Initial management of War Wounds CPG for further guidance.

c. Role of systemic and topical antibiotics. Initial antibiotic selection should avoid empiric broad spectrum coverage but rather focus on narrow spectrum antibiotics (such as first generation cephalosporins) and the liberal use of topical delivery with Dakin's soaked gauze or antibiotic beads. See Guidelines to Prevent Infection in Combat-Related Injuries CPG for specific recommendations.

d. Role of VTE prophylaxis. These patients are at very high risk of developing proximal deep vein thrombosis (DVT) and associated pulmonary embolus (PE). The presence of lower extremity amputation does NOT reduce this risk. In fact, patients with lower extremity amputations may actually be at higher risk for development of DVT and PE than those with similar injury severity without lower extremity amputation. It is recommended that these patients be started on appropriate DVT/PE prophylaxis as soon as coagulopathy is reversed. If contraindications to prophylactic anticoagulation persist, prophylactic IVC filter placement should be strongly considered. See Prevention of Deep Venous Thrombosis CPG for further recommendations.

e. Transfer of care. The down-range surgeon should make every effort to coordinate dressing changes and necessary repeat debridements in anticipation of required patient transport up-range. Given the propensity for wounds to evolve in their acute phase, the down-range surgeon must maintain a low threshold to perform additional debridement prior to evacuating the casualty if the patient would otherwise undergo an unacceptable interval between debridements. Given the unpredictable nature of the air evacuation system and to optimize timing of

subsequent serial debridements, the patient should remain NPO for flight so that they are prepared for the next operation.

6. Responsibilities. It is the trauma team leader's responsibility to ensure compliance with CPG adherence.

7. References.

a. Edens JW, Beekley AC, et al. Longterm outcomes after combat casualty emergency department thoracotomy. *J Am Coll Surg*. 2009 Aug;209(2):188-97.

b. Dorlac WC, DeBakey ME, Holcomb JB, et al. Mortality from isolated civilian penetrating extremity injury. *J Trauma*. 2005 Jul;59(1):217-22.

c. Wisner DH, Victor NS, Holcroft JW. Priorities in the management of multiple trauma: intracranial versus intra-abdominal injury. *J Trauma*. 1993 Aug;35(2):271-6; discussion 276-8.

d. Dubose J, Inaba K, et al. Bilateral Internal Iliac Artery Ligation as a Damage Control Approach in Massive Retroperitoneal Bleeding After Pelvic Fracture. *J Trauma*. 2010 May 20. [Epub ahead of print].

e. Urologic Trauma Management CPG.

f. Labler L, Trentz O. The use of vacuum assisted closure (VAC) in soft tissue injuries after high energy pelvic trauma. *Langenbecks Arch Surg*. 2007 Sep;392(5):601-9.

g. Initial Management of War Wounds CPG.

h. Guidelines to prevent Infection in Combat-Related Injuries CPG.

i. Prevention VTE CPG.

Approved by CENTCOM JTTS Director, JTS Director and Deputy Director and CENTCOM SG

# APPENDIX G

## DCBI TASK FORCE MEMBERSHIP

BG (Dr.) Joseph Carvalho, Jr.	Chairman, DCBI TF
COL (P) (Dr.) (b) (6)	US Army Forces Command Representative
COL (Dr.) (b) (6)	Chief of Staff, DCBI TF/Orthopedic Consultant
COL (Dr.) (b) (6)	JTAPIC Representative
COL (b) (6)	Critical Care Nursing Representative
COL (Dr.) (b) (6)	US Army Institute of Surgical Research Representative
COL (Dr.) (b) (6)	US Special Operations Command Representative
COL (Dr.) (b) (6)	Joint Theater Trauma Registry/System / Trauma Consultant
COL (b) (6)	Air Ambulance Representative
COL (Dr.) (b) (6)	Neurology Representative
COL (Dr.) (b) (6)	US Army Medical Command Health Policy & Services Representative
COL (Dr.) (b) (6)	Psychiatry Representative
COL (Dr.) (b) (6)	Neurosurgical Representative
COL (Dr.) (b) (6)	Physiatry Representative
COL (Dr.) (b) (6)	Urology Representative
COL (b) (6)	US Army Medical Command Rehabilitation & Reintegration Representative
COL (Dr.) (b) (6)	Rehabilitation and Amputee Representative
COL (Dr.) (b) (6)	Warrior Transition Command Representative
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LTC (Dr.) (b) (6)	General Surgery Representative
LTC (b) (6)	US Army Medical Command Operations Representative

LTC (Dr.) (b) (6)	Trauma Surgery Representative
Lt Col (Dr.) (b) (6)	Pain Representative
LTC (Dr.) (b) (6)	US Army Institute of Surgical Research Orthopedic Trauma Representative
LTC (Dr.) (b) (6)	OASD (Health Affairs) Representative
CAPT (Ret.) (Dr.) (b) (6)	TCCC Representative
COL (Ret) (Dr.) (b) (6)	US Army Medical Command PA&E Representative
Dr. (b) (6)	US Army Public Health Command Representative
Dr. (b) (6)	Veterans Affairs Representative
CPT (b) (6)	Task Force Executive Officer
Ms. (b) (6)	Army Medical Department Center and School Representative



# APPENDIX H

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## DCBI TASK FORCE CONTRIBUTORS

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Maj Gen (Dr.) Thomas W. Travis	Deputy Surgeon General Office of the Surgeon General Headquarters, U.S. Air Force
Mr. (SES) Mitchell Howell	Deputy Director, Joint IED Defeat Organization
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CH (COL) (b) (6)	Command Chaplain (b) (6)
COL (Dr.) (Ret.) (b) (6)	Medical Historian (b) (6)
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COL (Ret) (b) (6)	Chief, Amputee Patient Care Service Integrated Department of Orthopaedics and Rehabilitation (b) (6)
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Chief, Psychiatry Consultation Liaison Service  
(b) (6)

# APPENDIX I

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## GLOSSARY OF ACRONYMS

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ADL	Activity of daily living
AFSOC	Air Force Special Operations Command
AKA	Above knee amputation
AMEDDCS	US Army Medical Department Center and School
ARL	US Army Research Laboratory
AT	Assistive technology
ATO	Afghanistan Theater of Operations
ATTC	Army Trauma Training Center
BAMC	Brooke Army Medical Center
BAS	Battalion aid station
BI	Battle injury
BKA	Below knee amputation
BOG	Boots on ground
BTBIS	Brief traumatic brain injury screen
CAM	Complementary and alternative medicine
CAREN	Computer-assisted rehabilitation environment
CASEVAC	Casualty evacuation (to Role II or III facility in other than medical platform)
CCAT	Critical care aeromedical transport
CCCCC	Comprehensive Combat Casualty Care Center (C5) at Balboa Naval Medical Center
CCFP	Critical care flight paramedic
CFI	Center for the Intrepid
CFR	Case fatality rate
CG	Commanding General
CLS	Combat lifesaver

CoTCCC	Committee on Tactical Combat Casualty Care
COTS	Commercial-off-the-shelf
CPG	Clinical practice guideline
CRNA	Certified registered nurse anesthetist
CSH	Combat support hospital
CTC	Combat training center
DARPA	Defense Advanced Research & Projects Agency
DCBI	Dismounted complex blast injury
DMDC	Defense Manpower Data Center
DNBI	Disease and non-battle injury
DoD	Department of Defense
DoDD	Department of Defense Directive
DOTMLPFC	Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, and Contracting
DOW	Died of wounds
DWRIA	Died of wounds received in action
ERC	En route care
ERCS	En route care system
EMR	Electronic medical record
EMT-B	Basic emergency medical technician
EOD	Explosive ordnance disposal
ERAB	Navy Medicine's Executive Research Advisory Board
ETVB	Navy Medicine's Emerging Therapeutics Validation Panel
FATS	Firearms training system
FDA	Food and Drug Agency
FORSCOM	US Army Forces Command
FRSS	US Navy forward resuscitation and surgical squad
FRT	US Navy forward resuscitation team
FST	US Army Forward Surgical Team

FW	Fixed wing
GME	Graduate medical education
GU	Genitourinary
HP&S	Office of The Surgeon General, Health Policy and Services
ICU	Intensive care unit
IFAK	Individual first aid kit
IOTV	Improved outer tactical vest
IM	Intramuscular
IO	Intraosseus
ISR	US Army Institute of Surgical Research
ITO	Iraq theater of operations
IV	Intravenous
JIEDDO	Joint Improvised Explosive Device Defeat Office
JTAPIC	Joint Trauma Analysis for the Prevention of Injuries in Combat
JTTR	Joint theater trauma registry
JTTS	Joint theater trauma system
KIA	Killed in action
LRMC	Landstuhl Regional Medical Center
MEDCOM	US Army Medical Command
MEDEVAC	Medical evacuation using dedicated medical rotary wing transport
MATV	MRAP all-terrain vehicle
MERT	Medical emergency response team
MRAP	Mine-resistant ambush-protected
MRMC	US Army Medical Research and Materiel Command
MRO	Medical regulating officer
MTF	Medical treatment facility
MTV	Marine tactical vest
NHRC	Naval Health Research Center
NICoE	National Intrepid Center of Excellence

NMA	Non-medical attendant
NRL	US Navy Research Laboratory
NSRDEC	Natick Soldier Research Development & Engineering Center
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OND	Operation New Dawn
OSCAR	USMC's operational stress control and readiness program
PA&E	Program analysis and evaluation
PECC	Patient Evacuation Coordination Cell
POI	Point of injury
PHTR	Pre-hospital trauma registry
PM-SPE	Product manager for Soldier protective equipment
PM-SPIE	Project manager for Soldier protection and individual equipment
PM-ICE	Program manager for infantry combat equipment
PPE	Personal protective equipment
PTS	Post-traumatic stress
PTSD	Post-traumatic stress disorder
QOL	Quality of life
RC(SW)	Regional Command-Southwest
RN	Registered nurse
RW	Rotary wing
SAI	Spiritual attitude inventory
SOCET	Air Force special operations critical care evacuation team
SOF	Special operations force
SOST	Special operations surgical team
SSTP	US Navy surgical shock trauma platoon (2 FRSSs + STP)
STP	US Navy shock trauma platoon
STRATEVAC	Strategic evacuation (across theaters of operation)
TCCC (TC3)	Tactical combat casualty care

TMDS	Theater medical data store
TSG	The Army Surgeon General
UK	United Kingdom
USAARL	US Army Aeromedical Research Laboratory
USAISR	US Army Institute of Surgical Research
USAMEDCOM	US Army Medical Command
USAPHC	US Army Public Health Command
USMA	US Military Academy
USMC	US Marine Corps
USR	Unit status report
USSOCOM	US Special Operations Command
UUNS	Urgent universal needs statement
VA	Department of Veterans Affairs
VHS	Veterans health services
VTC	Video teleconference
WDMET	Wound data & munitions effectiveness team
WIA	Wounded in action
WIIW	Wounded, ill and injured Warrior
WRAMC	Walter Reed Army Medical Center
WT	Warrior-in-transition
WTC	Warrior Transition Command
WTU	Warrior transition unit
WW	Wounded Warrior