



ORIGINAL ARTICLE

A descriptive analysis of casualties evacuated from the Africa area of operations



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ABSTRACT

Introduction: The United States (US) military has expanded its area of operations into Africa. This medically immature theater is spread across a large region where prolonged field care (PFC) events are likely to occur. We describe trauma cases reported in the Africa Command (AFRICOM) area of operations to date within the Department of Defense Trauma Registry (DODTR).

Methods: We queried the DODTR for all subjects evacuated from the AFRICOM area of operations from January 2002 to June 2017.

Results: There were 49 subjects in the registry during our time frame from AFRICOM. Most of the evacuations came from Djibouti (53%). The median age was 29 years, most evacuees being male (92%). Non-battle injuries accounted for most of the injuries (82%), and most were US military (90%). All battle injuries were gunshot wounds (GSW). Composite injury scores were low (median 4, IQR 4–9.5). All subjects survived to hospital discharge. GSWs (22%) and sports injuries (24%) accounted for most evacuations. Serious injuries most frequently involved the extremities (18%) and the thorax (12%). The most frequent major injuries were open fractures (22%) and abdominal injuries (10%). The most frequent facility-based interventions performed were wound debridement (29%) and fracture/joint dislocation reduction (22%).

Discussion: Based on this dataset, most of the injuries from AFRICOM were non-battle injuries. All battle injuries were GSWs. Our study highlights the differences in casualty care needs in this region which contrast the primary explosive-based injuries seen within United States Central Command (CENTCOM) operations. The limitations of this dataset highlight the potential value of a Joint Trauma Service (JTS) data collection mandate and resource support for units within this region to facilitate targeted improvements in medical care.

African relevance

- The United States (US) military conduct advise and assist operations throughout Africa.
- Little is known about the US casualties throughout Africa.
- Service members are most frequently evacuated for non-combat injuries.
- Gunshot wounds accounted for all battle injuries.

Introduction

In 2007, President George W. Bush created the United States (US) Africa Command (AFRICOM) in response to national security concerns and Africa's growing geostrategic importance [1]. AFRICOM manages a large area of operations with limited resources. It has only one base on African soil (Camp Lemonnier, Djibouti), no organic operational forces, and no theater sustainment command [2]. Its military medical infrastructure is immature without an established evacuation system, which prevents traditional "golden hour" definitive care, and introduces

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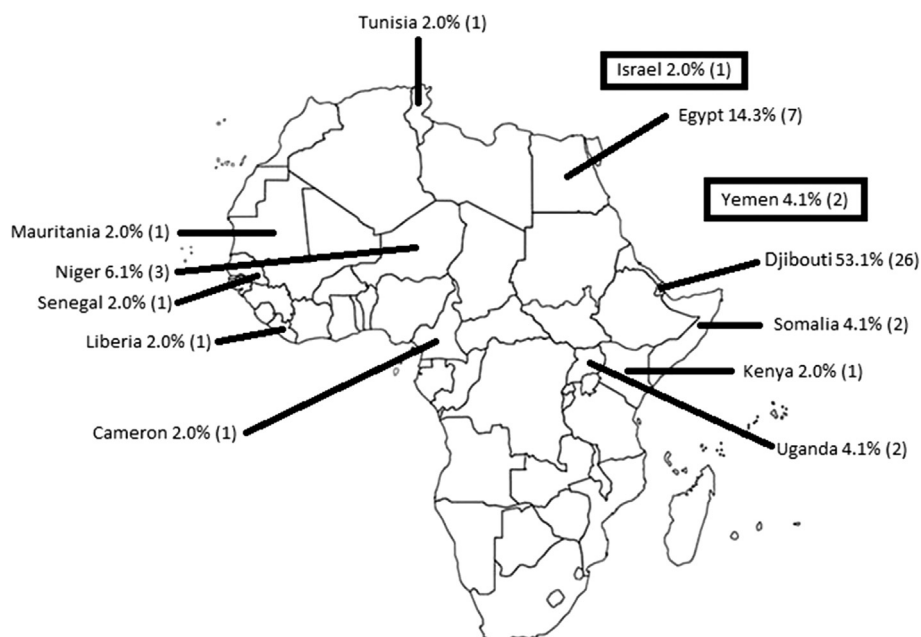


Fig. 1. Description of countries from which the evacuations occurred.

medical management challenges [3–6].

In 2015, medical personnel within US Special Operations Command that formed the Prolonged Field Care (PFC) Working Group and published a framework for the prehospital management of trauma casualties in operational environments such as AFRICOM [7–10]. In late 2016, the US military's Joint Trauma Service (JTS) published clinical practice guidelines (CPG) specifically for PFC [11]. The PFC CPG provides evidence-based recommendations for trauma patient management after exhausting all Tactical Combat Casualty Care (TCCC) interventions in the setting of delayed casualty evacuation. JTS does not have a mandate for data collection outside of US Central Command (CENTCOM). CENTCOM includes parts of the Middle East, northern Africa and parts of Asia – most notably Iraq, Syria and Afghanistan [12]. Thus, there is limited data available from this unique and immature theater of operations (internal communication, JTS data analysis branch). PFC outcomes and advances partly rely on data-driven, performance improvement initiatives [3,8,13]. To date, only case reports and questionnaire studies have reported data on this specific combat casualty population [14,15].

In the present study, we seek to describe traumatic injuries sustained during military operations in AFRICOM within the Department of Defense Trauma Registry.

Methods

The Department of Defense Trauma Registry (DODTR), formerly known as the Joint Theater Trauma Registry (JTTR), is the data repository for the Department of Defense (DOD) trauma-related injuries [16,17]. The DODTR includes documentation regarding demographics, injury-producing incidents, diagnoses, treatments, and outcomes of injuries sustained by US military and US civilian personnel in wartime and peacetime from the point of injury to final disposition. Short-term outcome data are available for non-US casualties. The DODTR comprises all patients admitted to a Role 3 (fixed-facility) or forward surgical team (FST) with an injury diagnosis using the International Classification of Disease 9th Edition (ICD-9) between 800 and 959.9, near-drowning/drowning with associated injury (ICD-9 994.1) or inhalational injury (ICD-9 987.9) and trauma occurring within 72 h from injury. We defined the prehospital setting as any location prior to reaching a FST or a combat support hospital (CSH) to include the Role 1

(point of injury, casualty collection point, battalion aid station) and Role 2 (temporary limited-capability forward-positioned hospital inside combat zone without surgical support).

We conducted a retrospective review of prospectively collected data within the Department of Defense Trauma Registry (DODTR). We queried the DODTR based on theater of operation and military operation. We sought all available prehospital and fixed-facility based care on the initial search to create the dataset.

The US Army Institute of Surgical Research regulatory office reviewed protocol H-17-020 and determined it was exempt from Institutional Review Board oversight. We obtained only de-identified data.

We performed all statistical analysis using Microsoft Excel (version 10, Redmond, Washington), and JMP Statistical Discovery from SAS (version 13, Cary, NC). We used descriptive statistics: we reported categorical variables as numbers with percentages and ordinal variables as medians with interquartile ranges. We categorized any hollow viscous laceration/hematoma or abdominal solid organ laceration/hematoma as abdominal injuries. We included open fractures proximal to the digits. We defined a serious injury by body region as an abbreviated injury scale of three or greater [18,19].

Results

From January 2002 to June 2017, there were 49 subjects in the registry from AFRICOM. Of note, all the entries within the registry occurred between April 2010 and June 2017. Most evacuations came from Djibouti (Fig. 1). The median age was 29 years, the majority were male (92%), non-battle injuries (82%), and US military (90%).

Composite injury scores were low (median 4, IQR 4–9.5). All subjects survived to hospital discharge (Table 1). Gunshot wounds (GSWs) (22%) and sports injuries (24%) accounted for most evacuations (Table 2). All battle injuries were gunshot wounds. Severe injuries occurred most frequently to the extremities (18%) and the thorax (12%, Table 3). The most frequent major injuries were open fractures (22%) and abdominal injuries (10%, Table 4). The most frequent facility-based interventions performed were wound debridement (29%) and fracture/joint dislocation reduction (22%, Table 5).

Only one subject had prehospital data available – he received supplemental oxygen, acetaminophen, intravenous fluids, hydromorphone,

Table 1
Demographics and outcome data [1,2].

Demographics	Age (median, IQR)	29 (24.5–36.5)
	Male	92% (45)
Battle-status	Battle	18% (9)
	Non-battle	82% (40)
Patient Category	US Military	90% (44)
	NATO military	2% (1)
	Non-NATO military	6% (3)
	Contractor	2% (1)
Injury Scores	Composite ISS	4 (4–9.5)
	AISBR1 (head/neck)	0 (0–0)
	AISBR2 (face)	0 (0–0)
	AISBR3 (thorax)	0 (0–0)
	AISBR4 (abdomen)	0 (0–0)
	AISBR5 (extremities)	0 (0–2)
	AISBR6 (skin/superficial)	0 (0–1)
	Ventilator Days	0 (0–0)
	ICU Days	0 (0–2.5)
	Hospital Days	4 (1–6.5)
	Survival to Discharge	100% (49)

IQR, Interquartile range; NATO, North Atlantic Treaty Organization; ISS, Injury Severity Score; AISBR, Abbreviated Injury Score by Body Region; ICU, Intensive care unit.

Table 2
Mechanisms of injury associated with evacuations.

Musculoskeletal injury NOS	10% (5)
Blunt object NOS	2% (1)
GSW	22% (11)
Crush	4% (2)
Electrical	2% (1)
Fall	8% (4)
Heat stroke	2% (1)
Helicopter crash	6% (3)
Scald	2% (1)
Knife or another sharp object NOS	4% (2)
Machinery	2% (1)
MVC	10% (5)
Sports	24% (12)

NOS, Not otherwise specified; GSW, Gunshot wound; MVC, Motor vehicle collision.

Table 3
Severe injuries by body region overall and select mechanisms of injury; based on Abbreviated Injury Score by body region of 3+.

	Overall (n = 49)	Battle (n = 9)	Non-battle (n = 40)
Head/neck	4% (2)	11% (1)	3% (1)
Face	0% (0)	0% (0)	0% (0)
Thorax	12% (6)	22% (2)	10% (4)
Abdomen	4% (2)	0% (0)	5% (2)
Extremities	16% (8)	11% (1)	18% (7)
External/skin	0% (0)	0% (0)	0% (0)

Table 4
Select major injuries based on diagnostic code.

	Overall (n = 49)	Battle (n = 9)	Non-battle (n = 40)
Skull fracture	2% (1)	0% (0)	3% (1)
Pulmonary contusion	8% (4)	11% (1)	8% (3)
Pneumothorax/hemothorax	4% (2)	0% (0)	5% (2)
Abdominal injury	10% (5)	11% (1)	10% (4)
Spinal fracture	8% (4)	0% (0)	10% (4)
Open fracture	22% (11)	56% (5)	15% (6)

Table 5
Select hospital interventions performed.

	Overall	Battle (n = 9)	Non-battle (n = 40)
Exploratory laparotomy	4% (2)	0% (0)	5% (2)
Fracture/joint reduction	22% (11)	11% (1)	25% (10)
Wound debridement	29% (14)	33% (3)	28% (11)
Fasciotomy	4% (2)	0% (0)	5% (2)

and ketorolac. Two subjects had a surgical cricothyrotomy documented on arrival to Landstuhl Regional Medical Center in Germany. However, the registry lacked documentation on when the cricothyrotomies were performed – one subject sustained injuries by motor vehicle collision (MVC), while the other sustained a GSW; both subjects survived.

Two subjects (4.1%, 525, 527) developed extremity compartment syndrome during their hospital course that was not present on admission. One subject experienced an injury by crush mechanism not otherwise specified, the other by MVC. Both were non-battle injuries. One subject underwent fasciotomy.

Three subjects had time from presentation to injury data available. All presented to the Multinational Force and Observers (MFO) south camp medical facility. Two of the subjects presented to the MFO facility within the first 24 h of injury, the third presented between 48–72 h from injury – all three survived.

Discussion

In this study, we describe the type and severity of injuries occurring within the AFRICOM area of operations using the DODTR. Our data revealed that only 49 trauma related evacuations occurred during the seven-year period for which data were available. However, this data comprised only subjects evacuated to a higher level of care that participates in the DODTR. The primary finding was that a clear majority of these injuries were not combat related (82%), with most of these injuries being associated with sporting activities. All combat related injuries (18%) were secondary to GSWs. This is in stark contrast to the signature blast injury of the Iraq and Afghanistan theaters. Overall injury severity was low, but for those injuries that were severe, the thorax and extremities were the most frequently involved body parts, with open fractures being the most frequent major injury.

This study is one of the few to focus on injury patterns and patient outcomes in a uniquely large and austere geographic area which serves as the prototypical setting for PFC. A survey study describing PFC operations lasting longer than four hours showed a higher mortality of 9.3% - the mortality in our dataset was lower [14]. However, our mortality data must be interpreted with caution. As previously stated, the DODTR does not have a data collection mandate outside of CENTCOM and thus entry into the registry does not occur until reaching the Role 4. Furthermore, even with a mandate, it is not clear whether such support mechanisms are in place (e.g. personnel, data entry points, methods for capture and quality assurance). Consequently, there may be significant survival bias as our subjects must have survived transport out of Africa to the Role 4 in Germany for DODTR entry. There may be multiple casualties who died before reaching the Role 4 that were not enrolled in the DODTR. Based on unpublished data, from 2013 through when our dataset ended, there were 171 evacuations (personal communications, Ramey Wilson, 22nd February 2018). It is not clear how many of those potentially met enrollment criteria for the DODTR, but it suggests there is a data capture mismatch occurring. Conversely, from 1st June 2016 to 1st June 2017, there were no surgical procedures documented by any general surgery-based specialties within the AFRICOM area of responsibility (AOR) (personal communications, COL Mary Edwards, 61 J consultant to the surgeon general; also presented at Excelsior Society meeting, American College of Surgeons, 22nd October 2017). All these findings, when taken together, suggests that both a

data capture challenge exists along with a limited understanding of the resources needed to support the medical challenges that are occurring.

Unlike Iraq and Afghanistan, where approximately 75% of all combat injuries were from explosive devices, we did not identify any blast injuries in the AFRICOM registry during the study period [20]. All combat injuries were secondary to GSW's, which, given the use of effective body armor, may explain the overall low injury severity score and 100% survival rate. Moreover, GSWs do not carry the polytrauma injury pattern associated with explosives. The large number of non-combat injuries also suggests most patients did not require PFC in AFRICOM. To this end, we are also unable to draw conclusions about prehospital interventions or average length of transport, as there was very limited information available.

The primary limitation of this study is the lack of adequate documentation of prehospital care and transport times; this limitation is common in investigations utilizing trauma registry data [21–23]. Only three of the patients had documentation of the length of time between initial injury and arrival at a fixed medical facility. Only one patient had documentation of prehospital interventions performed. Another major limitation is that the overall sample size was small. This is likely due to both under-reporting of US casualties who receive definitive treatment at lower levels of care and subsequently returned to duty, as well as due to incomplete tracking of non-US military casualties. The JTS only has a mandate to capture CENTCOM data. There is currently no system equivalent to that utilized in CENTCOM to track a patient in AFRICOM. A mandate within this region and personnel to support the data collection is necessary to better inform targeted improvements in medical care. Furthermore, implementation of quality assurance systems that interface with the systems within transportation commands would ensure that casualties that are transported out of theater have appropriate registry collection forms completed. It would also ensure that casualties that arrive to Landstuhl outside of the 72-hour enrollment window would be back-entered into the system appropriately. We also note our casualty population came from a limited number of countries within the vast continent. The ability to extrapolate data from these limited areas to the entire region remains unclear. The final, and perhaps strongest limitation, is the afore-mentioned survival bias built into the registry data collection – a casualty must survive long enough to get to a military treatment facility that participates in JTS data collection (e.g. Landstuhl Regional Medical Center). Thus, casualties that died in the AFRICOM AOR without surviving to reach a participating data capture point will not be included in the survival denominator.

To conclude, based on this dataset, most of the injuries from AFRICOM were non-battle injuries. All battle injuries were GSWs. Our study highlights the differences in casualty care needs in this region which contrast the primary explosive-based injuries seen within CENTCOM operations. The limitations of this dataset highlight the potential value of a JTS data collection mandate and resource support for units within this region to facilitate targeted improvements in medical care.

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Conflicts of interest

The authors declare no conflicts of interest. Opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Air Force, the Department of the Army, or the Department of Defense.

Dissemination of results

Results from this study were shared with other leaders within

military medicine, submitted to military-related conferences, and shared as part of the on-going performance improvement.

Authors' contributions

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: SS contributed 40%; MA, JN, JM, and DK each contributed 10%; CC, TB, TW and SK contributed 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

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Appendix A. Supplementary data

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References

- [1] Brown, D.E., AFRICOM at 5 years: the maturation of a new US combatant command. 2013, ARMY WAR COLLEGE CARLISLE BARRACKS PA STRATEGIC STUDIES INSTITUTE.
- [2] Tompkins, T.M., Africa's Oil Coast: How the Region's Strategic Importance May Cause Operational Challenges for AFRICOM as Currently Constructed. 2014, ARMY COMMAND AND GENERAL STAFF COLLEGE FORT LEAVENWORTH KS SCHOOL OF ADVANCED MILITARY STUDIES.
- [3] Rasmussen TE, et al. Ahead of the curve: Sustained innovation for future combat casualty care. *J Trauma Acute Care Surg* 2015;79(4 Suppl 2):S61–4.
- [4] Kotwal RS, et al. The effect of a golden hour policy on the morbidity and mortality of combat casualties. *JAMA Surg* 2016;151(1):15–24.
- [5] Keenan S, Riesberg JC. Prolonged field care: beyond the "Golden Hour". *Wilderness Environ Med* 2017;28(2S):S135–9.
- [6] Plackett TP, et al. Clinical practice guideline adherence during Operation Inherent Resolve. *J Trauma Acute Care Surg* 2017;83(1 Suppl 1):S66–70.
- [7] Keenan S. Deconstructing the definition of prolonged field care. *J Spec Oper Med* 2015;15(4):125.
- [8] Keenan S. Prolonged field care working group update. *J Spec Oper Med* 2016;16(2):105–6.
- [9] Keenan S. Prolonged field care for the winter 2016 edition. *J Spec Oper Med* 2016;16(4):86.
- [10] Keenan S. Prolonged field care for the summer 2017 edition. *J Spec Oper Med* 2017;17(2):131.
- [11] Walters, T., JOINT TRAUMA SYSTEM CLINICAL PRACTICE GUIDELINE (JTS CPG) 2016.
- [12] US Central Command Area of Responsibility. URL: <<http://www.centcom.mil/AREA-OF-RESPONSIBILITY/>>, [Accessed 05 FEB 2018].
- [13] Smith M, Withnall R. Developing prolonged field care for contingency operations. *Trauma* 2017. 1460408617728536.
- [14] DeSoucy E, et al. Review of 54 cases of prolonged field care. *J Spec Oper Med* 2015;17(1):121–9.
- [15] Barnhart G, Cullinan W, Pickett JR. Prolonged field care of a casualty with penetrating chest trauma. *J Spec Oper Med* 2016;16(4):99–101.
- [16] Glenn MA, et al. Implementation of a combat casualty trauma registry. *J Trauma Nurs* 2008;15(4):181–4.
- [17] O'Connell KM, et al. Evaluating the Joint Theater Trauma Registry as a data source to benchmark casualty care. *Mil Med* 2012;177(5):546–52.
- [18] Copes WS, et al. The injury severity score revisited. *J Trauma* 1988;28(1):69–77.
- [19] Baker SP, et al. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974;14(3):187–96.
- [20] Belmont PJ, Owens BD, Schoenfeld AJ. Musculoskeletal injuries in Iraq and Afghanistan: epidemiology and outcomes following a decade of war. *J Am Acad Orthop Surg* 2016;24(6):341–8.
- [21] Robinson JB, et al. Battlefield documentation of tactical combat casualty care in Afghanistan. *US Army Med Dep J* 2016;2–16:87–94.
- [22] Schauer SG, et al. A descriptive analysis of data from the Department of Defense Joint Trauma System Prehospital Trauma Registry. *US Army Med Dep J* 2017;3–17:92–7.
- [23] Therien SP, et al. Prehospital medical documentation in the Joint Theater Trauma Registry: a retrospective study. *J Trauma* 2011;71(1 Suppl):S103–8.