



ORIGINAL ARTICLE

An analysis of US Africa command area of operations military medical transportations, 2008–2018[☆]

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ABSTRACT

Introduction: With personnel scattered throughout a continent 3 times larger than the United States, a lack of mature medical facilities necessitates a significant transportation network for medical evacuation in US Africa Command (AFRICOM). We describe medical evacuations analyzed from the US Air Force Transportation Command Regulating and Command & Control Evacuation System (TRAC2ES).

Methods: We performed a retrospective review of all TRAC2ES medical records for medical evacuations from the AFRICOM theater of operations conducted between January 1, 2008 and December 31, 2018. We abstracted free text data entry in TRAC2ES for diagnostic and therapeutic interventions performed prior to the patient movement request.

Results: During this time, there were 963 cases recorded in TRAC2ES originating within AFRICOM. 961 records were complete for analysis. Most patients were male (82%) and military personnel (92%). Most transports originated in Djibouti (72%), and Germany (93%) was the most common destination. Medical evacuations were largely routine (66%), and routine evacuations were proportionally highest amongst US military personnel compared to all other groups. A small portion of patients were evacuated for battle injuries (4%), compared to non-battle injury (33%) and disease (63%). Within disease, the largest proportion of patient complaints centered on gastrointestinal symptoms (13%), behavioral health (11%) and chest pain (8%). Prior to evacuation, only 55% of patients were document as receiving any medication. Pain control was documented in 21% of cases, most commonly being NSAIDs (7%).

Discussion: Extremely low numbers of battle injuries highlight the unique nature of AFRICOM operations compared to areas with more intense combat operations. Limitations of the dataset highlight the need for a data collection mandate within AFRICOM as within other areas for optimization and performance improvement.

Introduction

The United States (US) military operations are expanding significantly throughout the African continent with limited medical support in many areas due to the vast size of the continent. After the creation of Africa Command (AFRICOM) in 2007, the US military presence has grown to over 8,000 personnel [1]. Escalating force numbers are driven by intensifying antiterrorism operations and efforts to expand American influence via civil affairs [1,2]. Increased troop levels necessitate increased medical support, to include medical transport and

evacuation for higher echelons of care. Outside of a few limited locations, US military and supporting personnel are scattered in small groups throughout the continent more than three times the size of the continental US [3]. Many teams have attached civilians from various departments to include the US Department of State (DoS), Department of Agriculture (DoA), and Department of Justice (DoJ) [4]. Compared to the build-up of medical infrastructure in more mature operational theaters like Central Command (CENTCOM) in charge of Operation Enduring Freedom, Operation Iraqi Freedom and Operation Inherent Resolve, AFRICOM must continuously grapple with the logistical strain

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of a thinly spread force largely reliant on local resources whenever available for both emergent and routine medical care. Moreover, AFRICOM has limited internal logistical supply chain for medical supply and resupply, and distances between areas of operation are generally outside the range of most rotary-wing aircraft, extending transport times with transfer of patients at fixed-wing airfields.

A recent review of the Department of Defense Trauma Registry (DoDTR) found 49 casualties evacuated from the AFRICOM theater over a 15-year period, while a similar DoDTR query for CENTCOM during a similar timespan found over 38,000 evacuations [5,6]. This disparity is likely related to the lack of a mandate for casualty data capture within AFRICOM which highlights the need for assessing multiple data capture systems to best understand the needs of the medical theater. Contrary to the theaters of Afghanistan and Iraq, AFRICOM personnel must often rely on host nation medical resources further complicating understanding the theater medical needs.

The US Air Force, through their Transportation Command (TRANSCOM), oversees the medical evacuation patient movements throughout military areas of operation as part of the military missions. The TRANSCOM Regulating and Command & Control Evacuation System (TRAC2ES) provides the electronic platform of medical coordination for all DoD patients [7]. As an automated information system, TRAC2ES assembles, assesses, and prioritizes patient movement requirements, assigns resources, and distributes data to relevant parties. Data entry into TRAC2ES includes an initial patient summary with demographics, primary diagnosis, evacuation priority level, origin, and destination [8]. Additionally, medical providers are able to provide a free text 'history' to provide details of pertinent history and describe initial clinical course. We sought to analyze data from patient movements throughout AFRICOM within the TRAC2ES to describe demographics, reasons for transport, and interventions of patient transports.

Methods

The US Air Force 59th Medical Wing regulatory office reviewed protocol FWH20180147E and determined it was exempt from institutional review board oversight. We obtained only de-identified data and conducted a retrospective review of all TRAC2ES medical records for medical evacuations from the AFRICOM theater of operations conducted between January 1, 2008 and December 31, 2018. We included all military and civilian patients that were tracked for transport by TRAC2ES during this timeframe. We sought all available evacuation data on the initial search to create the dataset. We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement in our research design, reporting, and analysis [9].

Most data descriptors were designated by the TRAC2ES system, to include military and civilian delineation. In differentiating battle injury (BI) and non-battle injury (NBI), we defined BI as an injury sustained from hostile action or mission-oriented tasks indicated by mechanism of injury, including gunshot wounds (GSW), improvised explosive devices (IED), mortars, rockets, other ordinance, or motor vehicle accidents or collisions. Nonbattle injury (NBI) was defined as any injury not defined under BI mechanisms. Disease was defined as any illness not defined by BI or NBI mechanisms.

Descriptive injury categories were based on a data dictionary developed by the research team, and data was primarily extracted by trained research associates (CDL, MAE, DR, NU). Research associates received formal training sessions as a group on data abstraction and orientation to the dataset prior to the start of the study. Study personnel provided direct observation and feedback for data entry of initial charts. Study personnel were available for questions on discrepancies or unclear entries. Data entries were reviewed by study personnel on a biweekly basis. Discrepancies and additional training were provided to abstractors as needed. Study personnel double entered a random sample of 10% of total charts to evaluate for reliability of data entry [10]. Each research associate extracted 25% of the charts based on

Table 1
Baseline characteristics.

	Overall (961)	US military (893)	US civilians (26)	Local civilians (26)	Other (16)
Demographics					
Age (median, IQR)	29 (23–38)	29 (23–38)	47 (40–56)	30 (21–36)	21 (9–40)
Male	82% (794)	82% (740)	73% (19)	100% (26)	56% (9)
Evacuation status					
Routine	66% (638)	67% (603)	26% (7)	100% (26)	12% (2)
Priority	25% (248)	25% (225)	50% (13)	0% (0)	62% (10)
Urgent	8% (75)	7% (65)	23% (6)	0% (0)	25% (4)
Transportation method					
Military	84% (809)	84% (752)	88% (23)	100% (26)	50% (8)
Civilian	15% (145)	15% (134)	11% (3)	0% (0)	50% (8)
Other	1% (7)	1% (7)	0% (0)	0% (0)	0% (0)
Origin country					
Djibouti	72% (693)	75% (674)	65% (17)	0% (0)	12% (2)
Liberia	1% (12)	1% (12)	0% (0)	0% (0)	0% (0)
Niger	1% (11)	1% (11)	0% (0)	0% (0)	0% (0)
Unspecified	26% (245)	21% (196)	34% (9)	100% (26)	87% (14)
Destination country					
Germany	94% (902)	97% (869)	76% (20)	15% (4)	56% (9)
United States	3% (29)	1% (8)	0% (0)	81% (21)	0% (0)
Other	3% (30)	2% (16)	23% (6)	4% (1)	43% (7)

*All data are presented as percentage (total number) unless otherwise specified.

randomization, and peer-reviewed at least 50% of the charts extracted by other research associates. Study investigators (BMC and WTD) reviewed a random sample of 15% of the charts. From this sample review of 12,905 total data points, less than 25 errors were discovered (< 0.19%), which was deemed acceptable by the investigation team. BMC and WTD reviewed all injury charts for a determination of BI versus DNBI.

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, reporting categorical variables as numbers with percentages and ordinal variables as medians with interquartile ranges.

Results

From January 1, 2008 to December 31, 2018, there were 968 total encounters from the AFRICOM theater listed in TRAC2ES. We excluded five military working dog encounters and included 963 records for initial analysis. 961 records were complete on all variables and used in the final analysis. The median patient age was 29 years and most (82%, n = 795) were male (Table 1). US military personnel (92%, n = 892) overwhelmingly comprised the largest proportion of transported patients, matching the overall trends of age and gender. Comparatively, the median age was higher amongst US and local civilian patients (47 and 30, respectively), while the median age of other patients was younger (21). US civilians (73%) and other personnel (56%) were less frequently male, while local civilians (100%) were entirely male. A small proportion of patients were evacuated for BI (4%, n = 43) compared to NBI (33%, n = 321) and disease (63%, n = 599). Most evacuees came from Djibouti (72%, n = 693), largely driven by US military and civilian personnel, as nearly all local civilians and other personnel originated from areas outside Djibouti. Germany was the most common destination for transport (93%, n = 902). Most local civilians were transported to the United States (81%, n = 21). Evacuation status was largely routine (66%, n = 638), followed by priority (25%, n = 248),

Table 2
Reason for transport and documented diagnostic and therapeutic interventions.

Variable	% (n)
Chief complaint	
Battle injury	4% (43)
Non-battle injury	33% (321)
Disease	63% (597)
Gastrointestinal	13% (123)
Behavioral health	11% (108)
Chest Pain	8% (79)
Head	3% (33)
Fever	2% (22)
Lower respiratory	1% (16)
Upper respiratory	1% (8)
Unspecified	21% (208)
Diagnostics	
Any radiograph	29% (281)
Extremity radiograph	13% (132)
ECG	10% (101)
Chest radiograph	8% (79)
CT scan	6% (66)
Ultrasound	5% (50)
Troponin	5% (47)
Interventions	
NSAID	7% (75)
Acetaminophen	6% (65)
Morphine	5% (51)
Saline	3% (25)
Oxygen	3% (25)
Fentanyl	1% (11)
Whole blood	1% (6)
Packed red blood cells	< 1% (5)
Ketamine	< 1% (4)
Tourniquet application	< 1% (2)

and urgent (8%, n = 75). While routine evacuation was used for most US military (67%, n = 603) and local civilians (100%, n = 26), priority status was proportionally highest amongst US civilians (50%, n = 13) and other personnel (62%, n = 10). Of note, in this dataset, evacuation status was separated into these three categories alone, compared to the usual five category delineation found in most military medical categorization.

Within the category of disease, the largest proportion of patient complaints centered on gastrointestinal symptoms (13%, n = 123), behavioral health (11%, n = 108), and chest pain (8%, n = 79) (Table 2). Diagnostic testing performed prior to evacuation most commonly involved radiographs (29%, n = 281). Overall, 55% of patients (n = 536) were documented as receiving any medication prior to evacuation. Pain control administration in any form was documented in a small proportion of cases (21%, n = 206), and non-steroidal anti-inflammatory drugs (NSAIDs) was most often documented for pain control (7%, n = 75).

Discussion

We report the first demographic analysis of TRAC2ES data for medical evacuations from the AFRICOM theater starting in the first full calendar year after its inception in 2007. Our data demonstrates 961 total cases of personnel evacuated under the TRAC2ES system over a ten-year study period. It is important to note that data comprised only subjects that were evacuated using TRAC2ES, and therefore is not expected to capture any patients who were treated solely by local medical facilities (military or civilian) or those who may have been evacuated by other means that was not military regulated in some method. Moreover, if they were treated by a unit member without evacuation the TRAC2ES system would not capture that encounter. While more than one-third of evacuations were secondary to injuries, only a small portion of all patients were found to have combat-related

injuries. Compared to prior analysis in literature that has examined only combat-related injuries in AFRICOM through the DoDTR [4], the analysis of this TRAC2ES data illustrates a broader range of combat and medical casualties that better reflect the setting of everyday operations.

We found that military service members, and specifically males, were overwhelmingly the largest proportion of AFRICOM evacuees. US service members comprised the largest demographic of medical evacuations. Prior descriptive studies of DoDTR in AFRICOM and CENTCOM have revealed similar proportional findings of military (90–99%) and male (92–97%) evacuees [4,5,11]. Despite a high presence from non-military entities such as DoS and DoA, this high proportion of military personnel generally reflects an estimated 7:1 military-to-civilian ratio operating within AFRICOM [3].

Evacuations mostly originated in Djibouti. This reflects the primary location of US military forces stationed at Camp Lemonier, which was originally built in 2002 and later expanded to accommodate the Combined Joint Task Force-Horn of Africa (CJTF-HOA) and AFRICOM. Camp Lemonier is located on the southern side of Djibouti-Ambouli International Airport, which allows easy access for military aircraft to facilitate medical evacuations. With troop levels of approximately 5,000, more than half of all estimated US military personnel operating in Africa are stationed there. Camp Lemonier is strategically vital in its proximity to the Strait of Hormuz, and it has been the only officially established US military base in AFRICOM's history, as well as the only location with a fixed US military hospital [12,13]. Disproportionate troop levels and unique established imprints therefore likely impact Camp Lemonier's prominent representation in this dataset. Additionally, TRAC2ES data input may have been skewed as Camp Lemonier may have been the first point of capture within TRAC2ES for patients that were seen locally but needed transport out of theater, and were transported by other means before using Djibouti as the egress point.

A previous 56-month study of 3,492 critical care air transport team (CCATT) patient movements during Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) found significantly different categorical proportions from our analysis of AFRICOM, including proportions of BI (4% in AFRICOM vs. 64% in OEF/OIF), disease (63% vs. 25%) and NBI (33% vs. 8%) [12]. This analysis centered on critical care patients (defined as requiring 3 or more medical attendants during transport), however, which contrasted with our population in which attendants were not homogeneously defined in the dataset. More comparatively, a 12-year analysis of NBI during OEF/OIF found nearly identical rates of NBI as revealed in our analysis (34% in OEF vs. 33% in AFRICOM) [11]. In this study, however, investigators found significant rates of GSW and explosions in NBI, which were not found in our analysis of AFRICOM evacuations.

Our analysis is limited by incomplete data entry into TRAC2ES. This is a global system that functions across many different clinical settings and patient acuity levels. Personnel entering data into TRAC2ES are often nonmedical personnel, which introduces a possible source of error in data entry. Patient movement records are often produced during the early phases of care, leading to incomplete documentation of performed diagnostics and treatments. There is no consistent standard as to which data are included in the free form section detailing the patient history and course of care. This limits the ability to both document interventions consistently and extract the data on accurately on the backend. Prior literature demonstrates that battlefield documentation has largely been poor and inconsistent [14,15].

Our analysis provides the first examination of all AFRICOM personnel medically evacuated utilizing TRAC2ES in the first ten full years following the inception of the command. The low numbers of combat-specific injuries continue to highlight the unique nature of the AFRICOM are of operations compared to that of CENTCOM, consistent with previous analysis. Limitations in data capture highlight the need for more robust data capture systems in AFRICOM.

CRedit authorship contribution statement

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: BMC, WTD and SGS contributed 20% each; CDL 10%; and JKM, KKC, DR, ME and NU 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors have no conflicts of interest to declare.

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