Forward aeromedical evacuation: A brief history, lessons learned from the Global War on Terror, and the way forward for US policy

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The US Army pioneered air evacuation of casualties from the battlefield to a forward operating surgical treatment facility after the advent of the helicopter. This rotary-wing capability was initially used for casualty evacuation (CASEVAC) during the Korean War but evolved to the extent that lifesaving resuscitation was initiated en route by the US Army during the Vietnam War. More recently in Iraq and Afghanistan, medical evacuation (MEDEVAC) by platforms operating under a US and UK joint system has matured to the point where advanced medical capabilities are brought forward to the point of injury (POI).

Emerging data from the Afghanistan experience however indicate that clinical and doctrinal gaps exist in US forward aeromedical evacuation (FAME) capability. In this review article, we provide a brief history of military MEDEVAC centered on the evolution of FAME, describe the current FAME platforms in Afghanistan, discuss lessons learned from recent studies examining the performance of the current FAME platforms, and propose the way ahead for FAME in future conflicts.

FAME EVOLUTION: A BRIEF HISTORY

Early Application of Battlefield Evacuation

In the first century, the Byzantine Empire’s army incorporated a system for battlefield CASEVAC using medics, called Scribones, who were stationed a hundred meters behind the battle and were paid a gold piece for each casualty they rescued. There is no record of organized CASEVAC again until late in the 18th century when during the French Revolution, Napoleon’s surgeon, Baron Dominique-Jean Larrey, rode into battle on a horse-drawn carriage to evacuate injured soldiers to the rear of the battle where treatment could be delivered. Before this, casualties were for the most part considered liabilities to the war effort and therefore were left where they fell with little-to-no care rendered. During the Civil War in 1862, Dr. Jonathan Letterman established the first military ambulance system for the US Army. The subsequent emergence of CASEVAC systems can in part be attributed to the advent of new technologies (enabling safe movement without sacrificing the overall war effort) coupled with increasing social activism (calling for care to the wounded soldiers), the latter of which was promulgated by the likes of Henry Dunant and led to the creation of the International Committee of the Red Cross and the first Geneva Convention. Until the mid-20th century, various forms of ground ambulances were used to clear battlefield casualties. The first, but isolated, report of CASEVAC accomplished via air ambulance occurred during World War I when the French used a fixed-wing craft to evacuate Serbian casualties retreating from Albania.

The Korean War Experience

Soon after the first year of the Korean War, the Army sent 12 newly procured Bell H-13 Sioux helicopters to Korea for CASEVAC. The H-13 had many shortcomings, limiting operational and clinical functions. Because of the aircraft’s low power, short range (273 miles), and lack of interior lighting, operations were limited to daylight evacuation of no more than two patients. Furthermore, owing to the external placement of patient litters, in-flight treatment was not possible. CASEVAC was also hampered by a lack of standard operating procedures, lack of a dedicated communications network (the aircraft had no radios), and limited use because of maintenance problems. Despite these shortcomings, helicopter detachments evacuated as many as 190,000 casualties.

Most importantly, the Korean War experience established the role of the helicopter in CASEVAC and convinced the Army it needed a permanent organization dedicated to this mission. After the end of the conflict, helicopter evacuation detachments were incorporated into the Army Medical Service, and shortly thereafter, the Surgeon General (MG George E. Armstrong) created an organization within the Surgeon General’s Office, capable of directing and administering aviation resources. Additional planning, personnel staffing, operations and aircraft changes occurred after the cease-fire in 1953.

The Vietnam War Experience

The US Army’s 57th Medical Detachment arrived in Vietnam in 1962 with the Bell HU-1 helicopter, which replaced the H-13 in 1955. The UH-1, colloquially known as Huey, had twice the speed and endurance of the H-13, carried patient litters in-board, displayed the Geneva Red Cross, and delivered en route care—a first for helicopter FAME. The enhanced flight crew included a pilot, copilot, crew chief, and flight medic. En route care included application of first aid, morphine...
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administration for pain, intravenously administered fluid resuscitation, and surgical airway establishment. Typically, the aircraft commander transported casualties to the nearest definitive care facility unless redirected by the medical regulating officer. In 1963, the 57th adopted “DUSTOFF” [Dedicated Unhesitating Service To Our Fighting Forces] as their radio call sign, a name that has endured for 50 years.

During the Vietnam War, the Air Force performed rotary-wing combat search and rescue (SAR) and personnel recovery (PR). This was a continuation of the Air Rescue Service, which stood up in 1946, before the 1947 Air Force designation as a separate service, and continued until late 1965 as the Aerospace Rescue and Recovery Service. Pararescuemen (PJs) were best known for being lowered down a hoist to rescue isolated personnel. At about this time, tactical training ensued to permit operation in hostile environments (John Cassidy, personal communication, December 15, 2012).

In the 1950s and 1960s, the initial Air Force helicopter, the HH-43 Huskie, was used for local SAR missions around bases. In 1965, capabilities increased with the introduction of the Sikorsky HH-3E “Jolly Green Giant,”6 and in 1966, “PEDRO” replaced the call sign “HUSKIE” (PEDRO was the call sign at Laredo Air Force Base). During this period, PJs received a basic medic course and provided only first aid.7 Overall, PEDRO fulfilled CASEVAC function far less often than DUSTOFF because it was not their primary mission. PEDRO also differed from DUSTOFF by operating without a Red Cross; thus, aircrew were considered combatants.

The experience and confidence of DUSTOFF and PEDRO units increased throughout the conflict and were considered an unqualified success during the war; the DUSTOFF units alone would evacuate nearly 900,000 allied military personnel and Vietnamese civilians from the battlefield in Vietnam,8 and PEDRO would rescue 4120.9 However, in addition to demonstrating its value in the mountains, jungles, and flood plains of Vietnam, DUSTOFF also demonstrated its vulnerability. Astonishingly, a third of the DUSTOFF aviators, crew chiefs, and medics became casualties, and the loss of air ambulances to hostile fire was 3.3 times that of all other forms of helicopter missions in the Vietnam War.3 This high loss rate led to questioning the value of openly declaring the vulnerability of these unarmed platforms with a Red Cross in asymmetrical conflict—a conflict between disparate military powers—in which the protection offered by the Geneva Conventions to the medical helicopters and personnel were/are not routinely afforded.10

Figure 1. FAME platforms operating in Southern Afghanistan—airframes (left) and interior working space (superimposed). Photo courtesy of Eric Kuncir, MD; interior PEDRO photo courtesy of Stephen Rush, MD; interior MERT photo courtesy of Jonathan Morrison, MD.
Post-Vietnam Era

MEDEVAC units were deployed several times in the post-Vietnam era in support of Operation Urgent Fury in Grenada, Operations Just Cause in Panama, and Desert Storm and Shield in Iraq. During each of the conflicts, combat operations were over quickly and resulted in few casualties transported by MEDEVAC units. The threat of war in Europe persisted until the Soviet Union dissolved in 1991. Large-scale war in Europe assumed massive numbers of casualties and continued to drive MEDEVAC’s focus on evacuating casualties from the battlefield.

With the historic focus being on battlefield “clearance,” innovation in prehospital trauma life support and en route care has only recently begun to emerge after 10 years of war in Afghanistan.\textsuperscript{11}

In the 1980s, the US Army began phasing out the UH-1 Huey in favor of the faster and larger Sikorsky UH-60 Black Hawk helicopter. During Operation Desert Storm, US Central Command dedicated 220 helicopters for FAME; 75\% of these were UH-1s, and 25\% were UH-60As.\textsuperscript{12} By the end of the 1990s, the UH-60A would completely replace the UH-1 with the exception of some reserve units. Although these units were assigned to the MEDEVAC mission for the 43-day Persian Gulf War of 1990 to 1991, they were lightly tasked because US Forces sustained less than 500 battle-related casualties during the conflict.\textsuperscript{13}

Leveraging the success of FAME during the Vietnam era, US state and local governments began to look at using helicopters in civilian emergency medical service systems. Throughout the 1970s and 1980s, civilian helicopter emergency medical service (HEMS) agencies proliferated and became more sophisticated. Most adopted a dual provider model, most commonly a nurse-paramedic team. These providers are required to have advanced training and certifications and are expected to provide critical care in the helicopter to include advanced airway management, blood administration, and the use of a variety of pharmacologic agents.

With the anticipation of large numbers of casualties during a NATO Soviet conflict and with no prolonged conflict to force examination of the Vietnam era legacy model of a single medic without advanced training, Army MEDEVAC had no reason to adopt the lessons learned from the rapidly evolving civilian HEMS experience, which has demonstrated some evidence of improved outcomes with the use of advanced care practitioners.\textsuperscript{14-17}

MODERN FAME PLATFORMS

Three FAME platforms have been operational in recent years of Operation Enduring Freedom (OEF) as shown in Figure 1. Each platform was borne out of unique requirements.
and therefore possesses a distinct combination of on-board medical and nonmedical capability, as outlined in Table 1. In 2009, Secretary of Defense Robert Gates mandated that US MEDEVAC deliver battlefield casualties to a field hospital with appropriate surgical care within 1 hour after the request for a MEDEVAC. This is known colloquially as the Golden Hour Rule.

**US Army MEDEVAC: Call Sign “DUSTOFF”**

DUSTOFF has been the most widely used MEDEVAC unit throughout the history of US warfare, including during the recent Operation Iraqi Freedom (OIF) and the current OEF. The current airframe is a UH-60A Blackhawk, distinguished by the characteristic Red Cross symbol, and is not armed with offensive weapons unlike the other two platforms. The rationality of dispatching unarmed DUSTOFF helicopters with overt outward designation by a Red Cross to hostile fire zones in an era of asymmetrical warfare has been questioned since its debut in the Vietnam War, yet this important topic is beyond the scope of the current review. DUSTOFF units went to Iraq and Afghanistan, operating under the legacy model that had essentially changed little since the Vietnam era. These aircraft were still staffed by a single medic, now credentialed at the emergency medical technician-basic (EMT-B) level. Under the legacy training model, there was no requirement to participate in the care of a single critically injured or ill patient before deploying to combat as a flight medic, and therefore, advanced capabilities are limited as shown in Table 1. No standardized protocols exist across MEDEVAC units, and medical direction was provided in most cases by general medical officers (GMO) serving with aviation units. These GMOs generally completed internships and were awaiting placement into residency programs. Their primary job was to provide routine medical care to the aviators in that unit. No standardized system of patient documentation, chart review, or process improvement exists.

Rotary MEDEVAC units are traditionally commanded by aviators with no clinical experience, and currently no formal clinical oversight of MEDEVAC by experts in trauma, emergency medical services, or critical care exists.

**US Air Force Expeditionary Rescue Squadron: Call Sign “PEDRO”**

Throughout OIF and OEF, PJs performed their designated PR mission, occasionally conducted MEDEVAC missions in support of the Army, and provided on-scene support for special operations serving as both a tactical/technical rescue specialist and an emergency medical casualty care provider. Their combination of advanced rescue and medical capabilities define the Pararescue role; being a paramedic is only one of their skills. After initial paramedic certification, clinicians were trained HEMS providers, a similar model of prehospital blood and rapid sequence induction (RSI), as shown in Table 1. The MERT has subsequently evolved into a scalable platform where the basic MERT configuration consists of an advanced paramedic or nurse, which can be enhanced as MERT-E with the addition of a physician and interventions such as prehospital blood and rapid sequence induction (RSI), as shown in Table 1. The MERT is not exclusively rotary-wing based, so it can also be littoral, sea, or land deployed.

This “militarized HEMS” concept has proven controversial because the asset is of high value and requires significant logistic support and limited clinical evidence supporting its deployment exists. Most studies are either observational or editorial and lack a comparison population. Davis et al. in 2007 reviewed the civilian literature and some unpublished military outcome data and concluded that a MERT physician improved outcomes in major trauma. Tai et al. reviewed the importance of early, skilled resuscitation in critical battlefield trauma and postulated that the MERT-E may serve to extend the physiologic window of salvage in such cases.

Calderbank et al. prospectively examined the quality of the physician’s contribution to MERT over 5 months and 324 missions in 2008. A physician flew on 88% of MERT missions and was felt not to be clinically beneficial in 77% of missions. However, there were few critical casualties during the study, although RSI was specifically identified as an intervention that was lifesaving in a small number of casualties with compromised airways.

Following the deployment of US forces in Helmand in mid-2008, UK MERTs started to operate in parallel with PEDRO and DUSTOFF assets. Integration of inter service and multinational platforms has permitted the deployment of a unique
prehospital system of care in Southern Afghanistan. For the first time, comparison of clinical outcomes between platforms, discussed in the next section, suggests that there is a survival benefit to an advanced clinical capability in certain patient groups. However, MERT and MERT-E have only ever operated in combat theaters characterized by asymmetric warfare with air superiority. It is also unclear how such an asset would or could perform in a conventional war, where the loss of even a single MERT-E could significantly limit operational effectiveness.

LESSONS LEARNED IN IRAQ AND AFGHANISTAN

The killed-in-action and died-of-wounds rates in the recent Iraq and Afghanistan conflicts are the lowest in the history of armed conflict. Eastridge et al. analyzing prehospital death on the battlefield noted that 88% of US combat fatalities occur in the prehospital phase of care and 92% of this group dies of hemorrhage. While evidence that advancements in tactical field and first responder care has contributed to improved battlefield survival has been forthcoming, literature that documents the contribution of advances in evacuation and en route care to casualty mortality rates has only begun to emerge. The following discusses studies that illustrate lessons learned from FAME operations in Iraq and Afghanistan.

DUSTOFF Survival Rates Improve With Paramedic Training

Questioning the long-accepted DUSTOFF model, Mahay et al. demonstrated in a recent study that casualty mortality was significantly lower when evacuation was performed by US Army National Guard DUSTOFF unit flight paramedics compared with the standard military air ambulance unit's staff by EMT-Bs. This study examined 671 casualties with an Injury Severity Score (ISS) of greater than 15 retrieved from POI by the Army Guard critical care flight paramedics (CCFP) compared with EMT-B flight medics or standard MEDEVAC. The unadjusted mortality was highest in casualties evacuated by the standard EMT-B flight medic platform (15% vs. 8%), and after adjusting for covariates including an observed interaction between evacuation system and patient category, the odds ratio for the association between evacuation system and mortality was lower for those transported by CCFP compared with standard MEDEVAC (odds ratio, 0.34; 95% confidence interval, 0.14–0.88). In response to this study, US Army policy shifted and now supports CCFP training for all flight medics, and training to that standard has commenced.

MERT Offers a Distinct Survival Advantage

Two recent combat trauma registry studies characterize mortality rates for casualties evacuated from the battlefield via the FAME platforms operating in Southern Afghanistan. The first study by Morrison et al. uses both the UK and US combat trauma registries. The study of Morrison et al. characterizes MERT as an advanced capability platform and compares mortality and timelines with the conventional platform—DUSTOFF and PEDRO, wherein the study examines 1,093 MERT patients and 628 conventional transported patients during a 33-month period grouped into three ISS bins (1–15, 16–50, and 51–75). The study demonstrates that times from tasking to arrival in the emergency department were similar across all platforms, and a high percentage of the most severely injured patients evacuated with MERT underwent an advanced intervention. The largest proportion of patients were in the lowest ISS category, where there was no difference in mortality across the platforms. However, casualties in the middle ISS category were associated with a lower mortality if they were retrieved by MERT. The study of Morrison et al. also reports a reduced time from admission to surgery in the MERT group, attributed to a combination of patient preparedness and direct communication between the platform and receiving hospital. Overall, this report suggests that mortality from certain patterns and severity of trauma are decreased with the deployment of advanced medical capability as part of POI en route care capability. However, it does not present evidence on which component(s) of this capability contribute most to this survival advantage.

A second study by Apodaca et al. is a US combat trauma registry performance improvement study currently submitted for publication. The study cohort consisted of 975 casualties evacuated by MERT (n = 543), PEDRO (n = 326), and DUSTOFF (n = 106) during the shorter period of June 2009 to June 2011. Results showed that MERT was preferentially tasked to transport polytrauma casualties and also casualties with single or multiple amputations. Not surprisingly, this study demonstrated that MERT casualties had on average more severe injuries and worse shock physiology manifested by lower systolic blood pressure and tachycardia compared with casualties transported by the either PEDRO or DUSTOFF. Overall crude mortality was equivalent for MERT and PEDRO (4.2% and 4.6%) but lower for DUSTOFF (0.9%). This was attributed, in large part, to the finding that DUSTOFF primarily was tasked to transport less severely injured casualties. When mortality was compared between MERT and PEDRO in four ISS groupings (<10, 10–19, 20–29, and 30–75), there was no difference in the lower (<10 and 10–19) and highest (30–75) ISS categories. However, mortality in casualties with an ISS of 20 to 29 was lower in the MERT compared with the PEDRO group (4.8% vs. 16.2%; p = 0.021). Using Trauma and Injury Severity Score (TRISS) methodology, the observed mortality for MERT was statistically lower than the predicted mortality for all ISS bins except for those with less than 10 demonstrating a high rate of unexpected survivors for MERT-transported casualties. PEDRO’s observed mortality was as-expected with the exception of the bin ISS 20 to 29; here, the observed rate was higher than predicted.

The study of Apodaca et al. further demonstrates and confirms the effectiveness of MERT as an en route care capability during combat operations. Specifically, the study showed that despite higher predicted mortality, physician-led tactical evacuation achieved greater survival rates than paramedic-directed evacuation for battlefield casualties with life-threatening injuries. The authors discuss the limitations of the study, which include its lack of visibility on the tactical scenarios that may have affected these outcomes especially for PEDRO. Lastly, the authors discuss the medical regulation process that likely underlies the preferential selection of MERT for the polytrauma casualty. This has been described as intelligent tasking and recognized as a critical element in the process of assigning the right platform to the right mission to match clinical capability with clinical need. This is an
exceptionally unique confluence of circumstances and may provide clues to addressing the way forward.

**PEDRO Performs a Unique FAME Mission**

The study Apodaca et al. is the first to document outcomes for PEDRO demonstrating a lower-than-predicted survival for a certain subset of severely injured casualties. These results, however, may not fully account for all factors contributing to survival in a combat setting because the PEDRO platform is traditionally reserved for SAR/PR missions, including offensive tactics and complex casualty extraction. In general, by virtue of its mission, PEDRO is more likely to be tasked to retrieve casualties when DUSTOFF and MERT are unable to owing to technical challenges and enemy fire. This tasking would presumably lead to prolonged evacuation times, which could explain a bias for PEDRO’s lower observed survival rate.

Clarke and Davis26 in a recently published largely descriptive analysis of MEDEVAC and triage of casualties in Helmond Province, Afghanistan, present comparative average transport time data for the three FAME platforms without offering any detail how the various times were derived. During a 6-month period ending in November 2010, Clarke and Davis examined times to response, scene, critical care, and Role 3 with critical care time ending for MERT upon arrival of the advanced care team at POI, whereas it coincides with Role 3 time for the other two platforms. Significantly, time to Role 3 was identical for MERT and PEDRO, while critical care time was only approximately 12 minutes to 15 minutes faster for MERT than for PEDRO. Taken together, the results from Clarke and Davis might suggest that tactical considerations, on average, did not impede PEDRO’s time to surgical care. However, removed from considerations of the different airframe maximum air speeds and divergent response times shown by Clarke and Davis, these results at first glance do not allow a precise estimate of time spent on scene and best demonstrate that advanced care started earlier for MERT.

It is also worth noting that PJ’s onboard PEDRO, unlike MERT, were not administering blood products and tranexamic acid until December 2010, which corresponds to the end of the study period for the two aforementioned studies. This factor must also be considered in the final characterization of a physician-driven platform being associated with higher survival rates. None of the recent studies precisely determine if improved survival for the advanced care platforms was caused by early blood transfusions on MERT or physician action and judgment in treating trauma patients.

**THE WAY FORWARD**

The Army Surgeon General’s Dismounted Complex Blast Injury Task Force Report27 and a deployed MEDEVAC Medical Director’s after-action report28 both noted that that the UK’s MERT has been used preferentially to evacuate the most severely injured casualties in Southern Afghanistan despite a lack of hard clinical evidence to any benefit.

Taking note, the Committee on Tactical Combat Casualty Care, which develops and recommends TCCCE guidelines to the Defense Health Board (DHB),29 made recommendations for improving US Department of Defense’s (DoD) FAME capability. On August 8, 2011, the DHB approved and forwarded the TCCC guidelines to the assistant secretary of Defense for Health Affairs.30 These recommendations called for extensive improvements to (1) platform, (2) provider skill level and oversight, (3) response time, and (4) standardization, documentation procedures, and quality assurance. Most prominently, the board recommended that DoD pursue the development of an advanced FAME capability led by an emergency or critical care physician for the transport of the most critical battlefield casualties that may be similar to MERT.

In response to the DHB on October 28, 2011, the assistant secretary of Defense for Health Affairs requested definitive evidence that would assist the DoD in meeting its critical objective to improve FAME care in theater.31 Movement toward that goal has been heretofore hampered by the fact that the DoD “lack(ed) such data as documentation comparing casualty outcomes across the various FAME platforms currently in existence in Afghanistan that support piloting such a capability.” Given the emergence of recent data demonstrating a survival advantage for severely injured casualties evacuated by critical care flight paramedics25 and the MERT platform21,22 for severely injured casualties, conditions seem to be in place for a paradigm shift to strongly favor fielding en route care POI FAME platforms with a range of scaled resuscitative capability as has been observed in Afghanistan. What the data and experience have shown is that the three platforms that represent different capabilities are complementary and bring something unique to the fight based on challenges presented in terms of weather/terrain, ongoing hostilities, and casualty severity of injury. The fundamental challenge then becomes one of recognizing and acknowledging these differences and working to appropriately task each platform to take full advantage of the differences to enable safe mission completion for both the casualty, the medical team, and air crew. It is critical to note that the possibility of tasking different medical platforms is unique to Southern Afghanistan.

A key logical question then becomes one of a discussion of degrees or provider credentials versus platform capabilities as the next generation advanced FAME platforms are designed, equipped, staffed, and deployed. It is clear from our point of view that FAME providers of the future should be capable of delivering a casualty from POI to the point of initial surgical intervention and skillfully perform lifesaving interventions and initiate advanced resuscitative measures. Simply stipulating that a doctor should be on board FAME missions could result in the deployment of the wrong skill set of providers who may not be trained and experienced in advanced evacuation trauma care and intervention, as is the case in medical direction of the legacy DUSTOFF. It is therefore best in our opinion to focus on capabilities and allow the Armed Forces to determine best how to achieve this capability while factoring in consideration of training and sustainment for FAME providers. Maintaining a force of medic/corpsmen/PJ and CCFP teams that could be augmented by nurses and physicians when needed might be more expedient and cost-effective to sustain compared with fielding fully augmented teams that include all breeds of advanced providers, or, with clear delineation of medical capabilities and scope of practice, training flight paramedics to advanced skills and facilitating ongoing real-world
work in that capacity outside of the conflict may achieve the same
goal. Alternatively, perhaps it would require the equivalent of a
specialized new shock trauma paramedic or physician’s assistant
to staff FAME platforms for future conflicts because it may be
easier to both train and sustain such a force of these providers in
times of peace.

CONCLUSION

Many potentially preventable deaths in recent conflicts have
occurred in the prehospital phase,23 of which FAME
casualty movement played a role. To address this, the FAME
mission has evolved from rapid and efficient clearing of the
battlefield to a relative extension of heretofore-fixed, facility-
based resuscitative capability. Despite these recent advances,
there remains convincing evidence that an opportunity to im-
prove upon this record exists through further improvements in
airframe, mission tasking, and clinical capabilities

Active involvement of physician experts in battlefield
medicine and forward lifesaving intervention and resuscitation
is fundamental to the success of such a program.

Evolution of future FAME models and requirements must
focus on saving lives while being survivable on the battlefield.

Factors not previously discussed such as the anticipated
number and type of casualties, the area of contested terrain and
distance between echelons of care, and air superiority also need
to be carefully considered.

As a desired end state, FAME platforms of the future will
represent a capability that will provide flexibility to the com-
mander and optimize scalable state-of-the-art forward care that
can initiate early damage-control resuscitation when called upon
to do so for severely injured combatants. The lifesaving potential
of such a capability would be difficult to undervalue in the
chaotic, dynamic, and asymmetric battle spaces of the future.

AUTHORSHIP

C.M.O., J.B. and E.J.K. conceived and designed the study. C.M.O., J.B.,
R.M., S.R., J.J.M. and E.J.K. drafted the manuscript. C.M.O., J.B., R.M., S.R., J.J.M.,
and E.J.K. critically revised the manuscript. E.J.K. provided administrative,
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REFERENCES

1. Lam DM. Medical evacuation, history and development—the future in
2. Green B. Challenges of aeromedical evacuation in the post-cold-war era.
3. Dorland P, Nanney J. DUSTOFF: Army Aeromedical Evacuation in
4. Neel, SH. Medical considerations in helicopter evacuation. U S Armed
5. Ginn VN. The History of the United States Army Medical Service Corps.
Washington, DC: Office of the Surgeon General and Center of Military
History United States Army; 1997.
10. Brady PH. DUSTOFF Operations in Vietnam. Army Logistician; July-
11. Mabry RL, DeLoenroza RA. Sharpening the edge: paramedic training for
Available at: http://www.ndu.edu/library/epubs/cpgw.pdf.
13. Fischer H. American War and Military Operations Casualties: Lists and
14. Garner AA. The role of physician staffing of helicopter emergency medical
services inprehospital trauma response. Emerg Med Australas. 2004;16:
318–323.
15. Hamman BL, Cue JI, Miller FB, et al. Helicopter transport of trauma
16. Baxt WG, Moody P. The impact of a physician as part of the aeromedical
prehospital team in patients with blunt trauma. JAMA. 1987;257:
3246–3250.
paramedic helicopter services decreases blunt trauma mortality. Aust N Z J
18. Davis PR, Richards AC, Ollerton JE. Determining the composition and
benefit of the pre-hospital medical response team in the conflict setting. JR
timelines—a consensus from the academic department of military surgery and
DM. Doctor on board? What is the optimal skill-mix in military pre-
21. Morrison J, Oh J, Dubose J, O’Reilly D, Russell R, Blackbourne L,
Midwinter MJ, Rasmussen TE. En-route care capability from point of
22. Apodaca A, Olson C, Bailey J, Butler F, Eastride B, Kuncir E. Per-
formance improvement evaluation of forward aeromedical evacuation plat-
Zubko T, Oetjen-Gerdes L, Rasmussen T, et al. Death on the Battlefield
24. Kotwal RS, Montgomery HR, Kotwal BM, Champion HR, Butler FK,
Mabry RL, Cain JS, Blackbourne LH, Holcomb JB. Eliminating pre-
Impact of critical care–trained flight paramedics on casualty survival
during helicopter evacuation in the current war in Afghanistan. J Trauma
26. Clarke JE, Davis PR. Medical evacuation and triage of combat casualties in
2012;177:1261–1266.
27. Caravalho J. Dismounted Complex Blast Injury—Report of the Army
Dismounted Complex Blast Injury Task Force. June 18, 2011. Available at:
http://www.armymedicine.army.mil/reports/DCB%20Task%20Force%20
Report%20(Redacted%20Final).pdf. 44–47.
28. Mabry R. MEDEVAC Medical Director’s After Action Report. APO, AE
29. Butler FK, Giebner SD, McSwain N and Pons P, eds. Prehospital Trauma
30. Dickey N, Jenkins D, Butler F. Tactical Evacuation Care Improvements
31. Woodson J. Response to Defense Health Board Recommendation for
Effective Evacuation of Wounded Soldiers from Afghanistan. D.C.: Office of
Assistant Secretary of Defense for Health Affairs Memorandum. 2011.