En Route Care Provided by US Navy Nurses in Iraq and Afghanistan

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BACKGROUND US Navy nurses provide en route care for critically injured combat casualties without having a formal program for training, utilization, or evaluation. Little is known about missions supported by Navy nurses.

OBJECTIVES To characterize the number and types of patients transported and skill sets required by Navy nurses during 2 combat support deployments.

METHODS All interfacility casualty transfers between 2 separate facilities in Iraq and Afghanistan were assessed. Number of patients treated, number transported, en route care provider type, transport priority level and duration, injury severity, indication for critical care transport, en route care interventions, and vital signs were evaluated.

RESULTS Of 1550 casualties, 630 required medical evacuation to a higher level of care. Of those, 133 (21%) were transported by a Navy nurse, with 131 (98.5%) classified as "urgent," accounting for 46% of all urgent transports. The primary indication for en route care nursing was mechanical ventilation of intubated patients (97%). Mean (SD) patient transport time was 29.8 (7.9) minutes (range, 17-61 minutes). The most common en route care interventions were administration of intravenous sedation (80%), neuromuscular blockade (79%), and opioids (48%); transfusions (18%); and ventilation changes (11%). No intubations, cricothyroidotomies, chest tube placements, or needle decompressions were performed en route. No deaths occurred during transport.

CONCLUSIONS US Navy nurses successfully transported critically injured patients without observed adverse events. Establishing en route care as a program of record in the Navy will facilitate continuous process improvement to ensure that future casualties receive optimized en route care. (*Critical Care Nurse*. 2018; 38[2]:e1-e6)

En route care (ERC) enables continuation of care during movement (evacuation) without clinically compromising the patient's condition.[1] In the US military, establishment of a program of record drives funding to man, train, and equip for a mission. The US Navy provides all medical support to both the US Navy and US Marine Corps (USMC), yet important differences exist in their approaches to ERC. Navy personnel participate in patient movement in challenging environments across the spectrum of Navy and USMC operations. For decades, both the Navy and USMC focused largely on point-of-injury rescue performed by Navy corpsmen trained in search and rescue and initial

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trauma management techniques. Little attention was paid to interfacility transport, the movement of patients from a smaller, less robust medical facility to a more advanced level of care. For decades, only 2 Navy Nurse Corps billets (the military term for full-time positions) required flight training. After completing Air Force flight nurse training, these 2 Navy nurses were stationed on a remote island in the Indian Ocean and were responsible for caring for patients on medical evacuation flights; other interfacility ERC tasks were assigned to the Air Force.

The lack of a Navy program of record in ERC meant no funding was allocated to staff, train, and equip a large-scale ERC mission. Navy ERC planning did not address interfacility transport of patients and methods of maintaining the level of care after damage-control surgical intervention. The far-forward deployment of advanced surgical capability to support USMC operations created a need for skilled interfacility patient transport.[2-4] Within the USMC, ERC was established as a program of record in 2002, which spurred development of dedicated medical equipment.[5]

Navy nurses have a critical patient care role during transport to support Navy and Marine Corps operations.

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A formal training program began in 2005. Within the Navy component, however, no ERC doctrine exists. Therefore, provider types, training requirements, transport vehicles, medical equipment, and other critical elements for safe and effective patient transport are not standardized.[6] A recent review of 428 Navy Search and Rescue reports (required any time naval aviation assets are used in patient movement) identified search and rescue medical technicians as the primary Navy ERC providers, despite anecdotal reports of nurses serving in that capacity.[7]

Navy nurses serve as primary en route critical care providers when deployed in support of USMC operations.[8] Most commonly, these ERC missions are undertaken to transport critically injured patients from a far-forward medical outpost with limited surgical capability (damage-control resuscitation but no holding capacity, or role 2) to a comprehensive role 3 combat support hospital with more robust staffing, holding, and specialty capacity. Although the critical patient transport role performed by Navy nurses has been mentioned in other articles describing Navy Medicine support of USMC operations during Operation Iraqi Freedom,[2,3] no systematic description of the types of patients and modern combat support missions in which US Navy nurses have provided ERC has been published. The purpose of this report is to describe a series of patients transported by US Navy nurses during conflicts in Iraq (2005-2006) and Afghanistan (2009).

Methods

We performed a retrospective review of a quality improvement database that included all medical evacuation flights whether or not ERC was required. The database reflected transports from Navy/Marine Corps role 2 facilities to US or coalition military role 3 facilities in Iraq (February 2005 through March 2006) and Afghanistan (July through November 2009). The role 2 trauma surgeon for all captured time periods and senior author of this paper (Z.T.S.) created and maintained the database. The study dates reflect the periods when this member of the study team was deployed. The institutional review board at Naval Medical Center Portsmouth, Portsmouth, Virginia, approved the protocol.

Recorded data elements reflected system attributes and patient/clinical characteristics. System attributes included the total number of patients treated at a Navy

role 2 facility, the number of patients transported during the study periods, ERC provider type, transport priority level, time of day the transport occurred, number of patients per transport, duration of transport, and total mission time. Patient and clinical characteristics were Injury Severity Score,[9] indication for critical care transport, medications administered, procedures performed, and pre- and posttransport vital signs.

Priority levels used were "urgent" (short-notice evacuation, within a maximum of 1 hour), "priority" (prompt evacuation, within a maximum of 4 hours), and "routine" (evacuation within 24 hours).[1] Duration of transport reflects actual ERC flight time, and total mission time was defined as the time the nurse was away from the role 2 facility. Total mission time was important to the operational readiness of the unit because it reflects a period of time for which the mission capability of the sending unit was degraded. Because these teams deployed without a specifically designated and trained ERC nurse and with only 3 nurses total, the loss of a nurse for the ERC mission resulted in a shortage of a critical patient care resource. The ERC provider type was classified as either a US Navy nurse or any other ERC provider. Navy nurses included critical care registered nurses and certified registered nurse anesthetists.

We performed descriptive statistical analyses by using statistical software (InStat, GraphPad Software). Categorical data are reported as frequencies and percentages. Continuous variables are reported as mean (SD). For all data comparisons, a *P* value of less than .05 was considered significant. Only available data are reported; no imputations were performed.

Results

System Attributes

Of the 1550 casualties cared for at the role 2 medical facilities (across both data collection periods), 630 required medical evacuation. When evaluated by priority level, missions requiring en route critical care accounted for 46% of all "urgent" missions. Among the casualties requiring medical evacuation, 133 (21% required en route critical care, with Navy nurses (6 registered nurses and 3 certified registered nurse anesthetists) staffing all en route critical care missions. Provider type for non–critical care ERC missions (all missions not staffed by Navy nurses) was not recorded. The priority level for 131 of 133 (98.5%) critical care ERC missions was "urgent."

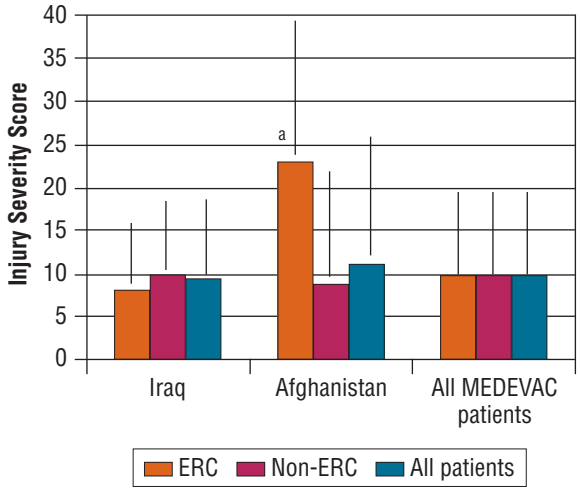

Figure 1 Injury Severity Scores of patients requiring MEDEVAC in Iraq (2005-2006) and Afghanistan (2009).

Abbreviations: ERC, en route care; MEDEVAC, medical evacuation.

[a] *P* < .001 for Afganistan ERC vs Afghanistan non-ERC, and for Afghanistan ERc vs Iraq ERC.

Of the 133 nurse-staffed ERC missions, 49 (36.8%) occurred at night, under tactical conditions without lights, adding to the complexity of the care environment. Most (89) critical care ERC missions were single-patient missions, whereas 10 missions cared for 2 patients and 3 missions transported 3 patients; data were unavailable for 15 patients. Mean (SD) ERC transport time was 29.8 (7.9) minutes (range, 17-61 minutes). For round-trip missions (including both patient transport and the return to base), the mean (SD) duration was 79 (29.6) minutes (range, 49-241 minutes).

Patient and Clinical Characteristics

The mean (SD) Injury Severity Score in the 2005 to 2006 data collection period did not differ significantly between patients who did and did not require en route critical care nursing (8 [7.3] vs 10 [9.0]; *P* = .07). In contrast, in 2009, patients who required ERC nursing had a significantly higher mean (SD) Injury Severity Score than did non-ERC patients (23 [14.8] vs 9 [12.9]; *P* < .05). The mean Injury Severity Score in 2009 was also significantly higher than in 2005 to 2006 (23 [14.8] vs 8 [7.3]; *P* < .01) (Figure 1). Overall, 97% of patients transported by Navy nurses were intubated, with monitoring and management of mechanical ventilation being the most common indication for en route critical care.

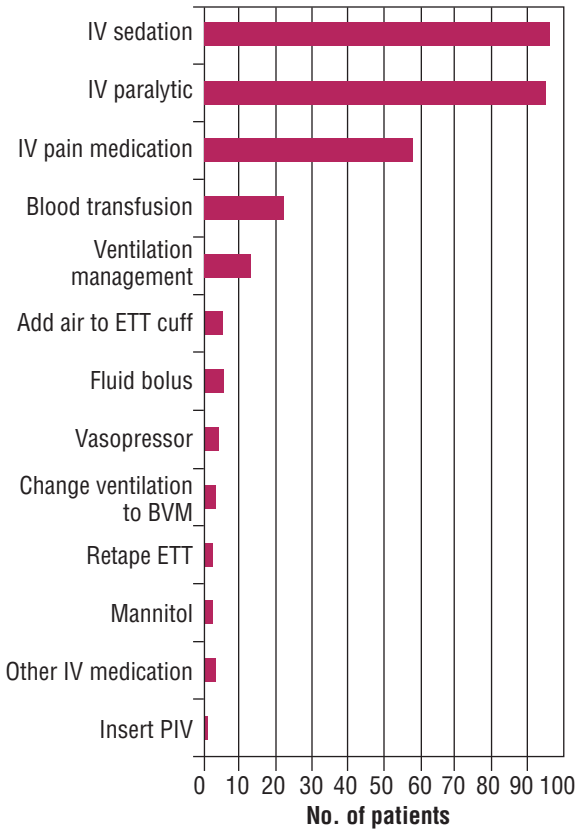

Figure 2 En route care interventions performed by Navy nurses.

Abbreviations: BVM, bag-valve mask; ETT, endotracheal tube; IV, intravenous; PIV, peripheral intravenous catheter.

The most common ERC medications administered by Navy nurses were intravenous sedatives (80% of patients), neuromuscular blocking agents (79% of patients), and opioids (48% of patients). The most common procedures performed were blood transfusions (18% of patients) and ventilation changes (11% of patients) (Figure 2). No intubations, cricothyroidotomies, chest tube insertions or manipulations, needle decompressions, or central venous catheter placements were performed en route. No adverse changes in vital signs during transport were reported for the nurse-transported patients. Available en route vital signs are reported in the Table. No patients undergoing critical care transport died en route.

Discussion

This review of 2 periods of interfacility patient transport from 2 USMC role 2 facilities to higher levels of care identified 133 of 1550 casualties who received en route critical care delivered by Navy nurses. In accordance with USMC ERC guidance, all transports were staffed by a critical care nurse as the primary ERC provider.[8] The mean patient transport time of 29.8 minutes to the receiving facility was long enough for critical patients to decompensate without appropriate medical management. The mean mission duration in this study was 79 minutes. Similar to a previous report,4 total mission durations were up to 4 hours (range, 49-241 minutes). This potential loss of a nurse for an extended period reinforces the need for dedicated en route critical care capability at a role 2 hospital. The use of "lifts of opportunity" also meant that multiple patients were often transported on the same flight, including both patients who did and did not require en route critical care. These challenging situations should be considered when the current Navy/Marine Corps concept of single-provider ERC is reviewed. Doctrine clarifying training requirements as well as mission roles and responsibilities could help to guide training and operational decision-making. We believe it is essential to highlight the ERC work done by Navy nurses, particularly before the systematic implementation of predeployment training. Although these data are inadequate to answer all ERC-related questions, it is our hope that our report spurs the development of a

Table En route vital signs for 133 critical care patients transported by Navy nurses

	At departure		At arrival		
Vital sign	Mean (SD)	Missing data, %	Mean (SD)	Missing data, %	*P*
Systolic blood pressure, mm Hg	123 (28.4)	13.5	130 (23.3)	15.0	.01
Heart rate, beats/min	103 (25.2)	12.0	102 (25.2)	12.8	.53
Respiratory rate, breaths/min	15 (4.0)	16.5	15 (3.6)	17.3	.73
Oxygen saturation, %	99 (3.0)	14.3	98 (4.4)	15.8	.15
Temperature, °C	36.9 (0.70)	72.2	36.7 (1.00)	85.7	.06

more detailed and systematic evaluation of ERC, particularly how patient outcomes are affected by provider education, training, and certification.

This is the largest review of ERC provided by Navy nurses in support of USMC in recent combat operations. Chambers and colleagues[4] reported a series of 338 combat casualties cared for at forward Navy surgical outposts in Iraq in 2003. Of these patients, 25 were transported by Navy nurses after damage-control surgical operations, and all arrived at the next level of care without deterioration. Similar to our report, in the report by Chambers et al[4] nearly all patients transported by the Navy nurses were intubated and ventilated, and nearly half required en route transfusions. Specific ERC training of the Navy nurses was not addressed in that paper, but few training resources existed at that time. Echoing earlier recommendations by other military surgeons,[3,4] our findings demonstrate a need for ERC providers qualified to monitor and manage critically ill and injured patients, prevent complications, and recognize early indications of deterioration. These attributes are core critical care nursing skills.[10]

Our findings are in contrast to those of Tobin and colleagues,[11] who reported that critical procedures (intubation, cricothyroidotomy, double-lumen endotracheal tube placement, needle or tube thoracostomy, central venous access placement, and cardiopulmonary resuscitation) were performed during 12% of combat casualty transports in Afghanistan. However, comparison is difficult between the studies because 53% of transports evaluated in Tobin's study were from point of injury, in contrast to our study, which included only patients transported from role 2 to role 3 medical facilities. Additionally, the Injury Severity Score for all patients in Tobin's study was greater than 15, in contrast to the range of Injury Severity Scores observed in this study.[11] Providing clear evidence of the patient types and transport conditions associated with patient movement in support of military operations will help inform resource decisions to optimize the readiness of Navy ERC providers in future engagements.

The Navy nurses in this study lacked standardized and mission-specific training. The senior author (Z.T.S.) has verified that none of the Navy ERC nurses included in this report had attended the Joint EnRoute Care Course. In January 2005, when the first cohort described deployed, the course had yet to be established. A year later, the deploying nurses were unable to obtain the training, which was again the case in 2009. These ERC nurses received on-the-job training after arriving in Iraq or Afghanistan; some had a brief static airframe familiarization immediately before deployment. Despite that handicap, they met the challenges (darkness, limited patient accessibility, evasive maneuvers, minimal resources) associated with providing critical care in the back of a helicopter in support of combat operations.

However, we are wary of attributing the finding of no en route deaths solely to the expertise of the ERC nurses. These nurses were able to overcome systemic shortfalls to provide effective critical care during transport. Likewise, the patients being transported had already been surgically evaluated, resuscitated, and often operated on before transportation, making them an optimized (if not stabilized) patient population.

Despite receiving only on-the-job training, Navy nurses met the challenges associated with providing critical care in a helicopter in support of combat operations.

In a large review of combat casualty care during an overlapping time period, Eastridge et al[12] reported that 87% of combat casualty deaths occurred before arrival at a role 3 surgical facility. Of those who died, researchers concluded that 24% had potentially survivable injuries such that better systems of care might have resulted in their survival. Mabry and colleagues[13] evaluated the impact of ERC provider training on 48-hour mortality of US and coalition patients in Afghanistan who were transported (both from point of injury and interfacility) during consecutive time periods from 2007 through 2010. The investigators found a 72% reduction in 48-hour mortality for patients transported by a team of critical care–trained flight paramedics and emergency medical technicians-basic using modern helicopter emergency medical services protocols than when patients were transported with the standard single Army flight medic trained to the emergency medical technician-basic level.[13] Although our study was not designed to examine the effect of provider type, the findings of Mabry and colleagues support the conclusion that patient outcomes are improved with more highly skilled ERC providers, such as critical care nurses.

There are several limitations to this study. First, we combined all Navy nurses into a single group for analysis,

without determining the effect of advanced clinical education and expertise (certified registered nurse anesthetist vs critical care nurse). A single clinician performed database entry without external verification or comparison with long-term outcomes. As with many retrospective reviews, particularly of out-of-hospital care,[14] our study is hampered by missing data. Using mean pre- and posttransport vital signs as the sole indicator of patient outcome does not capture a comprehensive representation of patient status en route and is not informative about individual patient outcomes. No deaths were reported during transport, but our data did not include vital signs for each patient. The use of multiple imputation for missing vital sign data could provide greater insight.[15,16] Future studies with evaluation of en route vital signs may render additional findings and illuminate important changes in patient hemodynamics, oxygenation, and mentation during transport that would better demonstrate the quality of en route critical care.

Conclusion

To our knowledge, ours is the largest, most detailed case series of interfacility transports completed by Navy nurses in the modern combat zone. Critical care patient transport is an essential mission for the Navy Nurse Corps. We included neither point-of-injury nor long-distance interfacility transports in our review because these missions are rarely completed by Navy nurses. However, because of their potential impact on patient outcomes, these periods of care should also be analyzed. This review of interfacility patient transports in support of USMC combat operations from 2005 through 2009 makes visible the ERC provided by Navy nurses to 133 trauma patients. More recent policy guidance should reduce the occurrence of nurses deploying to fulfill the ERC role without training.[17] However, the absence of other peer-reviewed publications and lack of searchable data sets documenting this mission make these data relevant. Moreover, these data represent untrained personnel performing contingency operations, an occurrence that requires study. Future research on the number and type of transport missions completed by Navy nurses is required to evaluate the volume, scope, and effectiveness of their care and develop the evidence to guide training and policy decisions on the ERC capabilities required to optimize patient outcomes. However, without systematic data capture of patient condition, ERC clinician actions, and patient responses, such research will be difficult, if not impossible, to conduct. Establishing ERC as a robust program of record in the Navy is a first step to facilitate continuous process improvement to ensure that future casualties receive optimized ERC. CCN

Financial Disclosures
None reported.

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