Distributed Maritime Operations and the Medical Challenge: How a Medical Common Operating Picture Can Help Bridge the Gap

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ABSTRACT This work explores the challenges of delivering medical care in the geographically dispersed and resource-constrained environment of Distributed Maritime Operations (DMO) and Expeditionary Advanced Base Operations (EABO). Traditional medical planning approaches may struggle to adapt to the vast operational space, extended evacuation times, and limited medical force present in these scenarios. The concept of a Medical Common Operating Picture (COP) emerges as a potential solution. By providing a shared view of the medical situation across the theater, encompassing logistics, personnel, and patient data, a medical COP has the potential to facilitate medical command and control (MED C2) in DMO/EABO. The implementation of a medical COP has the potential to optimize resource allocation, enhance situational awareness, streamline medical evacuation, and reduce healthcare provider moral injury in large-scale combat operations. A medical COP will allow medical planners to make informed decisions on triage, resupply, and evacuation, ensuring the best use of limited medical resources. This is done by leveraging a comprehensive understanding of the medical landscape, enabling informed clinical and operational decision-making by humanitarian and combat personnel respectively. A fully realized medical COP system will enable a dynamic theater evacuation policy, balancing the conflicting needs of patient care at higher echelons with the operational expediency of returning servicemembers to their operational units, thereby maximizing evacuation effectiveness. It will further enable medical personnel to perform dynamic casualty triage based on operational realities, mitigating potential ethical dilemmas. Implementing such a medical COP system will require overcoming communication limitations to facilitate data exchange and potentially integrating clinical decision support tools for real-time data analysis and recommendations. It will also require the rapid adoption of modernized operational medicine documentation solutions by medical assets within the operational forces. Ultimately, this work suggests that a medical COP has the potential to bridge the gap between traditional medical planning and the unique demands of DMO/EABO, ultimately optimizing casualty care, maximizing resource efficiency, and preserving the fighting force.

BACKGROUND

Modern warfighting requires a securely interconnected force. The battlefields of today have evolved to incorporate various information systems and networks that provide the ability to share information rapidly and securely. This sharing of information facilitates the common understanding of the operational battlespace by all participants. This process is known as creating a common operating picture (COP) and provides real-time situational awareness across all levels of war.

The concept of COP has been used by operational commanders to drive real-time tactical decision-making for decades. These COP systems are fed by a plethora of data sources including friendly force geospatial systems, intelligence, surveillance, and reconnaissance (ISR) reports, as well as logistics and infrastructure reporting systems. This has also been called C4ISR (Command, Control, Communications, Computers, ISR). For COP to be effective, it must generate a single, mirrored display that is accessible to multiple commands throughout a theater. It should present only the relevant information that enables commanders at all echelons to dynamically mesh their efforts with those of all other units

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in a theater in pursuit of centralized objectives. An example of a COP system that is widely implemented across the U.S. joint force is the Team Awareness Kit (TAK),[1] a representative image of which can be found in Figure 1.

As operational planners consider the challenges intrinsic to warfighting in Large Scale Combat Operations (LSCO), Distributed Maritime Operations (DMO), and Expeditionary Advanced Base Operations (EABO), so too must medical planners adapt the hard-learned tactics, techniques, and procedures from past conflicts to effectively deliver care in the geographically distributed combat theaters of tomorrow. The phrase "tyranny of distance" has been used to describe the source of most operational challenges in DMO. The operational factors of time, space, and force are both expanded and diluted in equal measure in DMO. While these terms are often used to describe combat operations, the concept of medical "force" can similarly be used to describe the clinical capability and capacity of theater medical units to treat both disease and non-battle injury (DNBI), as well as combat wounded.

As Milan Vego, one of the world's preeminent experts in naval operations, states, "The higher the level of war, the larger the factors of space, time, and force, and hence the more critical for the commanders and their staff to properly balance these factors with the respective objective."[2] Given the stated mission of U.S. Navy Medicine to "deliver…medical forces that…preserve the Naval human weapon system"[3] it follows that medical planners must seek to balance these operational factors if they are to preserve the human component of the maritime fighting force in DMO/EABO.

In recent conflicts, the factors of time and space were small due to rapid and freely available aeromedical evacuation capabilities. The factor of medical force was similarly strong given multiple Role 3 theater hospitals that were committed to any given operational theater. In contrast, in DMO/EABO, the factors of space and time are expansive, not only due to the geographic isolation of individual units but also to the need for prolonged patient holding in the setting of uncertain evacuation and resupply. Only a finite number of medical forces will be dispersed throughout DMO/EABO, with definitive surgical care at a Role 3 medical asset potentially lying days and thousands of miles away from the point of injury. Given this change in operational factors, the medical processes from the wars of the past two decades is not sufficient for this task. In planning to meet these unique and future challenges of medical care in DMO/EABO, the concept of generating a medical COP will be vital for both combat and medical operations.

Figure 1. Representative image of team awareness kit common operating picture software. Image Source: ATAK in the field: forging a tactical edge [Image 1 of 2]. Defense Visual Information Distribution Service. https://www.dvidshub.net/image/6174701/atak-field-forging-tctical-edge. Published April 15, 2020. Accessed April 17, 2024.

THE PROBLEM

Medical planners must efficiently leverage a finite amount of medical force, both human and Class VIII resources, over wide factors of both space and time in DMO/EABO to maximally preserve the human weapon system.

This can only be accomplished through (1) the generation of a medical COP and (2) the distribution of that medical COP and both the operational and clinical decision support tools that it provides to all medical decision-makers in each theater where DMO/EABO is required. It must be stated that a COP is not easily created in DMO/EABO. In this operational context, communications are limited not only due to the factor of space but also due to enemy action. Should a medical COP not be readily available, there will be grave consequences for patients across the continuum of care from the point of injury through evacuation from the combat theater.

Logistics and Class VIII Supplies

Without a medical COP, logistic planners will be unaware of Class VIII deficiencies for organic medical assets such as Fleet Marine Force or afloat corpsmen. This will result in a degraded ability of these clinicians to provide both tactical combat casualty and DNBI care for their respective units. Further, combat or DNBI attrition of vital medical personnel can have a profound impact on the tactical combat effectiveness of both combat and support units in DMO/EABO, where medical personnel cannot be readily replaced.

Likewise, a medical COP will guide what patient movement is available throughout a theater. Without this medical command and control (MED C2), evacuation may be prioritized for individuals who could eventually be returned to duty in place of critically injured servicemembers. Such a scenario would doubly degrade the Naval human weapon system not only due to the loss of a critically ill casualty but also to the evacuation of a non-critically ill servicemember who might otherwise be able to return to the fight. Throughout history, theater evacuation policies have been continually subjected to tension between operational commanders and medical planners.[4]

Operational commanders tend to prefer a long evacuation policy, enabling a smaller proportion of casualties to be evacuated and a greater number to be returned to duty. This policy serves to preserve the fighting force but requires

a greater factor of medical force within a combat theater. Medical planners generally prefer the opposite, instead advocating for short evacuation policies. These allow patients to be cared for at better facilities and for smaller medical units to accomplish their mission with less requisite medical force. This improved patient care, however, requires operational commanders to designate or dedicate more human and transportation resources to support this increased evacuation requirement. Given the dynamic factors of space, time, and medical force in EABO/DMO, these evacuation policies must likewise be flexible and driven by an awareness of the overall operational medical COP.

Dynamic Triage and Clinical Decision Support

Just as a theater evacuation policy must be flexible in EABO/DMO, a medical COP aids in the dynamic triage of casualties from the point of injury along the patient evacuation pathway. A Fleet Marine Force corpsman with access to decision support tools within the medical COP would be able to understand that there is minimal likelihood of resupply or evacuation for the days to follow an injury. The triage performed by that corpsman would consequently shift to incorporate that information. Without access to a medical COP, a tragic misallocation of resources toward a casualty with minimal chance of survival could occur. This theoretical scenario can be expanded to surgical triage in Role 2 surgical units. At this echelon of care, limited Class VIII supplies and capacity for patient holding, force these units to consider the overall medical COP when deciding whether to attempt damage control surgery on a casualty.

The reality of future conflicts in DMO/EABO is that there will likely come a time when triage must become more dynamic than the traditional algorithms of the past two decades. Operational constraints within the larger battlespace may require the care of otherwise salvageable casualties to be deferred in favor of providing care to more minimally wounded casualties who can be returned to the fight. The diluted operational factor of force throughout DMO/EABO will likely necessitate this "dynamic triage" as the limited human weapon system must be preserved to accomplish the most important priority, the warfighting mission. Without the information provided by a medical COP that allows a medical asset to understand its place within the greater operational mission, medical personnel in this scenario will be at risk for both massive moral injury and continuing to pursue traditional triage techniques despite operational necessities. This would have the dual effect of degrading the medical force brought to bear by that medical unit, while at the same time degrading the combat effectiveness of their supported entities.

This real-time analysis of medical triage priority represents the major clinical benefit that will be experienced by bedside clinicians when establishing a medical COP. The highest quality real-time data matched with advanced predictive algorithms has the potential to provide decision-makers with real-time survivability estimates of combat casualties. Triage decision support tools can help offload the moral burden during some of the most challenging decisions far forward when junior medical personnel are deciding to whom limited medical resources should be applied. While a medical COP will realize other clinical benefits such as more optimized logistics management and patient movement coordination, developing a dynamic triage algorithm will be the most impactful application of this technology for deployed medical forces.

RECOMMENDATIONS

Such a medical COP system represents a critical capability to maximize the efficiency of care to both combat and DNBI casualties in DMO/EABO. Despite this, past planners have identified that centralized C2 is a luxury only afforded to those with military superiority and that COP systems such as a

Table 1. Example components of a theater-wide medical common operating picture.

Data availability	Efficient access to the system from bedside clinician to theater command surgeon Cross-communication between medical and tactical commands Preparation for casualties and optimization of limited human and tactical resources Streamlining of data to ensure that relevant information is presented at the correct level The correct information, available to the correct person, at the correct time
Facilities/ Staffing	Real-time monitoring of capabilities at each theater medical asset including Bed availability, ventilator use, operating room availability, specialty care capability, etc.
Logistics	Data on the availability of relevant Class VIII supplies at theater medical assets Medical consumables, sterile surgical supplies, pharmaceuticals, blood products, etc.
Theater evacuation	Display of theater evacuation factors and capabilities Operational Decision Support tools to allow a dynamic theater evacuation policy Collates factors of patient acuity and medical need Anticipated holding times of patients given theater operating environment
Dynamic Triage	Clinical Decision Support tools for dynamic triage process given operational context Automatically assess resource management and patient needs Collates data from logistics, staffing, and theater evacuation data streams

medical COP are not feasible in peer conflict.[5] To accomplish a functional medical COP in DMO/EABO, solutions unique to the humanitarian mission of these units must be considered to ensure that communication between medical assets remains open. Without data transfer between these units, medical planners will be unable to generate a COP, and medical units will be hindered in their ability to optimally support the operational forces.

In addition to open communications, the rapid adoption of medical technologies that generate real-time clinical data to feed the medical COP is also required. Tools are emerging such as Battlefield Assisted Trauma Distributed Observation Kit (BATDOK) and other expeditionary medical technologies within the Joint Operational Medicine Information Systems (JOMIS) Operational Medicine Care Delivery Platform (OpMed CDP) that provide this capability.[6] Without the data generated by the operational electronic health record solutions, the benefit of a medical COP will never be realized. It is incumbent on the operational forces to recognize the benefit of a COP for not only medical force efficiency but also combat force optimization. Prioritizing the adoption of BATDOK and OpMed CDP solutions by ensuring their speedy integration into current operational medical processes is required to ensure that medical COP capabilities are ready to face any future conflict.

When considering how a medical COP may directly augment medical force, the creation of clinical decision support (CDS) tools within the COP that synthesize the available logistic, geospatial, operational, and clinical information throughout a theater would enhance bedside care of casualties (**Table 1**). Such a system could advise a clinician on the optimal amount of blood that they should consider using for a given casualty. This quantity may change based on impending operations and future-expected casualties or on the availability of blood resupply via drone or other means. It could also change based on the vital signs of a given casualty, advising the clinician to tolerate a suboptimal resuscitation in the face of a mass casualty event.

A fundamental understanding of the needs and expectations of both clinical and operational users will be required to ensure that the medical COP is efficient and functional in the chaos of an operational environment. A risk with such a system is that it provides access to so much data that it degrades effectiveness through information overload. Ensuring that a user-centric approach is implemented in the development of such a tool is essential to both its adoption and success.

Such a CDS is currently in the realm of the possible with existing technologies. That said, it would require both ready access to comprehensive and real-time data from throughout the battlespace, as well as accurate data input by clinicians and ancillary personnel throughout the continuum of casualty care. Should this occur, the medical COP will be efficient, comprehensive, and freely available, allowing for the maximum possible effectiveness of clinical decision-making to be leveraged in support of the Naval human weapon system.

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None declared.

DATA AVAILABILITY

No data were collected during this analysis, but all references can be made available upon request.

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