Guerilla Casualty Care Nodes and Web Networks on the Future Battlefield

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Health service support for the combat wounded must adapt to changing conditions on the battlefield.[1] While the last twenty years of combat have focused on counterinsurgency operations, future conflicts will likely feature large-scale combat operations (LSCO), with concurrent guerilla and irregular warfare shaping and kinetic operations.[2] The *National Security Strategy* outlines that the world is reaching an "inflection point" in which major powers will compete to shape the international order.[3] Underpinning this new era of global campaigning is the continuing threat of conflict with peer and near-peer adversaries.[4]

Future combat operations against enemies with comparable advanced technologies will challenge both our military and medical capabilities to simultaneously respond to threats in all combat domains (land, air, sea, space, cyber), the "gray zone," the electromagnetic spectrum, and the information environment.[5] Nested within or in concert with conventional warfare in future conflicts remains the employment of irregular warfare (IW) modalities to achieve strategic, operational, and tactical objectives. IW is "a form of warfare where states and non-state actors campaign to assure or coerce states or other groups through indirect, non-attributable, or asymmetric activities, either as the primary approach or in concert with conventional warfare."[6] IW often involves guerilla warfare tactics and may employ partisan or resistance forces to accomplish its aims.[7] As a result, the terms irregular warfare, guerilla warfare, and resistance operations will be used interchangeably in this piece to refer to the nontraditional operations and operators who play a role in IW.

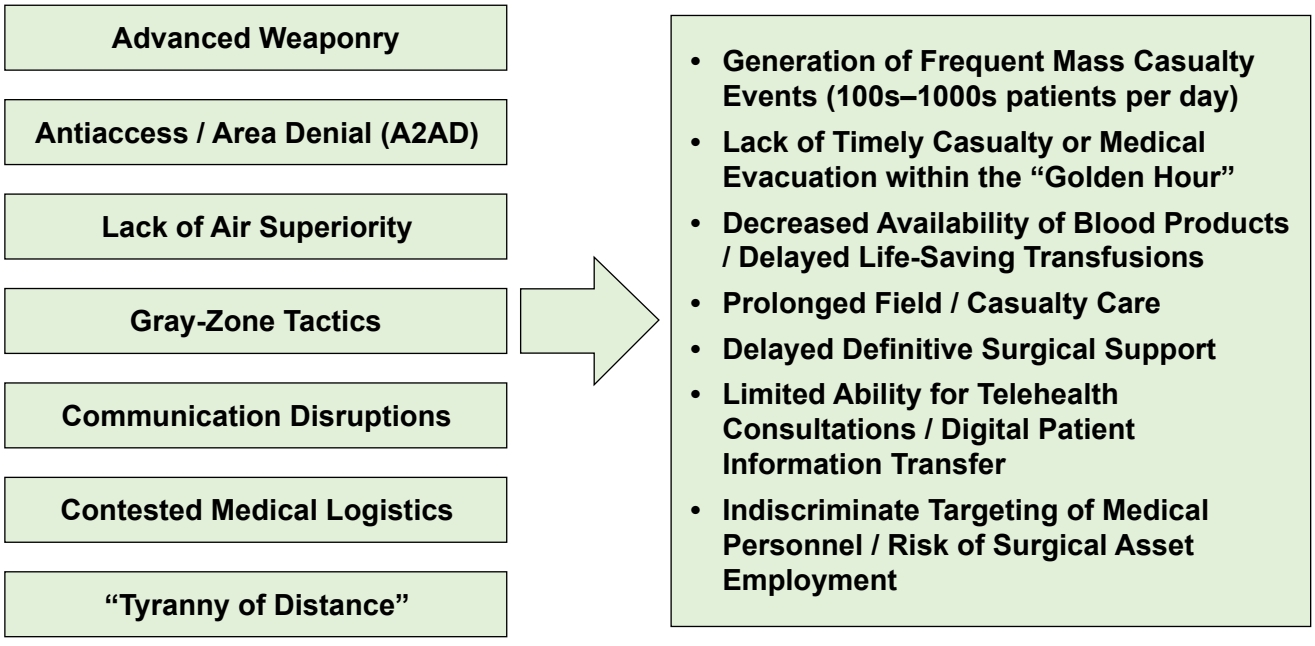
Given the complexity of IW, any medical support must be far forward, low footprint, highly mobile, and fully integrated within the construct of the deployed military trauma system care continuum so it is

Special operations surgical team (SOST) members assigned to the 24th Special Operations Wing stabilize a simulated patient on 17 March 2022 at Northeast Alabama Regional Airport, Alabama. SOST is an extremely lightweight, mobile, and rapidly deployable element that is medically and tactically trained to provide trauma resuscitation and lifesaving surgical care on or near the battlefield. (Photo by Sr. Airman Christopher H. Stolze, U.S. Air Force)

not isolated from broader conventional battlefields.[8] Therefore, to enhance survivability, this article analyzes the challenges to casualty care on the future battlefield and the subsequent medical support structures needed to gain and maintain medical overmatch in the environments of guerilla warfare, irregular warfare, or resistance operations integrated within conventional military operations. Doing so requires the synthesis of casualty care across the battlefield care continuum and its coalescence of medical support at *medical decisive spaces* through guerilla casualty care nodes and web networks. This proposed guerilla casualty care model parallels the tenets of irregular warfare, as they must be *nonattributable*, *asymmetric*, and *indirect*. Utilizing care nodes within web networks will enable joint force military, indigenous, and host-nation medical assets to overcome barriers to the continuum of combat casualty care that will be seen on the future battlefield.

Challenges to Future Battlefield Casualty Care

The conflict in Ukraine has illustrated how novel technologies such as antiaccess/area denial systems, long-range precision fires, and unmanned combat aerial vehicles threaten the unopposed aeromedical and tactical evacuation of injured warfighters. These advancements have changed the nature of war through the generation of immense casualty numbers, the need for prolonged casualty care over numerous days, limited medical resupply, and reduced access to surgical support within the "golden hour."[9] Figure 1 illustrates several of these unique features and their consequences. Furthermore, in Ukraine, Red Cross-marked vehicles have been tracked by drones as they returned to treatment sites, identifying their locations and then illegally targeting these areas with artillery fires.[10] Similarly, the conflict in the Gaza Strip following the attack on 7 October 2023 has shown that healthcare providers and



(Figure by 2nd Lt. Mason Remondelli)

Figure 1. Casualty Care Challenges of Future Combat Operations Against Near-Peer/Peer Adversaries

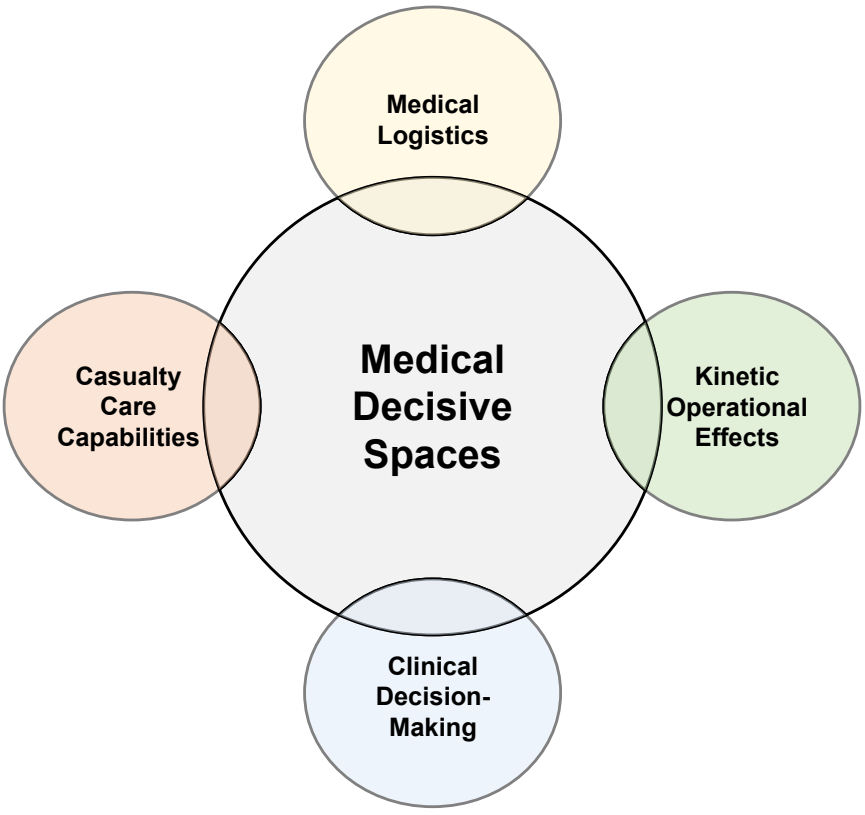
facilities may not be spared from hostilities.[11] Thus, on the modern battlefield, surgical assets are at especially high risk, and the extensive training and resourcing provided to them means they cannot easily be replaced.[12]

Moreover, communications systems, in-theater and intratheater patient accountability, telemedicine, and patient data collection will all be critical components of care, but such technological solutions will also face challenges from cyber warfare and electromagnetic disruptions. The numerous casualty care implications of LSCO would be further compounded by the unforgiving tyranny of distance, amphibious operations, and the distributed maritime environment if war were to occur in the Indo-Pacific.[13]

Before and during LSCO, irregular warfare and guerilla campaigns may occur, exacerbating threats by placing friendly personnel deeper into denied environments. The infrastructure for far-forward surgical care, medical resupply, and evacuation will be limited in future conventional conflicts, but they will be even more constrained in guerilla or irregular warfare settings. Health service support in IW settings will be characterized by prolonged casualty care, often by nonphysician providers, with forced reliance upon indigenous support networks.[14] Consequently, innovative medical planning will be needed to provide the appropriate role of combat casualty care at medical decisive spaces to both maintain the survivability of severely injured casualties and ensure a safe return to duty after minor or moderate injuries in future conflicts.

Overmatch at Medical Decisive Spaces

Decisive spaces on a battlefield are defined as "locations in time and space (physical, virtual, and cognitive) where the full optimization of the employment of cross-domain capabilities generates a marked advantage over an enemy and greatly influences the outcome of an operation."[15] Massing capabilities for effect at these decisive spaces enable formations to gain operational overmatch by rapidly exploiting the enemy's vulnerabilities. *Medical decisive spaces*, by proxy, are locations on the battlefield where the positioning of health service support assets synchronized with casualty care capabilities, clinical decision-making, medical logistics, and kinetic operational effects enable medical overmatch to improve survivability and increase force regeneration (see figure 2).[16]



(Figure by 2nd Lt. Mason Remondelli)

Medical decisive spaces are locations on the battlefield where the coalescence of combat casualty care, clinical decision-making, medical logistics, and kinetic operational effects help to extend the physiologic window of tolerance in critically injured warfighters enabling medical overmatch and enhancing survivability.

Figure 2. Medical Decisive Spaces

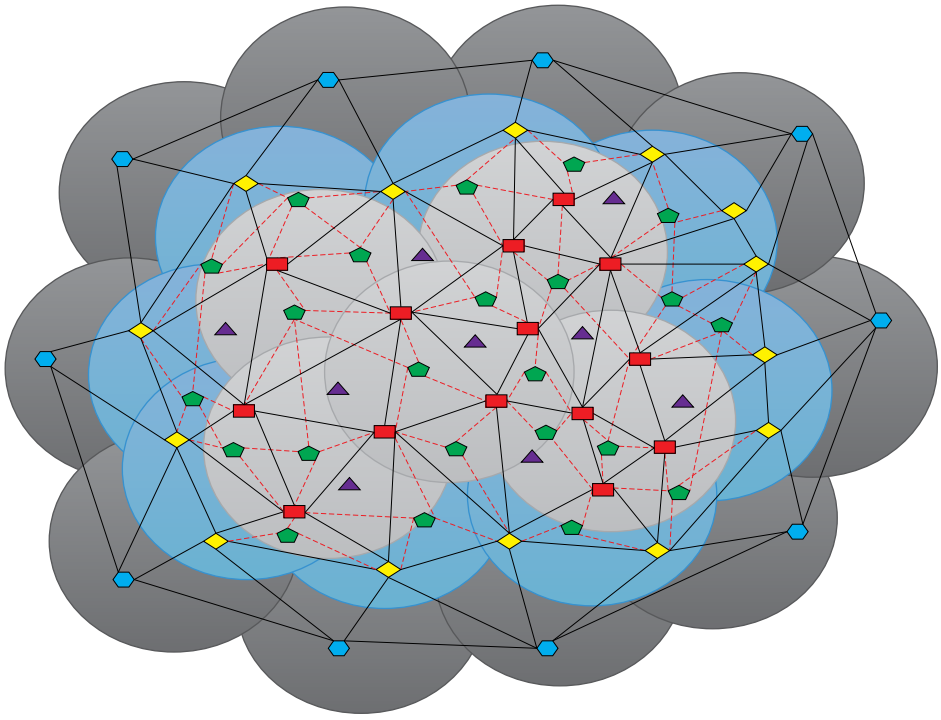
The establishment of adaptable and modular guerilla medical support structures that can be massed for effect at medical decisive spaces will be needed to reduce mortality on the battlefield. These guerilla medical assets must be specifically tailored to coalesce into larger capabilities to provide tactical combat casualty care, damage control resuscitation, and surgery as required to save lives and then disperse back to safer, hardened, or underground areas with a low signature to the enemy.[17]

A clear challenge of deploying assets at medical decisive spaces is weighing operational risk and casualty generation potential against medical capability needs. The fluidity of unit disposition on the battlefield combined with the kinetic evolution of maturing battlelines will require refinement of medical planning science. During the Global War on Terrorism, surgical assets were primarily located on secure forward operating bases and combat outposts within an established geographic theater of operation. While this posture worked for a small-scale, mature conflict within a fixed theater, future guerilla operations will be complex and may encompass dispersed geographic locations that cannot be predicted or mitigated by time alone. To enable precision trauma planning integrated with guerilla medical support at medical decisive spaces, we must leverage the tenets of irregular warfare, establishing layered and redundant medical care nodes and web networks to optimize combat casualty care on the battlefield.

Guerilla Casualty Care Nodes and Web Networks

Guerilla environments within conventional warfare necessitate layered, redundant, integrated, and networked medical formations that allow for hasty adaptation to rapidly changing, geographically dispersed casualty scenarios.[18] Rather than a linear battlefield, and even distinct from our recent concepts of medical support on nonlinear battlefields in Africa, future conflicts necessitate *guerilla casualty care nodes* and *web networks* comprising joint force military, allied, host nation, and indigenous assets that can expand and contract to maneuver to where medical capabilities are most needed. Guerilla casualty care nodes need to be operationally savvy enough to surge and mass at a medical decisive space to provide the right medical care at the right time and the right place, while just as rapidly dispersing care nodes back into the web network to avoid being targeted (see figure 3).[19]

Such movements within the network can be risky but may benefit from electromagnetic spectrum capabilities that obscure the location, amount, and types of injuries sustained, "hiding" casualty care nodes



Military Trauma System
- Point of Care
- Surgical Assets
- Field Hospital
- Evacuation and Logistic Hub
- Care Continuum

Guerilla Network
- Care Node
- Interlaced Web

- Point of care capabilities collocated with operational elements
- Surgical assets can "split" as needed and augment with ICU/holding capacity
- Guerilla nodes can "mass" at the "decisive" spaces to form larger capability / capacity within the web network and then "disband" back to safer areas
- Evacuation and logistic hubs arrayed around battlespace

(Figure by 2nd Lt. Mason Remondelli)

Figure 3. Guerilla Casualty Care Nodes and Web Networks Integrated Within the Military Trauma System

within the more extensive operational web networks until they are again required. These casualty care nodes must be modular and rapidly mobile and include node elements with or without surgical capabilities, medical hold, and intensive care capabilities that can mass at the *medical decisive space* when needed with the required role of care capability. Furthermore, traditional medical specialization must be augmented by ensuring medical personnel possess the military-specific range of knowledge, skills, and abilities required to survive in this operational environment. These include but are not limited to tactical combat casualty care, damage control resuscitation and surgery, as well as prolonged casualty care on the medical side, along with camouflage and concealment, communication, noise, and light discipline, constant 360-degree security, and survival techniques on the tactical side. Medical logistical challenges such as the ability to receive blood, medications, supplies, and equipment must also be layered into this networked system of combat casualty care delivery.

Medical nodes and care web networks would also require alignment with logistical resupply points as command-and-control hubs allowing them to expand and contract based on capability and capacity, which can be pushed to lower levels. Health information management also needs to incorporate nonmedical data while employing real-time machine learning to

inform decision-making around evacuation or treatment. Evacuation via a dedicated medical platform with en route care (MEDEVAC) or via nonmedical, nonstandard platforms with or without en route care (CASEVAC) will both likely occur in a dispersed fashion on agnostic platforms whether via ground, air, or sea, across physically enlarged LSCO battlefields. Critically injured combat casualties will be dispersed and have access to intermittent movement from one node to the next. Movement between nodes may not necessarily result in a higher capability or role of care but may be required due to compromised security, holding capacity, or availability of transport.

Finally, the composition of these nodes and medical personnel may vary. Some cases may require surgical control of bleeding or extracorporeal membrane oxygenation support, while others may warrant damage control resuscitation or management of a traumatic brain injury. A decision to move surgical assets to the node or evacuate the casualty from the node will need to be made based on the current operational environment. Modular sets and small surgical teams would be required for surgical care to surge and disperse as clinically indicated.[20] The skill set required for surgical teams to move forward will require additional operation training to minimize risk to the team.[21] Skills that are absent from the medical team at the node can be added remotely via secure telemedicine consultations as long as such consultations can occur without exposing one's location to adversaries. The origin of team members may also vary, with some U.S. forces, others from allied forces, and still others from local indigenous medical providers.[22] This latter group will be essential in irregular warfare environments because of their familiarity with the regional environment, their inconspicuous cover as locals, and their ability to tie into locally developed infrastructure such as hardened networks of underground tunnels and other components of a clandestine casualty care system.[23]

Conclusion

Future combat operations require convergent formations with medical assets that can rapidly adapt once the medical threat has been identified. This requires layered, redundant, integrated, and networked guerilla medical forces that can provide dispersed sustainment and expand or contract along nodes and networks rather than linear roles of medical care. By preparing for a level of unpredictability into health service support, logistical resupply, and evacuation, the U.S. military can better compete in future irregular warfare environments. Utilizing cutting-edge technology within the electromagnetic spectrum to "hide" personnel locations and movements and to employ telemedical reach-back capabilities can enable teams of all personnel compositions, including indigenous and local forces, to successfully treat casualties. Continued iteration upon this model must be done to sustain the fighting force, limit warfighter mortality and morbidity, and subsequently increase force lethality within a contested, protracted future battlespace. ■

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