



# *Army Futures Command Concept for Medical 2028*



**04 March 2022**

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## Preface

*From the Commanding General  
U.S. Army Medical Center of Excellence*

The Army Futures Command Concept for Medical 2028 is the first concept in the Army Concept Framework that focuses on medical operations. It describes how the Army Health System, along with its unified action partners, will support the health of operational forces during competition, the preservation of our fighting strength in conflict, and the reset of our forces in a return to competition. It articulates how future medical formations must be modernized to support dispersed Army forces conducting semi-independent operations along extended lines of communications in contested and austere environments.

This concept serves as the basis for modernizing our Army Health System to meet the challenges and demands of the future operational environment. It identifies implications and dependencies for other warfighting and supporting functions. It serves as the basis for experimentation, capability development, other modernization efforts and guides science and technology efforts to support the future force.

A handwritten signature in dark ink, appearing to read "D.P. Lemaster", with a long horizontal flourish extending to the right.

**DENNIS P. LEMASTER**  
**Major General, U.S. Army**  
**Commanding**

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## Executive Summary

The *Army Futures Command Concept for Medical 2028* describes changes to what and how the Army Health System will enable and sustain multi-domain operations against peer/near-peer competitors in the 2028 timeframe. The concept remains tied to and influenced by lessons learned and utilizes past experimentation results and the conceptual application of science and technology within the future operational environment.

The central idea is that the Army Health System, as a component of Globally Integrated Health Services, will support the Army and the Joint Force conducting multi-domain operations with expeditionary and interoperable medical capabilities during competition; when necessary, armed conflict, and a return to competition on favorable terms. Army medical forces employ an all-domain-capable command and control system, and treatment and multimodal evacuation capabilities designed to rapidly stabilize and clear casualties from the battlefield, while maximizing return to duty as far forward as possible. Medical information contributes to a common operational picture, providing all leaders, medical and non-medical, the information they need to make decisions. Force health protection capabilities promote, improve, or conserve the behavioral and physical well-being of the Joint Force; enabling a healthy and fit force, preventing injury and illness, and protecting the force from health hazards in both competition and conflict. The Army Health System force posture must support multi-domain formations operating semi-independently from multiple locations, globally and at home.

(See Figure 1. Logic Chart).

To support multi-domain operations the Army Health System must successfully:

1) ***Empower commanders at echelon with medical aspects of command and control*** by enabling leaders to optimize medical capabilities in support of commanders, executing commander's intent through an integrated command and control system regardless of the condition of the communications network, and assigning appropriate authorities and capabilities at the right echelon to enable rapid and risk informed decision making.

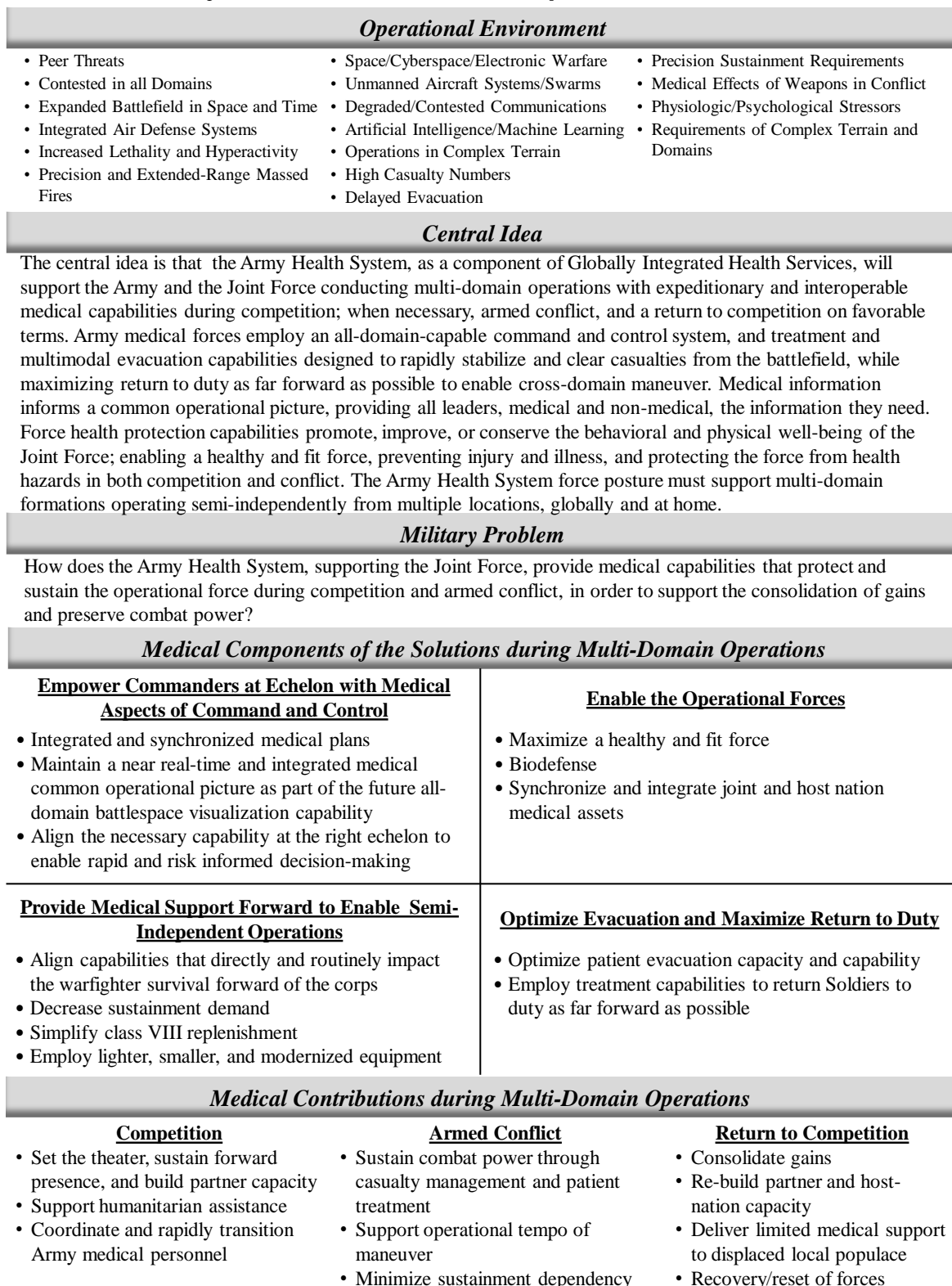
2) ***Enable the operational forces*** by maximizing a healthy and fit force. The Army Health System develops an effective health surveillance capability that supports operational activities and that enable risk analysis, inform protection decisions, and guide other hazard mitigation and containment activity. It also enables the operational forces by continuously synchronizing and integrating joint and host nation medical assets.

3) ***Provide medical support forward to enable semi-independent operations*** by aligning capabilities that directly and routinely impact the warfighter survival forward of the corps, decreasing sustainment demand, simplifying class VIII (medical supply) replenishment, and employing lighter, smaller, and modernized equipment.

4) ***Optimize evacuation and maximize return to duty*** by synchronizing effective medical treatment and evacuation, rapidly and efficiently clearing casualties from the battlefield, and focusing on maximizing returning Soldiers to duty. Returning Soldiers to duty as far forward as possible sustains combat power and enables forces to maintain the competitive advantage.

## Logic Chart

### ***Army Futures Command Concept for Medical – 2028***



**Figure 1. Logic Chart**



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Headquarters, U.S. Army Futures Command  
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Austin, TX 78701-2982

4 March 2022

## Force Management

### ARMY FUTURES COMMAND CONCEPT FOR MEDICAL 2028

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**History.** This document is a new U.S. Army Futures Command Concept for Medical.

**Summary.** This concept broadly describes the role Army Medicine has in supporting, sustaining, and enabling combatant commanders to conduct multi-domain operations. This document will lead modernization efforts and the development of specific required capabilities the Army Health System needs to support multi-domain operations.

**Applicability.** This concept applies to all Department of the Army activities that develop doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy. It guides force development and supports the Joint Capabilities Integration and Development System process. It also supports Army capabilities development processes described in the Army Futures Command Concepts and Capabilities Guidance.

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**Availability.** This pamphlet is available on the Futures and Concepts Center homepage at <https://www.army.mil/futuresandconceptscenter#org-resources>.

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## **Summary**

AFC Pamphlet 71-20-12

U.S. Army Futures Command Concept for Medical 2028

This concept:

- o Expands on the concepts described in U.S. Army Training and Doctrine Command Pamphlets 525-3-1 and 525-3-8 (Multi-Domain Operations and Echelons Above Brigade concepts respectively).
- o Expands on the concepts described in Army Futures Command Pamphlets 71-20-7 and 71-20-11 (Protection and Sustainment concepts respectively).
- o Challenges the current Army Health System principles (mobility) and medical functions (medical evacuation).
- o Recognizes and describes the need for medical interoperability and the need for the Army Health System to integrate efforts with the Army warfighting functions, unified action partners and host nations.
- o Describes the need for Army Health System capabilities to rapidly deploy operationally configured and task-organized medical forces across strategic distances with the capabilities necessary to transition to executing their mission immediately upon arrival.
- o Recognizes the role of manned and unmanned autonomous air and ground systems in support of medical evacuation and medical resupply.
- o Emphasizes the need for a unified, resilient, and secure communications network (to reduce the vulnerabilities associated with individual Soldier sensors utilized for medical information) achieved through strict adherence to a joint common operating environment that enables rapid decision making.
- o Emphasizes the need for reinvigorated field sanitation training for non-medical personnel and implementation of standardized Tactical Combat Casualty Care curriculum for all Service members.
- o Recognizes the need to expand medical training to include: 68W (Combat Medical Specialist) training consistent with capabilities expected in combat, realistic triage training for all health care providers, and training to provide medical support to amphibious operations.
- o Recognizes the need to enable a healthy and fit force via preventing injury and illness.



## Contents

<b>Preface.....</b>	<b>iii</b>
<b>Executive Summary .....</b>	<b>v</b>
<b>Logic Chart.....</b>	<b>vi</b>
<b>Chapter 1 Introduction.....</b>	<b>4</b>
1-1. Purpose .....	4
1-2. References .....	4
1-3. Explanation of abbreviations and terms .....	4
1-4. Assumptions .....	4
1-5. Linkages to other concepts .....	5
<b>Chapter 2 Future Operational Environment .....</b>	<b>7</b>
2-1. All-domain, lethal, hyperactive, and highly competitive .....	7
2-2. Impacts of the future operational environment on the Army Health System.....	8
<b>Chapter 3 Military Problem and Components of the Solution.....</b>	<b>10</b>
3-1. Military problem.....	10
3-2. Central idea.....	10
3-3. Solution synopsis .....	10
3-4. Empower commanders at echelon with medical aspects of command and control .....	10
3-5. Enable the operational forces .....	13
3-6. Provide medical support forward to enable semi-independent operations.....	15
3-7. Optimize evacuation and maximize return to duty.....	18
3-8. Contributions to multi-domain operations.....	21
<b>Chapter 4 Conclusion .....</b>	<b>22</b>
<b>Appendix A References .....</b>	<b>24</b>
<b>Appendix B Required Capabilities.....</b>	<b>27</b>
<b>Appendix C Science and Technology .....</b>	<b>30</b>
C-1. Introduction.....	30
C-2. Empower commanders at echelon with medical aspects of command and control.....	30
C-3. Enable the operational forces.....	31
C-4. Provide medical support forward to enable semi-independent operations .....	32
C-5. Optimize evacuation and maximize return to duty .....	35
C-6. Conclusion .....	37
<b>Appendix D Dependencies.....</b>	<b>38</b>
D-1. Introduction .....	38
D-2. Sustainment .....	38
D-3. Protection.....	39
D-4. Aviation .....	39
D-5. Command and Control.....	40
D-6. Maneuver .....	40
D-7. Army special operations forces .....	40
D-8. Intelligence .....	41
<b>Glossary .....</b>	<b>42</b>
<b>Endnotes.....</b>	<b>50</b>

## **Chapter 1**

### **Introduction**

#### **1-1. Purpose**

The U.S. Army Futures Command (AFC) Pamphlet (Pam) 71-20-12, *AFC Concept for Medical 2028*, describes changes to what and how the Army Health System (AHS) conducts medical operations in response to threats in the 2028 timeframe. This is the first concept included in the Army Concept Framework that focuses on medical operations. Chapter 2 describes the operational environment (OE) as it relates to medical operations. Chapter 3 describes the central idea, solutions to inform operational requirements and capability development, and provides a description of changes necessary for medical to contribute to operations during competition, armed conflict, and a return to competition. Chapter 4 summarizes the AHS role throughout the extended multi-domain operations (MDO) battlefield framework.

#### **1-2. References**

Appendix A lists required and related publications.

#### **1-3. Explanation of abbreviations and terms**

The glossary explains abbreviations and special terms used in this pamphlet.

#### **1-4. Assumptions**

a. The assumptions from U.S. Army Training and Doctrine Command (TRADOC) Pam 525-3-1, *The U.S. Army in Multi-Domain Operations 2028 (MDO Concept)*, apply to this concept.

b. The following assumptions also apply:

(1) The Services will retain authority over assigned medical capabilities, as provided in Title 10, United States Code, which provides the legal basis for the roles, missions, and organization of each of the Services.

(2) Commanders will have the necessary health authorities to support unified action partners (UAP).

(3) Army support to other Services (ASOS) responsibility will remain for rotary-wing and ground intratheater medical evacuation (MEDEVAC), consultation on operational public health, veterinary services, and class VIII A (materiel) and class VIII B (blood) management and distribution.

(4) U.S. Transportation Command will remain the lead for intertheater aeromedical evacuation.

(5) The continental United States (CONUS) medical infrastructure (CONUS-based military hospitals), Department of Veterans Affairs (VA), and civilian beds in the national disaster medical system (NDMS) will be capable of supporting all intertheater evacuated patients.

(6) The future operational environment (FOE) will further complicate health care delivery with a dynamic array of medical challenges resulting from disease and nonbattle injuries (DNBIs), new toxic chemical and biological threats, radiological hazards, and bio-engineered threats.

(7) Future threat capabilities and novel diseases will create new types of injuries and illnesses with greater severity resulting in larger numbers of injuries throughout the depth and breadth of the area of operations (AO).

(8) Conventional UAP medical forces will have capabilities that are interoperable to U.S. standards. However, Army special operations forces (ARSOF) partnered with unconventional UAP may be required to develop medical forces or capabilities to support operations within the deep maneuver areas.

(9) The Defense Health Agency (DHA) will sustain sufficient definitive care capability and capacity throughout the competition continuum to account for deploying medical forces working in their hospitals and to account for an uptick in the volume of casualties returning during armed conflict.

(10) DHA will have authority, direction and control of all Army CONUS and outside the CONUS (OCONUS) medical treatment facilities (MTF). DHA will be able to meet requested readiness requirements for individual proficiency and skills sustainment.

(11) Widely dispersed forces located at increased operational distances will result in a greater reliance on aeromedical evacuation as a means of obtaining responsive MEDEVAC support.

## **1-5. Linkages to other concepts**

a. TRADOC Pam 525-3-1 is the foundation document from which all subsequent MDO-related concepts are derived. The MDO Concept describes how Army forces, as an element of the Joint Force, conduct MDO to prevail in competition; when necessary, Army forces penetrate and disintegrate enemy anti-access and area denial systems and exploit the resultant freedom of maneuver to achieve strategic objectives (win) and force a return to competition on favorable terms.<sup>1</sup> The MDO Concept describes the FOE and the threats and lays out the foundation for what it will take for U.S. forces to win in the FOE. The MDO Concept also emphasizes the need for U.S. Army forces to modernize and adapt to a more lethal, hyperactive future environment. Modernizing and adapting applies to Army Medicine. In order to support U.S. forces, Army Medicine must modernize to the FOE or risk failure in providing support to U.S. forces conducting MDO in armed conflict.

b. *AFC Concept for Protection 2028*. The protection concept describes how the Army preserves the force from threats in all domains, generating stand-off so commanders can apply maximum combat power to accomplish the mission. The concept describes the ever-changing OE and provides actions they may take and formations they may employ at echelon, throughout the expanded battlefield framework, and across the competition continuum as part of MDO. Preserving the force includes protecting personnel (combatants and noncombatants) and physical

assets of the U.S., UAPs, and host nations (HNs).<sup>2</sup> The Army force health protection (FHP) capabilities (personnel, equipment, and activities) establish and sustain a healthy and fit force, provide health promotion and nutrition programs, identify the health threat in all settings, develop and implement personnel protective measures to eliminate or reduce exposures to health hazards and mitigate the adverse long and short-term effects of the impact of health threats to military personnel. FHP consists of preventive and treatment aspects of medical functions that include: combat and operational stress control (COSC), dental services, veterinary services, operational public health, and laboratory services.<sup>3</sup> The protection concept articulates the necessity to preserve the force from threats to maximize combat power.

c. *AFC Concept for Sustainment 2028*. The sustainment concept states that sustainment forces and activities must extend the operational reach of U.S. forces. Commanders and staff increase operational reach through deliberate, focused operational design, and the allocation of appropriate sustainment resources. This requires strategic sustainment functions, such as materiel, supplies, health services, and other support, and global distribution systems to deploy, maintain, and conduct operations over great distances for extended periods.<sup>4</sup> In line with the sustainment warfighting function, the AHS must establish precision medical logistics (MEDLOG) that is reliable, agile, and responsive to maneuver's demands and is integrated with the sustainment community to reduce the logistical burden in support of the Army's expeditionary and dispersed forces conducting MDO.

d. *AFC Concept for Aviation 2028*. The aviation concept describes how Army Aviation will enable the Army and the Joint Force to compete with, penetrate, dis-integrate, and defeat adversaries in armed conflict and consolidate gains. The concept describes three broad categories: 'See' (reconnaissance and security), 'Move' (air assault, air movement and aeromedical evacuation), and 'Strike' (attack, close support, interdiction, electronic warfare (EW)). Army Aviation brigades and battalions maintain command and control (C2) of the air ambulance units and split-based crews that are dedicated in support of the MEDEVAC mission. Use of Army rotary-wing aircraft (air ambulances) for AE requires both a medical mission approval authority as well as an aviation launch authority. In the FOE, air and ground evacuation will require constant synchronization throughout the competition continuum. This synchronization demands close coordination between medical, aviation, and maneuver commands.

e. *AFC Concept for Brigade Combat Team Cross-Domain Maneuver 2028*. The brigade combat team (BCT) concept describes how BCTs conduct operations to deter adversaries and defeat or destroy enemy forces in 2028. The BCT concept also describes how corps and divisions continuously converge effects enabling BCTs to conduct cross-domain maneuver, thereby facilitating their freedom of maneuver and action and allowing them to accomplish their mission objectives. As corps and divisions converge effects, the AHS plays a critical role in clearing the battlefield of casualties forward of the corps rear boundary enabling freedom of maneuver and action. In doing so, BCT requires enhanced medical capability at the point of injury which provides advanced trauma and resuscitation skills, and which possesses prolonged patient holding abilities to enable cross-domain maneuver. Additionally, the increase in existing and emergent health threats to the force must be offset by expanding force health protection capabilities to mitigate disease and non-battle injury casualties from non-traditional agents, chemical, biological, radiological, and nuclear (CBRN) threats and hazards, disease vectors, and toxins.

f. *AFC Concept for Special Operations 2028*. The concept for special operations outlines ARSOF dependencies for Army medical support. This document also establishes the required capabilities (RCs) to be developed for future conventional force and ARSOF integration and interoperability.

g. *AFC Concept for Command and Control 2028: Pursuing Decision Dominance*. To achieve decision advantages in multi-domain competition, crisis response, and armed conflict, the C2 concept identifies the capabilities of the future C2 system as a system of systems that includes people, processes, the communications network, and a command post (CP) constellation. Using this framework, it describes a future C2 system that enables the timely convergence of effects across all of the domains by facilitating the seamless flow of information from and between Army, joint, and other UAPs sensors, other network points of presence, and information systems. The seamless flow of information, to include medical information, will enable future AHS planning and patient regulating decisions. The command and control concept depends on the medical concept for force health protection capabilities to identify, assess, and protect Army forces from health hazards. The AHS force posture must support multi-domain formations operating independently from multiple locations, globally and at home, to align with the maneuver and protection concepts which will ultimately enable maintaining and protecting decision advantages.

h. *The Joint Staff, Joint Concept for Health Services*. The Joint Concept for Health Services describes in broad terms the Chairman's vision for what the future Joint Force will need from its collective medical enterprise to support the Globally Integrated Health Services (GIHS). This concept encompasses the global employment of joint operational health services and interoperable service capability guided by common standards and procedures, to tailor support to a wide variety of operational and strategic requirements. Future Army medical forces at strategic and operational levels require the capability to assess and integrate with UAP health system agencies supporting the delivery of health care in the AO to optimize the health care delivery continuum and improve patient outcomes.

## **Chapter 2**

### **Future Operational Environment**

#### **2-1. All-domain, lethal, hyperactive, and highly competitive**

a. As the Joint Force responds to adversaries contesting international norms throughout the competition continuum, U.S. forces will conduct operations in an OE shaped by four interrelated characteristics: (1) adversaries will contest all domains (cyber, space, air, land, sea, the electromagnetic spectrum (EMS), and the information environment) threatening U.S. dominance; (2) smaller armies will fight on an expanded battlefield that is increasingly lethal and hyperactive; (3) nation-states will have more difficulty imposing their will within a politically, culturally, technologically, and strategically complex environment; and (4) adversaries will more readily compete below armed conflict, making deterrence more challenging. These characteristics allow adversaries, particularly near-peer threats like China and Russia, to blur the distinction between peace and war and expand the battlefield in time in all domains, the EMS, and the information environment and geographically. Adversaries can extend competitive spaces into the homeland to

create tactical, operational, and strategic stand-off to separate U.S. forces and allies in time, space, and function, and allow them to achieve their objectives before friendly forces can respond.<sup>5</sup>

b. Adversaries have made and continue to make significant advances in destructive and disruptive capabilities, integrating space, cyberspace, EW, robotics, hybrid strategies, and hypersonic and information technologies as key components of their operations.<sup>6</sup> Environmental and occupational hazards, to include CBRN, are threats that have significant potential impacts on the force and on the success of health care delivery in contested environments. Adversaries' willingness to employ proxy forces in order to achieve political and strategic objectives while maintaining ambiguity necessitates a need to maintain the ability to fight irregular warfare while simultaneously engaged in conventional force on force battles.

c. Large wars are comprised of many small battles. The AHS's ability to conserve the fighting strength throughout the battlefield and in many different but simultaneous conflicts while contested in all domains will enable success of the Joint Force during competition and armed conflict. Protecting critical infrastructure, such as crucial energy, communication, and health systems, will become an increasingly important security challenge for the MDO force and supporting medical operations.

## **2-2. Impacts of the future operational environment on the Army Health System**

a. *High casualty numbers in a short period of time in armed conflict.* Russia and China rely heavily on the integration of artillery networks and numerically superior, longer-range cannon and rocket artillery systems to support layered stand-off to shape the close combat fight. U.S. maneuver forces will be faced with non-line-of-sight systems, manned and unmanned air and ground weapons systems, and advanced multifunctional mines that will potentially result in large numbers of casualties from large munitions, directed energy, and weapons of mass destruction. The FOE will require medical personnel to manage and selectively allocate resources to large fluctuations of casualties in dispersed locations over extended distances. It will also require non-medical personnel to conduct more advanced medical care than has historically occurred.

(1) Medical effects of weapons in conflict. Future threat capabilities will cause—either intentionally or unintentionally—new illnesses and injuries and will challenge current medical diagnosis and treatment capabilities. Future forces will incur casualties at an unprecedented rate, scale, and dispersion with a high degree of simultaneity. Managing mass quantities of casualties with blast and burn injuries will consume significant equipment and resources, and the incapacitating and damaging weapons effects of intense sound and light will increase hearing and eye injuries. The potential adversarial employment of CBRN will continue to require detection, identification and diagnosis, protection, treatment, and evacuation during and post incidents.

(2) Physiologic and psychological stressors. Extended exposure to lethal environments, adversarial propaganda, psychological stressors from the home front, and the implications of continuous operations will create cumulative, traumatic, and operational combat stress effects within the force. High casualty numbers will result in traumatic experiences across the depth and breadth of the battlefield.

(3) Other health threats. DNBI will create an additional, potentially greater demand for treatment capability. Continuous identification, assessment, prevention, or mitigation of DNBI is a major enabler of Soldier readiness. World regions have differences in prevalent endemic, emerging, and reemerging diseases, which are being influenced by climate change. This must be considered when planning and executing medical surveillance and biodefense activities. Occupational and environmental health (OEH) threats are present in all OEs and include food-, water-, vector-, and arthropod-borne diseases, zoonotic diseases; poisonous or toxic flora and fauna; toxic industrial chemicals and toxic industrial materials; hazardous noise; and other physical, biological, chemical, and radiological agents. Army FHP capabilities must provide near real-time prediction, detection, identification, quantification, risk assessment, and communication of OEH threats in order to inform commanders' risk decisions during military operations.

*b. Delayed evacuation and disrupted replenishment.* Long range precision fires (LRPF) and layered integrated air defense systems will limit friendly maneuver and subsequently degrade and disrupt ground and air sustainment operations. U.S. forces should not assume they can maintain domain superiority indefinitely. Delays in achieving dominance will result in delays in movement and adversely create requirements for prolonged care on the ground with unknown evacuation timelines. Operational commands will create limited windows of opportunity for enabling forces to conduct forward and rearward movements that require immediate decision authority and execution at echelon. Medical and non-medical leaders will face challenging triage decisions with unknown timelines of resolution. This execution requires situational understanding of capabilities and capacities, casualty requirements, and available resources to synchronize and optimally utilize platforms and facilities.

*c. Requirements of complex terrain and domains.*

(1) Dense urban terrain (DUT). The strategic importance of cities suggests that Army forces will conduct operations within DUT. DUT impacts the ability of units to effectively evacuate casualties from the point of injury (POI), requires added security at collection points, and limits the forward echeloning of treatment and sustainment capacity within a city to extend duration and mitigate time distance factors. Use of front line ambulance exchange points (AXPs) splits treatment and surgical capabilities, and doctrinal employment of support may not be feasible. Medical formations must be designed to support semi-independent operations for extended periods.

(2) The EMS. China and Russia possess significant EW capabilities that support communications jamming, electromagnetic deception, electronic probing, electromagnetic intrusion, and direction finding that support operational success. Medical data transmission for things such as operational virtual health (OVH) requirements and diagnostics equipment must be limited to essential information only to reduce bandwidth demands, be both synchronous and asynchronous, and minimize electronic signature footprint.

(3) Island groups. Adversaries will operate from positions of relative advantage close to shore-based networks. Littorals and inner waterways will canalize or impede maneuver throughout an AO where space between land masses is dominated by water. Army medical capabilities must be highly interoperable, possess the ability to integrate joint medical solutions, and possess the



knowledge and skill set through training to operate in austere environments, such as jungles and littorals, in providing medical support to amphibious operations.

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## **Chapter 3**

### **Military Problem and Components of the Solution**

#### **3-1. Military problem**

How does the AHS, supporting the Joint Force, provide medical capabilities that protect and sustain the operational force during competition and armed conflict, in order to support the consolidation of gains and preserve combat power?

#### **3-2. Central idea**

The central idea is that the AHS, as a component of GIHS, will support the Army and the Joint Force conducting MDO with expeditionary and interoperable medical capabilities during competition; when necessary, armed conflict, and a return to competition on favorable terms. Army medical forces employ an all-domain-capable C2 system as well as treatment and multimodal evacuation capabilities designed to rapidly stabilize and clear casualties from the battlefield, while maximizing return to duty (RTD) as far forward as possible. Medical information informs a common operational picture (COP), providing all leaders, medical and non-medical, the information they need. FHP capabilities promote, improve, or conserve the behavioral and physical well-being of the Joint Force; enable a healthy and fit force; prevent injury and illness; and protect the force from health hazards in both competition and conflict. The AHS force posture must support multi-domain formations operating semi-independently from multiple locations, globally and at home.

#### **3-3. Solution synopsis**

The AHS must (a) *empower commanders at echelon with medical aspects of C2* (b) *enable the operational forces*, (c) *provide medical support forward to enable semi-independent operations*, and (d) *optimize evacuation and maximize RTD*. These components are in line with the tenets of MDO and provide the basis for AHS operations throughout the competition continuum within the battlefield framework.

#### **3-4. Empower commanders at echelon with medical aspects of command and control**

a. *Integrated and synchronized medical plans.* The AHS is a complex system of systems that is interdependent and interrelated, requiring continuous planning, coordination, and synchronization. The AHS will *integrate and synchronize* its capabilities within the totality of joint and multinational operations.

b. *Maintain a near real-time and integrated medical common operational picture (MEDCOP) as part of the future all-domain battlespace visualization capability.*

(1) Army Medicine must be able to support Army-specific missions while operating within integrated joint and other UAP medical systems. Technical interoperability with UAP (and among the Army's own information systems) should be attained through strict adherence to a joint

common operating environment and a universal set of computing technologies and standards. The AHS MEDCOP must operate as an integrated part of the Army's future all-domain battlefield visualization capability within a unified, protected, and resilient communications network.

(2) The future all domain-capable, artificial intelligence (AI) enabled MEDCOP will rapidly receive, organize, analyze, interpret, and display contextually relevant information and generate risk-informed recommendations that comprehensively considers the use of Army and UAP capabilities. The MEDCOP will utilize common, standardized, shareable, and secure data processed within advanced information and battle management systems that is intuitive and simple to use.

(3) The Army's unified communications network is the totality of enterprise and deployed networks. In order to exercise C2 effectively within the limitations of the future unified communications network and under potentially degraded network conditions, medical personnel must differentiate between operational information requirements that feed the MEDCOP and individual patient information that aids in medical treatment. An echeloned approach to the data and information transmitted is necessary to provide relevant information while minimizing impact to operational bandwidth. The MEDCOP provides commanders at all levels a visual understanding of how medical capability is arrayed throughout the area of responsibility (AOR). The MEDCOP identifies unit locations, unit medical capability and capacity status, MEDEVAC capability and capacity status, and patient status. At a higher level, the MEDCOP informs situational understanding through wound types and DNBI rates that communicates enemy effectiveness, trend analysis, and supports enemy situational template development. Data transmissions occur only when necessary through a series of Soldier- and platform-based passive sensors to reduce electronic signature and bandwidth requirements.

(a) At the strategic level, the MEDCOP provides aggregated data with minimal delay through secure transmission windows. The consolidated information communicates forecasted intertheater aeromedical evacuation requirements, potential areas requiring realignment of medical support, and potential joint and other UAP support. This strategic COP also feeds the sustainment enterprise system with class VIII resupply estimates and requirements, informs medical risk and surveillance data, and assists in theater medical asset management.

(b) At the operational level, the MEDCOP enables medical regulating forward of the corps rear boundary, identifies medical treatment and evacuation capacities from Role 3 to the casualty collection point (CCP), availability of FHP capability, and MEDLOG status, provides objective health data for the force, and informs operational and health threat risk assessments.

(c) AI supports the MEDCOP at all echelons but is most critical at the tactical level because it most immediately affects the treatment a soldier will receive. To achieve optimization, units employ medical capabilities nonlinearly and unconstrained by operational boundaries. At the tactical level, the MEDCOP and other AI-enabled collaboration, decision-support, and casualty-management systems enable medical regulating forward of the division rear boundary and the identification of expected MEDEVAC arrival, area medical capabilities and statuses, and expected arrival of medical resupply.

(d) At the Soldier level, the MEDCOP will aid in the management of patients and improve evacuation decisions. Treatment and CBRN exposure sensors will help the combat medical specialists manage multiple patients. Combat medical specialists will activate passive patient identification and tracking sensors for attended patients at a CCP. Select critical information will feed information systems to drive MEDEVAC risk requirements (standard/unmanned, air/ground, manned/unmanned, crew cycles, and routes) to optimize patient movement. Future medics will also have access to information that will increase their level of situational understanding and identify the best possible solution for patient treatment and management of resources. In addition, the MEDCOP will continually inform the patient's unit of their location and medical condition.

*c. Align the necessary capability at the right echelon to enable rapid and risk informed decision making.* Medical C2, coordination, and synchronization capabilities must enable speed and agility to succeed in a MDO environment. Given equal access to technological tools, decision advantage will fall to the side whose decision makers are more adaptable problem solvers, who have the most access to actionable information and intelligence, and who are more empowered through decentralized authority.

(1) Throughout the competition continuum, medical command and control nodes will operate in the strategic support, operational support, and tactical support areas. The C2 structures of medical formations must have distinct and defined roles, responsibilities, and authorities that effectively manage the AHS at echelon. Future medical organizations (to include command structures at echelon) will be designed for efficient accomplishment of the health service support (HSS) mission and will eliminate redundant staffs. Both theater and operational medical command nodes must be tailorable to meet geographic combatant commander (GCC) requirements. Tactical medical command nodes focus on assigned mission execution and provide C2 to assigned units to ensure mission accomplishment. The capability and authority of each deliberate medical command node must allow rapid, decentralized decision making to support time sensitive requirements.

(2) Decision-support and information-management tools used in competition must be the same as those used in conflict. To support information requirements, all Army medical information, information management, and casualty-management systems must be integrated into and protected by the Army's future unified, secure, and resilient communication network. Leaders must utilize these systems throughout the competition continuum to track, manage, and provide medical care and fulfill requirements of tactical units. These AI-enabled decision-support tools can also recommend the most efficient MEDEVAC routes and MTF locations. Finally, these AI-enabled tools can support risk-informed command decisions by informing the emplacement of surgical and resuscitative capabilities, identifying the right mix of manned or unmanned, ground or air MEDEVAC and resupply systems, and assisting in establishing casualty accountability at the CCP.

(3) Conduct credentialing and privileging. To improve clinical practice oversight, pre-established authorities, permissions, and responsibilities of joint, HN, and other UAP health care providers is necessary to optimize use of capabilities and skills. An AI-enabled automated system will maintain credentialing and privileging documentation that assigns providers with the requisite skill sets to support requirements within Army, joint, and other UAP units.

(4) Leaders will ensure their organizations use realistic and integrated live, virtual, constructive, and gaming training. Advanced simulators add realism that enable Soldiers to learn through repetition to build and sustain their skills. Training for combat medical specialists must be consistent with the capability they are expected to possess in conflict.

### **3-5. Enable the operational forces**

#### *a. Maximize a healthy and fit force.*

(1) The holistic health and fitness system will culturally change the way the Army trains, develops, and cares for Soldiers. The AHS will strive to optimize and enhance the ability of Soldiers, leaders, and teams to remain healthy and fit despite being exposed to a multitude of health and performance threats. Maintaining the health and fighting fitness of Soldiers is a vital responsibility of all leaders. Commanders can reduce the health threat by emphasizing preventive measures. All leaders must be active in promoting the importance of personal hygiene, field sanitation, adequate rest, counseling, and the treatment of mild traumatic brain injury (TBI), as well as combat and operational stress reactions.

(a) Future cognitive solutions for Soldiers will aim to sustain continuous alertness, maximize their potential to manage a multitude of input, and optimize resilience to continuous psychological hazards.

(b) Future physical solutions will aim to increase strength, endurance, and tolerance to environmental extremes and poison and toxic exposures.

(c) Other solutions that will sustain a healthy, fit, and resilient force are nutrition and nutraceutical interventions, ergogenic aids, real-time physiological status monitoring, pharmacological interventions, psychotherapeutic interventions, individual or multimodal cognitive enhancement strategies, sleep manipulation and interventions, and real – or near real – time detection, identification, communication, and prevention of health threats.

(2) Wearable medical sensors. Wearable sensors will provide useful information on the cognitive and physical attributes of personnel when required by the unit medic and provider. During mass casualty (MASCAL) events, sensors will provide patient information informing treatment and prioritization decisions. Potential sensors will identify musculoskeletal injuries, hypoxia, dehydration, alertness and cognitive status, physical fatigue, detection of blast exposure and exposure to CBRN, and other occupational and environmental hazards. However, due to the security vulnerability of sensors, measures must be taken to ensure they are integrated into the overall network security solution.

(3) The Army requires FHP capabilities (personnel, equipment, and procedures) that reduce vulnerabilities through the real – or near real – time prediction, detection, identification, communication, prevention, and treatment of the following health threats: biological (endemic and emerging/re-emerging diseases; food-, water-, vector-, and arthropod-borne diseases, zoonotic diseases; and biological weapons), chemical (toxic industrial chemicals, chemical warfare agents, and residues from current or previous activities such as agricultural, industrial, or commercial

activities), radiation (ionizing and non-ionizing resulting from weapons, industrial operations, and use of medical devices), physical hazards (noise, heat, cold, and altitude), and physiological (musculoskeletal injuries). FHP forces conduct occupational and environmental health site assessments (OEHSA). Unit field sanitation equipment across the force (medical and non-medical alike) as a FHP measure must be modernized and training must be reinvigorated in order to prevent illness and injury as well as retain combat power. The use of unmanned aircraft systems (UAS) to collect environmental data reduces the potential impacts and effects on personnel due to exposure to unknown hazards.

(4) Synthetic biology. The AHS must leverage the advancement and research in synthetic biology conducted by the Department of Defense (DOD). The use of synthetic biology (beyond blood and blood products) has the potential to improve warfighter and weapon system survivability through advanced materials. Additionally, advances in immunology, new biological materials, and other biodefense initiatives could impact vaccine development and enhance individual Soldier resilience to harmful pathogens. Health care providers will be able to develop a better understanding of and ability to monitor Soldier microbiomes to ensure the health of Soldiers in stressful situations. Advancements in all these areas will contribute to advances in Army Medicine and, therefore, are necessary to maximize a healthy and fit force in the FOE.

b. *Biodefense*. Biodefense is a set of overarching activities federated across both the Army generating and operating forces, supported by Army Medicine to prepare, respond, and recover Army units to retain operational effectiveness. An effective health surveillance capability supports operational activities and will enable risk analysis, inform protection decisions, and guide other hazard mitigation or containment activity. A robust laboratory infrastructure will support near and far-term research and development activity and will advance biological hazard detection, identification, diagnosis, and treatment (pre & post exposure) technology.

c. *Synchronize and integrate joint and HN medical assets*.

(1) Interoperability. The AHS must employ a holistic interoperable medical strategy that integrates MEDLOG, technology, policy, guidance, planning, and development of RCs to support Army, Joint, and other UAP.

(2) AHS force projection. AHS force structure composition is modernized and tailored to each component (COMPO) (1. Active Army, 2. National Guard, 3. Army Reserve) to allocate critical capability needed to rapidly transition from competition to conflict. To improve force projection timelines, AHS forces must designate, organize, and resource essential evacuation, treatment, surgical, hospitalization, and FHP force structure in COMPOs 2 and 3 for rapid deployment to support theater forces.

(3) Forward medical presence. The forward presence of AHS assets in multiple theaters during competition shapes the strategic and international environment and serves as an impetus to modernize and revalidate the AHS's forward capabilities. The responsibilities and authorities of forward presence AHS assets include outlining strategies to procure, store, distribute, and/or maintain forward MEDLOG class VIII A and class VIII B capabilities (such as Army prepositioned stock) necessary to support force projection and sustainment of operational forces

during joint reception, staging, onward movement, and integration (JRSOI) and establishing medical operations. This includes the utilization of forward OCONUS research and development laboratories and facilities and integration of lab services in the overall logistics support plan. Medical personnel within the AHS will work closely with allied partners to develop and validate agreements and gain access to commercial capabilities. This may include medical facilities, manpower, and transportation assets in order to create additional capacity without increasing permanent forward presence while adding surge capability (CONUS and OCONUS) to support rotational units during strategic exercises and time-phased force and deployment data activation. Similarly, Army medical personnel will work closely with Army service component commands (ASCCs) and GCCs to determine the best allocation (right types and right numbers) and pre-positioning of AHS forces in theater during competition to remain balanced with theater requirements.

(4) Use of operational contract support. The ASCC will use operational contract support to procure AHS capability and capacity required to deliver medical functions and services while minimizing permanent forward presence requirements to unencumber forward presence forces of theater opening activities and to allow the GCC to employ AHS units immediately required during transition from competition to conflict.

### **3-6. Provide medical support forward to enable semi-independent operations**

*a. Align capabilities that directly and routinely impact the warfighter survival forward of the corps.*

(1) Distribution of medical functions within the operational framework. While all medical capabilities are force multipliers, during MDO medical personnel must prioritize different medical functions during different periods. For example, during competition, the priority may be FHP (operational public health) to prevent illness and injury, while during armed conflict the priority may shift to HSS (treat/hospitalize, evacuate).

(2) Operational contract support will be used to augment functional capabilities particularly during competition. Operational contract support may be leveraged, for example, to support the medical tasks inherent with supporting JRSOI.

(3) Robust telemedicine, telemaintenance, electronic health care, or other communication platforms may augment functions that increase the delivery of health care in the operational area and extend operational reach. Telemedicine systems will allow for provider consultation and treatment that otherwise would have required further evacuation. Likewise, improvements in small lightweight diagnostic imaging systems in tactical-level facilities will enable early diagnosis and intervention reducing unnecessary evacuation. Telemaintenance capabilities will provide the ability to repair diagnostic systems and other medical devices far forward with a reduced logistical footprint.

(4) During MDO there may be times when medical units will not have access to the communications network for reach-back using OVH. Medical providers will still be required to provide patient care that is potentially beyond their scope of training. Clinical decision-support

devices that will not require network access will assist in diagnosis and treatment decisions. These clinical decision-support systems (CDSS) will provide the foundational platform. CDSSs are computer systems designed to impact clinician decision making about individual patients at the point in time that these decisions are made. Such systems leverage data collected at the POI (physiological, video, and audio) as inputs into AI-enabled decision-support system that can offer actionable guidance for monitoring, diagnosing, triaging, and treating an injured Soldier. In this way, CDSSs could operate much like an OVH solution for care at the point of need, providing automated support, predictive demand analysis, and expertise to the medic or Soldier.

(5) Distribution of Enlisted Corps (Medical) personnel within the operational framework and medical training for non-medical personnel. While the battlefield will remain nonlinear and contested in all domains, the area of greatest lethality will remain in the tactical to deep maneuver area. Maneuver units require experienced and technically competent Enlisted Corps (Medical) personnel who are retained within tactical units to support the number and severity of expected casualties in conflict with a peer/near-peer adversary. Positioning the experienced Enlisted Corps (Medical) personnel with the requisite knowledge and training to perform a wider range of operational public health tasks and medical life-saving skills at locations of injury and collection points will increase survivability far forward. The current paradigm of positioning the most junior and inexperienced Enlisted Corps (Medical) personnel far forward within the deep maneuver area operating with minimal oversight will significantly degrade delivery of required medical care. Additionally, increased treatment may be provided at the POI accomplished through Tactical Combat Casualty Care (TCCC) training of non-medical military occupational specialty (MOS) personnel.

(6) To decrease risk, robotic advanced trauma life support capabilities maintained in the joint security area can be pushed forward when necessary and provide care within the tactical support area.

*b. Decrease sustainment demand.* The Army requires reduced dependencies on external support for replenishment of large volume consumables and other classes of supply to optimize mobility and achieve greater self-sufficiency, operational reach, and endurance when contested in all domains.

(1) AHS capabilities, particularly forward of the corps rear boundary, must be modernized (medical equipment and materiel sets) to reduce their sustainment demand, including weight, cube, power, water, required transportation, and required movement support. Reduction of sustainment demand can derive from new technologies as well as changes to medical tactics, techniques, and procedures.

(2) AHS capabilities from the SSA to deep maneuver area must maximize use of leap-ahead technology<sup>7</sup> that will provide reliable energy with reduced logistical burdens and risks, reducing the fuel consumed by generators and leveraging the amount of fuel available for the forward supply chain. Innovative use of technology to include temporary sheltering, isolated temperature control, and smart power will significantly reduce AHS consumption rates and demand on sustainment capabilities.



(3) Demand forecasting. Demand forecasting throughout the competition continuum will involve the AHS, Army sustainment, and Defense Logistics Agency (DLA) working in concert to leverage historical data, after action reports, and commercial off-the-shelf databases that utilize actual medical treatment data and AI to proactively identify, plan, and implement MEDLOG requirements and key readiness class VIII A during initial phases of crisis and transition to conflict. These tools will be augmented by consumption reporting capabilities throughout armed conflict and the return to competition.

(4) Consumption reporting. Class VIII expenditures, blood consumption, MASCAL situations, and prolonged care are captured through identification and reporting of injuries and illnesses through the Army's future unified, secure, and resilient communications network and an automated database of usage data for similar injuries and illnesses.

*c. Simplify class VIII replenishment.*

(1) The AHS will establish a joint force capable, seamless, integrated, end-to-end MEDLOG system. MEDLOG requirements will be supported through a layered, agile, and responsive process from the strategic support area (SSA) to the deep maneuver area. Precision logistics requires formations to implement practices that significantly improve the reordering process, and reduce waste, demand and distribution requirements. Medical replenishment requirements and consumption rates will be available on real-time common operational pictures (COP) such as MEDCOP, joint/multinational logistics COP and command post computing environment (CPCE). MEDLOG requirements will integrate into medical and sustainment enterprise information management systems that enable commanders to make rapid decisions at echelon.

(2) The MEDLOG system will integrate medical and medically related logistics information required to provide life-cycle management of medical products and services. The MEDLOG system will deliver integrated medical logistics capabilities (medical supplies and equipment management, equipment maintenance, blood, medical gasses, optical, medical facilities, and contracting) in support of Army and Joint operational medical forces (non-deployed, forward-based, and/or deployed) when required or designated.

(3) Medical equipment set, veterinary equipment set, dental equipment set, medical materiel set replenishment as well as emergency re-supply for class VIII must be automated (semi-autonomous or decision support reordering process) and supported by modular packaging that is operationally configured to support the end user. Automatic and retail exchange for depleted sets occurs after significant events, or in high operational tempo (OPTEMPO) operations when line item ordering is unfeasible. Whole set replenishment will be pushed from wholesale when required.

*d. Employ lighter, smaller, and modernized equipment.*

(1) All COMPO 1, 2, and 3 medical units will have some medical formations equipped with lighter, smaller, and more capable diagnostic and treatment equipment variants that can support patient care during delayed evacuation and decrease sustainment demand during semi-

independent operations. Technology improvements in digital imagery, sterilization, oxygen generation, blood storage, and blood products will enable significant advances in forward care while decreasing lift requirements, maintenance, and sustainment support.

(2) Future medical devices will fill multiple roles and utilize new technology, such as advanced manufacturing, to decrease medical equipment size and weight, system-processing time, and reduce casualty treatment wait times. Single devices performing multiple functions; innovative sterilization methods using faster cycle times, lower heat and lower temperatures; hand-held digital imagery devices; and high volume, low weight oxygen generation are necessary to support anticipated patient flow and reduce sustainment demand.

### **3-7. Optimize evacuation and maximize return to duty**

*a. Optimize patient evacuation capacity and capability.* Periods of limited MEDEVAC requiring medical care for prolonged periods will challenge the AHS in the FOE. The AHS must maximize available evacuation resources to alleviate and prevent prolonged care emergent requirements by:

(1) Prolonged care. Battlefield casualties contribute to the reduction of combat power, maneuverability, and morale. In armed conflict, the AHS must rapidly evacuate casualties to the appropriate MTF as soon as possible to enable freedom of maneuver and improve the survivability of the wounded. Evacuating the large number of casualties expected to occur across the depth and breadth of the battlefield in the FOE will heavily challenge AHS evacuation assets. Moreover, as the Army attempts to visualize and describe characteristics of armed conflict in the FOE, it predicts that portions of the battlefield could become inaccessible for short periods of time, thereby delaying evacuation. During these periods of inaccessibility, AHS planners envision the use of prolonged care to sustain life until evacuation is possible. During these periods of prolonged care, the evacuation requirement increases as patient numbers increase and overall patient health deteriorates over time (e.g., PRIORITY patients deteriorate to URGENT). Therefore, the Army requires a synchronized and responsive MEDEVAC system (ground, sea, and air) that is capable of rapidly clearing the battlefield casualties, providing en route care that ensures the highest possible survivability rates, and effectively unencumbering maneuver elements to enable freedom of maneuver.

(2) Prioritize efficiency and RTD. In order to clear the battlefield and control resources effectively, evacuated patients will follow one of two evacuation paths: those who will and those who will not RTD (RTD vs. theater evacuation). Patient severity will drive the evacuation path to minimize the impact on resources consumed forward of the corps. MEDEVAC with telemedicine patient monitoring technology integrated into a MEDCOP will allow for medical C2 and patient regulating that will deliberately place patients into a treatment path that either expedites their evacuation to definitive care or maximizes capabilities and resources to return them to duty.

(3) The future MEDEVAC system will employ ground and air ambulance assets with greater mobility, speed, modularity, and en route care capabilities (medical equipment and medical provider skill sets). These capabilities are essential to effectively evacuate and maintain proximity

with the maneuver element they support, or the population at risk they support within a given geographic area.

(a) Future ground ambulance platforms will provide en route care capabilities and operate throughout the continuum of care, starting at the POI. The ground ambulance will be responsible for moving the pre-hospital injured patient as well as a patient who has recently undergone damage control surgery (DCS) (surgical interventions for those critically injured patients who cannot be transported over long distances). This will require the future ground ambulances to be reconfigurable to meet the units' mission(s) and accommodate for the treatment space required for access to the post-surgical patient by the combat medical specialists and other advanced medical providers to provide the appropriate en route care. Future ground ambulances will have improved speed, extended unrefueled operating range, improved stability (for en route care), and survivability (to include CBRN contamination survivability) as compared to current ground ambulance platforms.

(b) Future air ambulances will derive from the Army Future Vertical Lift (FVL) program and deliver vastly improved aeromedical evacuation capabilities. Enduring fleet aircraft (i.e., HH/UH-60M/V) are expected to remain in the force beyond the fielding of FVL. However, Future Long Range Assault Aircraft (FLRAA) air ambulances will provide significantly increased speed, payload, extended unrefueled range, and improved stability and survivability. As such, FLRAA MEDEVAC will provide greater geographic coverage; faster response times as well as near all-weather capability. In addition, supervised autonomous operational capabilities will increase aircrew efficiency, performance and safety, while reducing pilot workloads, and planning and execution timelines.

(c) Adaptive systems to meet mission requirements. The AHS requires procedural systems, training, and capabilities to execute ship-to-shore and shore-to-ship evacuation during periods when aeromedical evacuation may be interdicted or otherwise unavailable. In predominantly over-water OEs, the AHS requires over-the-shore MEDEVAC capabilities to bridge ship-to-shore and shore-to-ship movement. Army watercraft (brown water vessels) will need to be configurable to support evacuation and en route care for inter-island evacuation over distances normally supported by ground ambulances.

(d) En route care. Increased combat tempo and evacuation distances, two likely characteristics of armed conflict in the FOE, will increase the requirement for en route care aboard evacuation platforms. Future ground and air ambulances, as well as casualty evacuation (CASEVAC) platforms, will need to be designed and/or configurable to enable the provision of en route care and must be medically staffed and equipped to provide critical life-saving interventions, when necessary. Ground ambulances may be crewed with combat medical specialists as well as continued staffing of air ambulances with critical care flight paramedics. Augmenting CASEVAC with medical providers or, at a minimum, personnel trained in TCCC is essential to patient survival.

(e) Robotic and autonomous systems (RAS) within the MEDEVAC system will augment the assigned medical provider to provide care, monitor, and provide treatment decision-support. Medical RAS will be used as a force multiplier decreasing the cognitive and physical workload of the provider, which increases the amount of patients treated and the level of treatment

performed. There will be a need for future use of medical closed-loop systems with supportive AI that will assist with triage and potentially casualty extraction and CASEVAC support capabilities. RAS evacuation capabilities could augment standard platforms and increase overall capacity. Additionally, RAS can significantly improve the AHS capability to evacuate casualties from lethal areas following a CBRN event. Autonomous or semi-autonomous capabilities, like leader-follower technology (technology that links vehicles), may increase single-lift capacity and extend range and reach without increasing personnel. Commanders will have to make necessary risk decisions to place patients in unmanned and non-standard evacuation platforms.

(5) MEDEVAC request and response. The future MEDEVAC system must include streamlined procedures for the transmittal and receipt of 9-line MEDEVAC requests to intelligently task air and ground MEDEVAC platforms. Requests will be routed directly to the appropriate echelons and MEDEVAC C2 authorities without delay. The future MEDCOP and AI-enabled casualty-management systems will facilitate more efficient and expedient tasking, risk assessment and approval, and launching of evacuation assets. Additionally, the integration of the MEDCOP and medical decision-support and casualty-management systems into the future communications network are critical to facilitate the necessary coordination, synchronization, and tracking of evacuation assets across boundaries and echelons at the speeds required for MDO. Future evacuation platforms will incorporate the same MEDCOP technologies to improve crew capabilities and reduce workload while facilitating successful mission accomplishment.

(6) Improved CASEVAC capabilities. During peak periods of demand, evacuations will occur through CASEVAC means to augment MEDEVAC capability based on expected casualty rates, dispersion of forces, and windows of domain dominance. MEDEVAC may need to be reserved for the most severely ill and injured. CASEVAC will be an asset to support initial movement of casualties to a CCP or AXP and support the movement of RTD patients. Patient movement items to support designated non-standard platforms are necessary to extend reach and required support and must be prepared to accommodate the transport of contaminated casualties. Commanders at all levels must incorporate CASEVAC into all planning and training. Elements designated or dedicated to conduct CASEVAC will be included in the MEDCOP to support the overall evacuation mission. Increasing combat lifesaver and TCCC training for non-medical personnel will increase survivability when medical personnel or MEDEVAC are not immediately available.

*b. Employ treatment capabilities to return Soldiers to duty as far forward as possible.*

(1) Given the austerity of the environment, lethality of the threat, anticipation of the operational tempo, unit dispersion, and expected casualty streams, medical units will be designed and equipped with the essential functions to deliver necessary treatment far forward, near, and on the POI commensurate to the constraints of the environment (including extreme weather conditions):

(a) The operations and organization of Role 2 medical capabilities may not change; however, augmentation (FHP or surgical capabilities), prioritization of OVH and telemaintenance capabilities, and expanded training (i.e., basic veterinary treatment tasks) of assigned personnel will enable Role 2 capabilities to enable faster RTD rates and in larger numbers.

(b) Division hospitalization. Division hospitalization delivers far forward resuscitative surgery capability with minimal ancillary services. There is no definitive care or convalescent and rehabilitative capability. Telemedicine and telemaintenance capabilities will provide additional ancillary consult to providers and personnel.

(c) Corps hospitalization. Corps hospitalization will reconstitute forward capabilities when necessary and have sufficient treatment and rehabilitation care capabilities to enable far forward convalescence with the goal of returning Soldiers to duty **within 5-7 days**.

(d) Theater hospitalization. Theater hospitalization will support in-theater treatment, rehabilitative care, and convalescence to return Soldiers to duty within a potentially expanded theater evacuation policy.

(2) The fundamental principle of triage will not change. In a constrained environment of supplies, personnel, and capabilities, depleting efforts to save one patient versus multiple patients is not always ideal. Providers will have to use their best judgment to provide the greatest good to the greatest number of casualties and will require realistic training utilizing all triage categories.

### **3-8. Contributions to multi-domain operations**

a. *Competition*. In competition, the AHS employs a medical C2 node with the requisite capabilities required to maintain an enduring presence, set the theater, build partnership capacity, and sustain forward presence forces. In collaboration with UAP, the AHS conducts activities that enable a healthy and fit force while simultaneously executing global health engagements to support security force assistance and security cooperation activities that will optimize opportunities for building partner capacity and HN partner medical capabilities. Leaders within the AHS must clearly delineate roles and responsibilities among Office of the Surgeon General (OTSG), U.S. Army Medical Command (USAMEDCOM), U.S. Army Materiel Command (USAMC), DHA, and the ASCC and define what functionalities they will support if forces transition to conflict. Within the SSA, the AHS must generate medical forces capable of deploying in scale, within deployment timelines, for ample duration, and with sufficient mobility to support forces regionally. The Army has dependencies on commercial, government, and national strategic capabilities (DHA, USAMEDCOM, U.S. Army Public Health Center, Armed Forces Health Surveillance Division, NDMS, CONUS VA and HN facilities) that are key to ensuring a medically ready force. However, the potential divestiture of strategic medical capabilities and the ability to integrate and synchronize the delivery of U.S. medical strategic capabilities or enablers will impact the theater Army and corps during armed conflict. These dependencies enable a network of critical skill providers, joint integration, availability of expanded capabilities and capacities, and strategic FHP capabilities.

(1) Strategic messaging. AHS capability and capacity is a force multiplier that enables the combatant commander to create favorable conditions and project a positive image of U.S. forces. The employment of AHS services during competition has significant potential for lasting strategic impact. Combatant commanders must leverage opportunities for the AHS to support international medical organizations during competition and to support humanitarian assistance efforts to aid in projecting this positive image. Combatant commanders must carefully consider AHS capability

and capacity to ensure effective application of formations to support efforts. Leaders must clearly understand this role within the overall strategic engagement as well as communicate AHS effectiveness and resilience.

(2) Modified Table of Organization and Equipment (MTOE) assigned personnel (MAP). During the transition to conflict, Army MAP serving in DHA facilities and other DOD facilities (to include but not limited to, Army military research institutes) will assume their positions in their assigned medical units. Adequate coordination in competition is necessary to synchronize the rapid transition of MAP between DHA, USAMEDCOM, the ASCC, and a theater-level medical command node to mitigate potential gaps in theater hospitalization support. Supported ASCCs must clearly understand what capabilities the DHA and USAMEDCOM will continue to provide during conflict.

b. *Contributions to armed conflict.* Army medical operations employ layered, agile, mobile, and responsive formations and expeditionary treatment and dedicated multimodal evacuation capabilities designed to rapidly stabilize and clear casualties from the battlefield while maximizing RTD as far forward as possible to enable cross-domain maneuver and maintain combat power. Units are equipped with FHP capabilities to detect, identify, and communicate health threats and eliminate or reduce exposure and are also equipped with the HSS capabilities to treat casualties. Medical units organize to support calibrated forces operating semi-independently in multiple locations while minimizing impact to sustainment. CONUS-based, fixed MTFs are key enablers to forces conducting MDO and provide not only strategic reach back for resources (personnel) but also extend the patient care continuum (definitive care) for patients who cannot be RTD by projecting capability forward with telemetry, telehealth, and robotic surgical capabilities.

c. *Contributions to return to competition.* During the return to competition, the Army serves as a supporting element, expanding access to the range of medical functions. It is critical that any medical effort is appropriate and consistent with available statutory authorities. Essential support provided by the Army to the civilian population as forces conduct consolidation of gains is directed by the overall lead federal agency and leading implementing agency. The consolidation of gains is an integral part of armed conflict. This will produce positions of long-term advantage and is essential in retaining the initiative in competition and for achieving long-term deterrence. After armed conflict and a return to competition, there will be significant need for recovery and reset of Soldiers and forces beyond basic casualty management and treatment (including in the psychological domain). Medical personnel within the AHS will ensure optimal rehabilitation and treatment for those who have returned from deployment, which includes individuals whose skills, experience, and knowledge are critical to maintaining high-training levels for future operations. Medical forces will reinforce and integrate other medical efforts to maintain or reestablish a safe and secure environment and to provide essential governmental services, emergency infrastructure reconstruction, and humanitarian relief to prevent or mitigate further instability in fragile and conflict-affected states.

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## Chapter 4 Conclusion

The medical concept significantly changes how the AHS operates. In order to support MDO, Army Medicine must fundamentally change how it mans, trains, organizes, and equips formations to

provide the greatest good and ultimately conserve the fighting strength. As the Army becomes more expeditionary, regionally aligned, and globally responsive, the AHS must adapt to support MDO in sufficient scale, for ample duration, and with UAPs in order to achieve Joint Force objectives.



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## **Appendix B**

### **Required Capabilities**

#### **B-1. Introduction**

This appendix reflects RCs necessary to conduct operations as described in this concept. RCs identify and focus capability development within the campaign of learning and in collaboration with the warfighting function and domain leads.

#### **B-2. Medical required capabilities**

a. Integrity of intent. The following capability statements are not stand-alone; they must be understood based upon this concept and not individual interpretation. These capabilities are interrelated, and potential doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy solutions may simultaneously fulfill more than one RC.

b. The below RCs are based on the broad ideas from the MDO Concepts, proponent analytical work, lessons learned from the last decade of conflict, and this concept. Each RC is followed by a citation that refers to amplifying data within this concept. In order for the AHS to support the Army and the Joint Force conducting MDO the following capabilities are required:

(1) Army medical forces require the ability to tailor C2 formation mission sets in support of GCC theater requirements and/or configure medical C2 formations conducting operations in support of operational forces [Medical Concept: 3-4.c.(2)].

(2) Army medical forces require the ability to assess and align with UAP military and civilian health systems supporting the delivery of health care in the AO to optimize the health care delivery continuum and improve patient outcomes [Medical Concept: 3-4.b.(1), 3-5.c.(4), 3-8.a.(1)].

(3) Army medical forces require the capability to rapidly conduct OEHSAs, data collection, and surveillance (remotely or otherwise) to inform decision making while minimizing risk to Soldiers in the competition continuum to prevent illness and injury to the Joint Force enabling operational force freedom of maneuver and action [Medical Concept: 3-5.a.(3); Protection Concept: 3-5.g.].

(4) Army medical forces require the ability to provide real-time patient status as well as evacuation and treatment decision-support in order to maintain shared understanding and situational understanding (operational information and patient data) and to enhance the AHS's ability to provide medical C2, improve patient outcomes to enable freedom of maneuver, action, and keep the patient's unit informed of the patient's location and status [Medical Concept: 3-4.b.(3)(a-c)].

(5) Army medical forces require the ability to enable freedom of action, extend operational reach, prolong endurance, and support Title 10 and ASOS requirements and regeneration in order to enable freedom of maneuver and action for the Army and Joint Forces operating in the FOE

[Medical Concept: 3-5.c.(3), 3-6.d.(1-2), 3-7.a.(3).c.; Sustainment Concept: 3-3(a), 3-4(a); Aviation Concept: B-2.b].

(6) Army medical forces require the ability to treat and care for Soldiers, leaders, and teams with enhanced cognitive, physical, and emotional capabilities with minimal impact to those enhancements in order to sustain individual or collective continuous alertness, maximize their potential to manage a multitude of input, and enhance resilience to continuous psychological and physical hazards during competition and armed conflict [Medical Concept: 3-5.a.(1)(a-c), Maximize Human Potential: Logic Chart].

(7) Army medical forces require an AI-enabled capability to maintain credentialing and privileging documentation that assigns providers with the requisite skill sets to support requirements within Army, joint, and UAP units in order to improve clinical practice oversight, pre-established authorities, permissions, and responsibilities of joint, UAP, and HN health care providers in both competition and armed conflict [Medical Concept: 3-4.c.(4)].

(8) Army medical forces require the ability to coordinate for strategic and national-level (reach-back) resources, such as medical personnel and strategic medical stocks, and to synchronize with the NDMS to enable freedom of maneuver and action [Medical Concept: 3-5.c.(1-5), 3-8.a-b.].

(9) The AHS requires the capability to reduce vulnerabilities to biological threats, either biological weapons (intentionally or unintentionally released) or infectious diseases (endemic, reemerging, or emerging/novel), through the ability to rapidly assess, protect, understand, and mitigate these and other CBRN and biodefense threats without severe impact to operational tempo, to respond to the illness while supporting operations, and to formulate a plan to integrate and employ all of the Army's response capability to counter the disease and protect or extend medical capacity to enable freedom of maneuver and action (Medical Concept: 3-5.b.).

(10) Army medical forces require the competencies of global health engagement policies and procedures and the personnel with knowledge, skills, and abilities for performing tasks related to global health engagement (Medical Concept: 3-8.a).

(11) Army medical forces require the ability to evacuate casualties and conduct medical resupply to transport casualties and execute medical resupply across extended distances and unsecure lines of communication at echelon in order to provide medical capability and capacity during forward-care scenarios to enable freedom of maneuver action and to clear the battlefield of casualties [Medical Concept: 3-7.a.(3).e.].

(12) Army medical forces require the ability to conduct health surveillance and health risk communication to anticipate, predict, identify, prevent, and control of diseases, illnesses, injuries due to exposure to OEH threats (in all environments), including nonbattle injury threats, combat operational stress, and to mitigate other threats to the health and readiness of military personnel and units in order to preserve combat power and unencumber the warfighter to enable freedom of maneuver and action [Medical Concept: 3-5.a.(3); Protection Concept: 3-5.g.].

(13) Army medical forces require the capability to synchronize and intelligently task ground and air ambulances to optimize and enable the evacuation of patients across multiple domains (including shore-to-ship) and operational boundaries to clear the battlefield of casualties, improve patient survivability and RTD rates, and enable operational freedom of maneuver and action [Medical Concept: 3-7.a.(5); Aviation Concept: B-2.b].

(14) Army medical forces require the ability to be expeditionary, provide agility and flexibility, and possess the same level of mobility of units or forces operating in the tactical and operational support areas the AHS is supporting with equivalent communication resources (to forces supported) to enable freedom of maneuver and action [Medical Concept: 3-6.d.(1), 3-7.a.(3), 3-8.a.; Sustainment Concept: 3-4(b)11, B-2(13)].

(15) Army medical forces require the ability to conduct point of need production (of medical devices, equipment, and parts) during dispersed and expeditionary operations in order to conduct continuous operations and reduce the logistics burden in support of the Army's expeditionary, dispersed forces conducting MDO [Medical Concept: 3-6.d.(2); Sustainment Concept: 3-4(b)7].

(16) Army medical forces require the capability and capacity to treat wounded, ill, and injured Service members through variations of hospitalization that can expand and contract to meet requirements (including extreme weather conditions and survivability from CBRN contamination) from the tactical, operational, and SSAs to maximize RTD and clear the battlefield of casualties to enable operational force freedom of maneuver and action [Medical Concept: 3-7.b.(1)(b-d)].

(17) The AHS requires increased speed, range, and en route care capability of its air ambulance fleet (FVL) to enable aeromedical evacuation support to dispersed forces over extended LOCs in armed conflict to enable freedom of maneuver and action and improve the survivability of the sick and wounded, evacuate URGENT and URGENT-SURG casualties directly to appropriate MTF, and extend the operational reach and enable freedom of maneuver and action of ground force commanders at echelon [Medical Concept: 3-7.a.(3)(b); Aviation Concept: 3-3.3.d.(4)].

## **Appendix C**

### **Science and Technology**

#### **C-1. Introduction**

a. The purpose of this appendix is to align AHS RCs to current and emerging scientific research. Investing in scientific research and technology, which will result in future material solutions, will be critical to conserving the fighting strength of an MDO-capable force by 2028. The technologies described in this appendix are intended to mitigate critical gaps derived from the examination of the RCs regarding the ability to empower commanders at echelon with medical aspects of C2, enable the operational forces, provide medical support forward to enable semi-independent operations, and optimize evacuation and maximize RTD. This appendix is not intended to provide an exhaustive or prioritized list of science and technology (S&T) investments but instead provide exemplars of efforts that meet the intent of the supporting concept and medical RCs. The AHS can improve capability and capacity through AI-enabled evacuation and treatment decision-support (e.g., biomarkers to detect illness/toxic exposures or identify and prevent injuries, data mining of public health trends, or robotic medical treatment). The AHS must leverage S&T to improve casualty accountability (e.g., biometric or DNA systems to track casualties) and to expand evacuation and resupply capacities (e.g., leader-follower, littoral evacuation vessels, autonomous systems, or auto resupply). The AHS must increase treatment capacity from the deep maneuver through the operational support area (e.g., drones to collect vector sampling, biological and chemical surveillance, or robotic medical treatment capabilities).

b. Acquiring these capabilities requires targeted research and investment, comprehensive experimentation, and continuous reassessment within medical and non-medical scientific fields that will contribute to the development of the required technologies. To achieve this, the AHS must work with the Army modernization enterprise, experts in academia, joint and coalition partners, industry leaders, and other key stakeholders to develop the requisite capabilities.

#### **C-2. Empower commanders at echelon with medical aspects of command and control**

a. *MEDCOP*. Operational and tactical medical units will need CPs that are scalable, modular, Soldier-operated and maintained, deployable, mobile, and survivable. These CPs must enable leaders to understand, visualize, describe, direct, lead, and assess across the full range of military operations. New technologies that improve the connectivity, survivability, durability, and speed of these CPs and their communications network to give medical leaders full understanding of the OE are essential.

(1) The communications network on which medical operates in the FOE must be planned, engineered, installed, operated, and defended to ensure availability.

(2) Automated, analytic, decision tools must be developed that enable a medical leader to collect, analyze, and quickly act on data gathered from the OE. AI and machine learning can be used to conduct continuous and automated monitoring of the OE and develop an accurate MEDCOP to create shared situational understanding and enable rapid decision making by commanders and staffs.



(3) A capability must be developed that enables the integration of risk modeling and mitigation for MDO/disaster response across a range of medical capabilities. This capability must be carefully integrated into the Army's future unified communications network.

(4) Wearable sensors or similar technology will enable leaders to see down to the individual casualty level. Feeding individual casualty data directly from the source into the medical network will improve the MEDCOP across multiple fronts: casualty accountability, patient regulation and movement, and automatic population of electronic health information and medical records.

b. *Medical recordkeeping.* The AHS will require an electronic medical record that is cloud-based and accessible across all echelons of care, capturing treatment data from the POI through rehabilitation at CONUS VA hospitals. This will enable seamless documentation and continuity of care through the continuum of a patient's medical treatment course.

(1) Technologies must be developed that allow the deployed medical record to accept data inputs from numerous sources to include data gathered from individual wearable sensors or non-medical sensor systems that collect contextual data at the unit or vehicle level, scanned hardcopy documentation, or verbal input.

(2) This cloud-based technology must be developed with the ability to incorporate the care of non-U.S. personnel being treated at a deployed location or within U.S. MTFs.

(3) The medical record must be capable of operating in low bandwidth or non-communication environments and capable of operating as a stand-alone application or web-enabled of store-and-forward (information sent to an intermediate station until a later time when it is sent to the final destination).

(4) In addition to the technical capabilities described above, this cloud-based record must be able to interface with multiple systems. This capability must support operational medical analysis, forecasting, surveillance, and biodefense reporting, and interface with VA electronic health records, COMPO 2 and COMPO 3 websites and DOD enterprise data repositories.

### **C-3. Enable the operational forces**

a. *DNBI.* DNBI will remain a significant threat to the readiness of the force in both competition and armed conflict. In the FOE, threats from extreme environmental conditions and demanding OE will play a prominent role. During conflict, behavioral and mental health considerations will be paramount due to the complex, high intensity nature of operations. The force will require technologies that enable detection, understanding, rapid assessment, and analysis of these threats.

(1) The AHS requires further means to understand, assess, prevent and protect against, and mitigate the threat from industrial and agricultural chemicals, toxins, and poisons that may be released on the battlefield, either intentionally or unintentionally.

(2) The AHS requires the development of novel detection and diagnostic devices for endemic and emerging infectious diseases in order to provide rapid medical intelligence (awareness of emerging infectious disease threats and disease outbreaks) to commanders. Technologies that leverage AI or machine learning can assist commanders and medical leaders in understanding the OE by recognizing disease threats early to inform prudent decision making.

(3) The AHS requires the development of novel, safe, and effective, broad-spectrum preventive measures for infectious disease threats with low-logistical burden and high levels of end user acceptability and ease of use.

(4) The AHS requires improvements in auto-injectors offering broad-spectrum protection, flexible route of administration, and lower dosing requirements which are used by self/buddy aid to counter chemical warfare threats to preserve life prior to casualty presenting to medical care. Further research into prophylactic medical countermeasures (MCMs) designed to prevent severe morbidity and mortality upon exposure to nerve agents by unprotected personnel are also required.

b. *Employment of novel systems.* The FOE will likely see the employment of novel systems, such as directed energy, that may cause new patterns of injury not previously seen. The force requires a better understanding of these threats and their effects in order to appropriately plan the medical response.

(1) The AHS requires a better understanding of the effects of directed energy and other novel weapons systems (when combined with injuries caused by conventional weapons systems and munitions) on the human body and associated injury patterns in order to inform the development of preventive measures, diagnostic techniques, and treatment options.

(2) The AHS requires improved treatment of and countermeasures against toxic chemical and biological threats, radiological hazards and bio-engineered threats to include an understanding of how injuries from these agents interact with or magnify tissue damage from concurrent injuries acquired by conventional munitions.

#### **C-4. Provide medical support forward to enable semi-independent operations**

a. *Streamlined, adaptive, and predictive MEDLOG support.* Operations in contested, degraded, or denied environments require streamlined, adaptive, and predictive MEDLOG capabilities that improve the forward movement of class VIII A and class VIII B as far forward as the POI. The AHS must be able to sustain high operational tempo and semi-independent operations while concurrently providing area support throughout the continuum of care. The FOE requires the AHS in coordination with sustainment to employ resilient and alternate capabilities to move, see, and communicate class VIII A and class VIII B resupply. The replacement of whole blood is currently the most important life-saving intervention on the battlefield and will likely remain so during MDO in the FOE, but the provision of blood requires a large sustainment tail.

(1) Technologies that enable autonomous class VIII A and class VIII B supply and CASEVAC are essential and will increase the ability to provide medical sustainment far forward while decreasing risk to the force.

(2) The AHS requires development of advanced manufacturing capabilities for producing medical instruments and class VIII A. This would enable point of need production of medical instruments, devices, medical repair parts, and pharmaceuticals. This capability will have to be employed at echelons that have the greatest need and greatest demand, with the appropriate resources to fulfill production requirements.

(3) Development of synthetic blood products with prolonged shelf life and no refrigeration requirements would eliminate the cold-chain requirements for blood support and greatly improve the capacity and speed of blood delivery across the battlefield. Until that technology is available, development of novel methods to extend the shelf life of human and canine blood and blood products at room temperature are essential to decrease the cold-chain requirements for delivering blood in the interim. Methods to improve the blood donor supply by mitigating the risk of infection and transfusion reactions are likewise essential. The development of pharmaceutical and other measures to mitigate the effect of tissue damage caused by hemorrhage induced hypoxia could allow decreased reliance of blood support overall.

b. *Smaller, lighter, and more mobile technology.* The future medical force requires new technologies to become smaller, lighter, and more mobile in order to enable freedom of maneuver. Power generation, diagnostic imaging systems, surgical instrument sterilization, and oxygen generation are mission essential, but technological advances are critical to reduce the size and weight and increase mobility.

(1) Development of new technologies for sterilization of surgical and other equipment with minimal logistic footprint is required. Sterilization is an essential component of surgical capability, but it comes at a high cost in terms of logistics and is often the rate-limiting step in the capacity of a surgical unit. Technologies that shrink the size of sterilization equipment and speed up the process while maintaining effectiveness will be essential in the FOE.

(2) Development of new technologies for medical-grade oxygen generation with minimal logistic footprint is required. Similarly, further medical research to determine the appropriate level of supplemental oxygenation for combat casualties is necessary to ensure the right amount of oxygen is generated on the battlefield.

(3) The AHS requires development of new technologies for diagnostic imaging capability with minimal logistic and power footprint. New developments that shrink the size of current diagnostic imaging systems (X-ray, ultrasound, or computed tomography (CT)) will enable medical units to become more mobile and use less power. Novel technologies for medical imaging that eliminate the need for CT scanners at hospital units would benefit those units, not just in mobility and power requirements, but also by eliminating the need for radiation shielding required by this imaging modality.

(4) The AHS requires development of advanced, power-generation solutions for medical units. Advanced power solutions encompass the energy required for training, moving, and sustaining medical forces and platforms for medical operations to include energy used by tactical power systems, generators, and platforms. Alternative fuels can decrease demand for fossil fuels and provide the future force with improved endurance and greater, self-sustaining capability.

Alternative fuels can also extend unit endurance and further reduce the logistical footprint associated with fuel storage and distribution requirements. Alternative power solutions include propulsion systems, vehicle electrification technologies, and power management and battery power technologies that significantly reduce or eliminate fossil fuel dependency and provide future medical forces with improved endurance and greater, self-sustaining capability. These technologies must possess improved maintenance reliability and reduce acoustical, electronic, and heat recognition. These technologies need to be distributive, regenerative, and standardized across platforms and systems. Alternative power can reduce supply lines, extend operational reach, and provide increased efficiency and management of power generation and distribution along with increased redundancy and reliability of available power sources.

(5) Leap-ahead technology for alternative solutions to generate water for patient care will be required. Alternative sources of water enable inpatients to conduct personal hygiene and enables medical personnel to conduct personal hygiene prior to providing patient care. This reduces distribution requirements through improved water generation and purification, and it reuses capabilities in an MDO environment. Advanced water generation technologies are deployable down to Role 1 and can produce potable water from multiple sources to include brackish water and saltwater. These technologies can extend unit endurance, reduce transportation and storage requirements for bulk water from the Role 1 to the Role 3, and provide more self-sufficient, redundant, and reliable sources of water. In addition to providing improved water support for medical treatment, the logistics footprint associated with centralized water production and distribution is reduced.

(6) Similarly, technologies that would allow production, distillation, and sanitation of medical grade fluids (such as fluids for intravenous administration) far forward would significantly decrease the medical footprint and logistic demands of medical units, in particular hospital units.

*c. Remote medical care and medical procedures.* During MDO, medics and other care providers will often be working independently and far from support. Specialty care, and in some cases even medical oversight, will not be readily and physically available. Technologies that enable the medic to operate independently are essential.

(1) The AHS requires development of novel technologies such as AI-enabled devices that enable medics or non-medical personnel at echelon to provide medical care or first aid without direct provider supervision.

(2) Advances in OVH technology that can provide remote specialty support far forward in contested environments are essential to improve both capacity and capability of the combat medical specialists and combat lifesaver far forward.

(3) The AHS requires development of novel medications, technologies, or devices that can be applied or administered by medics or non-surgical providers and provide life-saving interventions to stabilize a head, neck, junctional, or truncal injury in the event that surgical care is delayed.

(4) The AHS requires new technologies and techniques that enable mental health resilience for medics and providers operating in extreme or contested environments as well as technologies that allow treatment and rapid RTD for medics and providers suffering from the psychologic injury of operating in those environments.

### **C-5. Optimize evacuation and maximize return to duty**

a. *Technologies and platforms for evacuation.* In a contested environment, units must be able to take advantage of opportunities to evacuate casualties when they occur. These opportunities may be fleeting and will require rapid decision making in order to maximize benefit. Additionally, these situations may require the use of new transportation technologies or the use of CASEVAC platforms.

(1) Development of AI-enabled decision tools for patient movement in order to inform triage, evacuation, and disposition decisions will be essential in the FOE. Medical leaders may encounter large numbers of casualties requiring evacuation and current methods to determine triage and prioritize evacuation decisions will not be sufficient. AI could assist leaders with appropriately analyzing large amounts of data and make rapid decisions regarding the effective use of evacuation assets.

(2) As the Army develops new technologies such as FVL, autonomous transport systems, and similar transportation platforms, the AHS will require understanding of how these platforms can support en route medical care, medical devices, and casualty status, especially when operating in extreme environmental conditions or moving highly infectious patients.

b. *Prolonged care and patient hold.* In the contested FOE, MEDEVAC of casualties may be delayed, resulting in medical personnel at echelon having to care for patients longer than accustomed to in previous conflicts since 2001. This will likely lead to medical sequelae not normally encountered in the current operating environment. New technologies and knowledge are needed to train medical personnel to provide this extended care.

(1) The AHS requires development of new measures to predict the risk of sepsis in injured Service members, detect sepsis in its early stages or before its development, and treat appropriately at echelon. This will require further understanding of the pathophysiology of early sepsis to include identification of sepsis associated biomarkers and biologic signals.

(2) Further understanding of the pathophysiology of organ dysfunction caused by tissue or ischemia is needed to inform development of measures that predict the risk of organ dysfunction in injured Service members, detect organ dysfunction in its early stages or before its development, and treat it appropriately at echelon.

(3) New capabilities are needed to treat wounded tissue; prevent, delay, or treat infection; and mitigate tissue damage from wounds at echelon when evacuation is delayed and surgical care is not immediately available.

(4) The AHS requires novel methods of burn wound assessment and treatment that can be utilized near POI, have limited logistical footprint, and do not require specialized training or equipment to administer.

(5) The ability to provide initial DCS, timely evacuation, and complex post-operative critical care remains an integral aspect of effectively clearing the battlefield for the most severely injured casualties. Technologies to enhance the control of non-compressible hemorrhage and treat severe or penetrating TBI remain essential, along with those that extend the allowable time to surgical care.

c. *RTD*. During MDO in the FOE, Army forces may not have freedom of maneuver to allow evacuation and rapid replacement of evacuated Soldiers. Returning an ill, injured, or wounded Soldier to duty as far forward as possible will be essential to conserve combat power. The Army needs further research into diseases that may be amenable to increased RTD rates such as mild TBI, mild or moderate burn injury, mental health disorders, or directed energy injuries.

(1) Improved or new means to diagnose, treat, and prevent these injuries as far forward as possible will be essential along with further understanding of these injuries to better inform evacuation and disposition decisions. This requires further research into the pathophysiology of brain injury (to include unconventionally acquired brain injury) to better understand the nature of the injury, the relationship between injury severity and level of exposure to trauma, and the cumulative impact of repeat injuries over time.

(2) The AHS needs improved devices or other methods to prevent TBI or to mitigate its effect in all OEs.

(3) The AHS requires novel methods to treat burn injury at echelon that allow a Soldier to remain with his or her unit or rapidly RTD.

(4) The AHS requires development of effective pain medications or other measures to alleviate pain that do not have a negative effect on a Soldier's performance, cognitive ability, or alertness, that have an acceptable safety profile, that have minimal to no habit forming potential, and that do not require monitoring by medical personnel. This will be essential in returning Soldiers to duty or allowing a Soldier to perform duties after injury.

(5) The FOE will likely result in higher rates of acute stress reaction and post-traumatic stress disorder (PTSD) than prior conflicts. The AHS needs novel methods to prevent or treat these conditions as far forward as possible.

(6) The AHS needs further understanding of the biological-effects of directed energy weapons in order to develop appropriate treatment guidelines that allow safe but rapid RTD as far forward as possible.

(7) The AHS requires development of novel technologies that mitigate the effect of musculoskeletal injury (from both battle and nonbattle injury) on Soldier performance, allow the

Soldier to remain with the unit while receiving care, or return the Soldier to duty as rapidly as possible if evacuated.

**C-6. Conclusion**

The descriptions of the scientific research, technology and development efforts in this appendix support the required AHS MDO capabilities necessary for 2028 and beyond. The solutions are focused on providing extensive improvements to Soldier lethality, FVL, AI-enabled networking systems for Soldier sensors and medical C2. Critical areas for future advancement include, but are not limited to, synthesized blood technologies and novel methods of diagnosing, treating, and managing infections and musculoskeletal injuries as well as TBI and PTSD. Achieving these capabilities will require targeted investment, extensive research and experimentation, and continuous collaboration with academic experts, joint partners, key stakeholders, and industry leaders. Without these significant investments, the AHS will lack the capabilities required to conserve the fighting strength of future Army forces conducting MDO.

## **Appendix D**

### **Dependencies**

#### **D-1. Introduction**

This appendix identifies the dependencies on other functions required to perform the capabilities identified in this concept. The AHS depends on the development of these capabilities to support the realization of the ideas contained within this concept.

#### **D-2. Sustainment**

a. The AHS depends on sustainment to support the rapid deployment of medical capabilities from multiple locations into austere, complex environments while minimizing the need for robust JRSOI operations (Medical Concept: RC #14).

b. The AHS depends on sustainment for modernization and for adding to and reconfiguring of pre-positioned stocks (ashore and afloat) that are dispersed for survivability and operationally configured in unit sets for rapid deployment with alignment to calibrated force posture. During windows of opportunity, the AHS will require all available, appropriate, sustainment platforms for movement of medical stock. In order to support the Army's mission, the AHS requires the sustainment capability and capacity to support distributed and dispersed operations down to the POI for extended periods with an objective of achieving seven days of supply. Initially roles of care will carry three to five days of supply. The division sustainment support battalion (DSSB) or a supporting brigade support battalion (BSB) with support from sustainment formations external to the DSSB or supporting BSB is required to enable semi-independent operations and extend endurance beyond three days (Medical Concept: RC #8).

c. The AHS depends on sustainment for multimodal distribution of class VIII A and class VIII B in all domains with manned and unmanned systems for delivery to all echelons to sustain medical operations. The DSSB with a supporting logistics task force has the responsibility to coordinate resupply and can conduct throughput down to the POI. MTFs require logistic resupply or replenishment using manned and unmanned ground and/or aerial platforms. Coordinated CASEVAC and MEDEVAC will be conducted at Roles 1 through 3 and higher medical facilities (Medical Concept: RC #5, 11, 13, 14).

d. The AHS depends on sustainment to incorporate advanced manufacturing procedures at the point of need. Advanced manufacturing, including all required associated materials, provides the necessary capability to 3D-print medically relevant items of equipment, supplies, or medication (Medical Concept: RC #15).

e. The AHS depends on sustainment for maintenance of dedicated MEDEVAC and CASEVAC platforms (to include ground and air ambulances) and power generation equipment. Sustainment also provisions the fuel and non-class VIII items necessary (i.e., semi-permanent facility construction) for AHS elements to sustain combat support operations (Medical Concept: RC #5).

f. The AHS depends on sustainment to provide uninterrupted access to and local generation and distribution of power between Soldiers and platforms, while operating dispersed when



conducting semi-independent operations at a tempo the enemy is unable to match (Medical Concept: RC #5).

### **D-3. Protection**

a. The AHS at echelon depends on protection support to protect and secure all medical platforms and facilities (permanent or temporary) commensurate with their supported echelon to include providing CBRN contamination survivability capabilities (collective protection) for medical treatment facilities prior to deployment, detecting and mitigating threats (e.g., CBRN) as well as conduct the decontamination of patients exposed to CBRN agents prior to their admission into MTFs. This enables the AHS at echelon to sustain MDO and accomplish continuous operations to conserve the fighting strength of the Army's expeditionary, dispersed forces and the tenants prescribed in the MDO (Medical Concept: RC #9, 16).

b. The AHS has a dual dependency on protection and cyber in employing procedures for rapidly identifying, operating during, and recovering from significant cyberspace and electromagnetic attacks. The AHS depends on protection and cyber to monitor and protect the integrity of medical information using cyberspace operations to provide reliable, redundant, sustainment enterprise information with accurate reporting and visibility for medical units operating semi-independently in order to enable shared understanding and forecasting of sustainment related AHS activities from the tactical to the strategic levels (Medical Concept: RC #1-4, 5, 7).

c. The AHS at echelon requires the protection of patient movement item nodes, ground and air evacuation routes or flight paths, AXPs, MEDLOG sites, MTFs (temporary and permanent) locations, and sites associated with medical HN support in order to provide medical treatment and evacuation to clear the battlefield of casualties and maximize RTD and to enable corps, division, and BCT freedom of maneuver and action (Medical Concept: RC #9, 16).

### **D-4. Aviation**

a. The AHS depends on aviation to conduct the rotary-wing aeromedical evacuation mission. MEDEVAC is a function of the AHS; however, Army aviation exercises C2 of aeromedical evacuation (Medical Concept: RC #13, 14, 17).

b. MEDEVAC and CASEVAC in MDO will require close coordination between Army Aviation and the AHS to ensure an integrated air-ground evacuation scheme that effectively supports operations by enabling freedom of maneuver and action and provides timely patient movement and en route care that enhances survivability and reduces long term disability (Medical Concept: RC #13, 14).

c. The AHS depends upon aviation for UAS and airspace management, training, and/or personnel to support AHS UAS operations (Medical Concept: RC #11, 13).

## **D-5. Command and Control**

a. The AHS depends on C2 to enable AHS at echelon to employ and integrate into a secure and robust intelligence architecture (network), encompassing sensors, platforms and organizations, that is scalable and that enables timely processing, exploitation, and dissemination with shared analytics, distributed analysis, and collaboration tools in conditions of limited bandwidth and network outages to support commanders' situational understanding in all OEs. The AHS depends upon network bandwidth to support unique needs of OVH for remote monitoring and robotic surgery, and it may also require added frequency allocation or bandwidth for wearable sensors. (Medical Concept: RC #2, 4, 7).

b. The AHS depends on C2 for the ability to task organize to the lowest practical level with capabilities that enable semi-independent operations, minimizing the need for enablers from higher echelons of command (Medical Concept: RC #1, 2, 4).

c. The AHS depends on C2 to employ networks that are robust and self-healing, providing access and information at the point of need for dispersed and distributed formations and UAPs. The AHS requires external support to maintain extended communications across the depth and breadth of the theater, corps, and division AO (Medical Concept: RC #2, 3, 7, 9).

## **D-6. Maneuver**

a. Maneuver formations conduct offensive, defensive, or security operations to enable medical capabilities to conduct casualty accountability and medical regulation of patients across the competition continuum. During armed conflict, maneuver formations disrupt and deny the enemy's ability to sense, detect, and target medical capabilities in the deep maneuver, close, and tactical support areas (Medical Concept: RC #4, 11, 17).

b. Maneuver formations also provide security for organic, assigned, and attached medical assets that exceed unit capabilities enabling health care during prolonged delays in evacuation (Medical Concept: RC #16, 17).

## **D-7. Army special operations forces**

a. The AHS depends on ARSOF special operations combat medics (68WW1 MOS), special forces medical sergeants (18D MOS), and special operations civil affairs medical sergeants (38BW4 MOS) in Army special operations and special missions units to deliver a select level of medical care normally provided by health care providers. Special operations medics provide POI and point of need care, forward resuscitation, and prolonged care capabilities (Medical Concept: RC #6).

b. ARSOF medics at echelon plan for medical considerations, such as MEDEVAC or CASEVAC, prolonged care, MEDLOG, and challenges of medical care in austere and contested areas within the deep fires area (Medical Concept: RC #4, 9, 11, 15).

**D-8. Intelligence**

a. The AHS depends on intelligence to determine the enemy's capabilities for anticipating battlefield illnesses and injuries (Medical Concept: RC #9, 12).

b. The AHS depends on intelligence to identify secure locations to provide treatment to the Joint Force and secure evacuation routes to clear casualties from the battlefield (Medical Concept: RC #4, 13, 16, 17).

## **Glossary**

### **Section I Abbreviations**

ADP	Army doctrine publication
AFC	Army Futures Command
AHS	Army Health System
AI	artificial intelligence
AO	area of operations
AOR	area of responsibility
ARSOF	Army special operations forces
ASCC	Army Service component command
ASOS	Army support to other Services
AXP	ambulance exchange point
BCT	brigade combat team
BSB	brigade support battalion
C2	command and control
CASEVAC	casualty evacuation
CBRN	chemical, biological, radiological, and nuclear
CCP	casualty collection point
CDSS	clinical decision-support systems
COMPO	component
CONUS	continental United States
COP	common operational picture
COSC	combat and operational stress control
CP	command post
CPCE	command post computing environment
CT	computed tomography
DCS	damage control surgery
DHA	Defense Health Agency
DNBI	disease and nonbattle injury
DOD	Department of Defense
DSSB	division sustainment support battalion
DUT	dense urban terrain
EMS	electromagnetic spectrum
EW	electronic warfare
FHP	force health protection
FM	field manual
FOE	future operational environment
FVL	future vertical lift
GCC	geographic combatant commander
GIHS	globally integrated health system/services
HN	host nation
HSS	health service support
JCIC	joint concept for integrated campaigning

JP	joint publication
JRSOI	joint reception, staging, onward movement, and integration
LRPF	long-range precision fires
MAP	MTOE assigned personnel
MASCAL	mass casualty
MCM	medical counter measures
MDO	multi-domain operations
MEDCOP	medical common operational picture
MEDEVAC	medical evacuation
MEDLOG	medical logistics
MOS	military occupation specialty
MTF	medical treatment facility
MTOE	modified table of organization and equipment
NDMS	national disaster medical system
OCONUS	outside the continental United States
OE	operational environment
OEH	occupational and environmental health
OEHSA	occupational and environmental health site assessment
OPTEMPO	operational tempo
OTSG	Office of the Surgeon General
OVH	operational virtual health
Pam	pamphlet
POI	point of injury
PTSD	post-traumatic stress disorder
RAS	robotic and autonomous systems
RC	required capabilities
RTD	return to duty
S&T	science and technology
SSA	strategic support area
TBI	traumatic brain injury
TCCC	tactical combat casualty care
TRADOC	United States Army Training and Doctrine Command
UAP	unified action partners
UAS	unmanned aircraft systems
USAMC	United States Army Materiel Command
USAMEDCOM	United States Army Medical Command
VA	Veterans Affairs

## Section II

### Terms

#### **aeromedical evacuation**

The movement of patients under medical supervision to and between MTFs by air transportation. Also called AE. (JP 4-02)

**ambulance exchange point**

A location where a patient is transferred from one ambulance to another en route to a MTF. Also called AXP. (ATP 4-02.2)

**armed conflict**

When the use of violence is the primary means by which an actor seeks to satisfy its interests. (JCIC)

**Army Health System**

A component of the Military Health System that is responsible for operational management of the HSS and FHP missions for training, pre-deployment, deployment, and post deployment operations. The AHS includes all mission support services performed, provided, or arranged by the Army Medicine to support HSS and FHP mission requirements for the Army and as directed, for joint, intergovernmental agencies, coalition, and multinational forces. (FM 4-02)

**authority, direction, and control\***

The responsibility and accountability for the execution of day-to-day administration, management and operations of MTFs via direct from the services. (DHA-AI 1025.01)

**battlefield\***

The area where military operations are conducted to achieve military goals consisting of all domains (air, land, maritime, space, and cyberspace), the EMS, and the information environment (including human cognitive aspects). It includes factors and conditions that must be understood to successfully apply combat power, protect the force, or complete the mission including enemy and friendly armed forces, infrastructure, weather, and terrain within the operational areas and areas of interest. (TRADOC Pam 525-3-1)

**biodefense\***

Actions to counter biological threats, reduce risks, and prepare for, respond to, and recover from bio-incidents. (National Biodefense Strategy)

**casualty**

Any person who is lost to the organization by having been declared dead, duty status—whereabouts unknown, missing, ill, or injured. (JP 4-02)

**casualty collection point**

A location that may or may not be staffed, where casualties are assembled for evacuation to a MTF. (ATP 4-02.2)

**casualty evacuation**

The movement of casualties aboard non-medical vehicles or aircraft without en route medical care. (FM 4-02)

**class VIII A and class VIII B**

Includes medical materiel (Class VIIIA), medical equipment maintenance and repair, patient movement items, medical gases, blood (Class VIIIB) storage and distribution, regulated medical waste (including hazardous material). (FM 4-02)

**competition\***

The condition when two or more actors in the international system have incompatible interests but neither seeks to escalate to open conflict in pursuit of those interests. While violence is not the adversary's primary instrument in competition, challenges may include a range of violent instruments including conventional forces with uncertain attribution to the state sponsor. (JCIC)

**continuity of care**

Attempt to maintain the role of care during movement at least equal to the role of care at the preceding facility. (FM 4-02)

**cross-domain maneuver\***

The synchronization and employment of forces and capabilities through movement in combination with converged lethal and nonlethal capabilities across multiple domains, the EMS, and the IE. Cross-domain maneuver creates synergistic effects in the physical, temporal, virtual, and cognitive realms that increase relative combat power and provide the overmatch necessary to destroy or defeat enemy forces, control land areas and resources, and protect populations. (AFC Pam 71-20-2)

**deep maneuver area\***

The area where maneuver forces can go (beyond the Close Area) but is so contested that maneuver still requires significant allocation and convergence of multi-domain capabilities. (TRADOC Pam 525-3-1)

**definitive care**

Care or treatment which returns an ill or injured Soldier achieving maximum medical improvement. (FM 4-02)

**dense urban terrain\***

Areas characterized by extraordinarily closely-packed manmade infrastructure and high population density, potentially including concentrations of high-rise buildings, subterranean features, and densely packed slums. (TRADOC Pam 525-3-1)

**disease and nonbattle injury**

All illnesses and injuries not resulting from enemy or terrorist action or caused by conflict. Also called DNBI. (JP 4-02)

**dis-integrate\***

Break the coherence of the enemy's system by destroying or disrupting its subcomponents (such as C2 means, intelligence collection, critical nodes, etc.) degrading its ability to conduct operations while leading to a rapid collapse of the enemy's capabilities or will to fight. (TRADOC Pam 525-3-1)

**domain\***

An area of activity within the OE (land, air, maritime, space, and cyberspace) in which operations are organized and conducted. (TRADOC Pam 525-3-1)

**en route care**

The care required to maintain the phased treatment initiated prior to evacuation and the sustainment of the patient's medical condition during evacuation. (ATP 4-02.2)

**force health protection**

(Joint) Measures to promote, improve, or conserve the behavioral and physical well-being of Service members to enable a healthy and fit force prevent injury and illness, and protect the force from health hazards. Also called FHP. (JP 4-02) (Army) FHP are measures that promote, improve, or conserve the behavioral and physical well-being of Soldiers comprised of preventive and treatment aspects of medical functions that include: COSC, dental services, veterinary services, operational public health, and laboratory services. Enabling a healthy and fit force, prevent injury and illness, and protect the force from health hazards. (FM 4-02)

**forward resuscitative surgery**

Urgent initial surgery required to render a patient transportable for further evacuation to a MTF staffed and equipped to provide for the patient's care. (FM 4-02)

**health service support**

(Joint) All services performed, provided, or arranged to promote, improve, conserve, or restore the mental or physical wellbeing of personnel. Also called HSS. (JP 4-02) (Army) HSS is support and services performed, provided, and arranged by the Army Medicine to promote, improve, conserve, or restore the behavioral and physical well-being of personnel by providing direct patient care that include medical treatment (organic and area support) and hospitalization, MEDEVAC to include medical regulating, and MEDLOG to include blood management. (FM 4-02)

**hyperactive\***

More active than usual or desirable; hyper-competitive during competition and hyper-violent in armed conflict. (TRADOC Pam 525-3-1)

**intelligent tasking**

The coordinating process that incorporates operational, clinical, and regulating considerations into comprehensive guidance for the real-time management of patient movement activities (DODI 6000.11)

**leap-ahead technology\***

Something completely unusual, and would provide tremendous leverage of the U.S. military forces against any adversary. (See endnote 7)

**mass casualty**

Any number of human casualties produced across a period of time that exceeds available medical support capabilities. (JP 4-02)



**medical evacuation**

The timely and effective movement of the wounded, injured, or ill to and between MTFs on dedicated and properly marked medical platforms with en route care provided by medical personnel. Also called MEDEVAC. (ATP 4-02.2)

**medical regulating**

The actions and coordination necessary to arrange for the movement of patients through the roles of care and to match patients with a MTF that has the necessary HSS capabilities, and available bed space. (JP 4-02)

**medical treatment facility**

(DOD) A facility established for the purpose of furnishing medical and/or dental care to eligible individuals. (JP 4-02) (Army) MTF refers to any facility established for the purpose of providing medical treatment. This includes battalion aid stations, Role 2 facilities, dispensaries, clinics, and hospitals. (FM 4-02)

**multi-domain formations\***

Army organizations possessing the combination of capacity, capability, and endurance necessary to operate across multiple domains in contested spaces against a near-peer adversary. (TRADOC Pam 525-3-1)

**multi-domain operations\***

Operations conducted across multiple domains and contested spaces to overcome an adversary's (or enemy's) strengths by presenting them with several operational and/or tactical dilemmas through the combined application of calibrated force posture; employment of multi-domain formations; and convergence of capabilities across domains, environments, and functions in time and spaces to achieve operational and tactical objectives. (TRADOC Pam 525-3-1)

**near-peer adversaries\***

Those nation states with the intent, capabilities, and capacity to contest U.S. interests globally in most or all domains, the EMS, and the information environment. (TRADOC Pam 525-3-1)

**operational support area\***

The AOR from which most of the air and maritime capabilities derive their source of power, control, and sustainment as well as where ground forces enter theater, organize, and prepare for rapid onward movement and integration. (TRADOC Pam 525-3-1)

**patient**

A sick, injured or wounded Soldier who receives medical care or treatment from medically trained personnel. (FM 4-02)

**patient movement**

The act of moving a sick, injured, wounded, or other person to obtain medical and/or dental treatment. (ATP 4-02.2)

**peer adversaries\***

Those nation states with the intent, capabilities, and capacity to contest U.S. interests globally in most or all domains, the EMS, and the information environment. (AFC Pam 71-20-1)

**precision logistics\***

The art of delivering support forward utilizing a combination of sensor-driven predictive analysis, condition-based maintenance at the point of need, and robotic autonomous delivery combined with the beneficial results of demand reduction to enable multi-domain formations to present a credible deterrence during competition, to transition to armed conflict with speed and agility, and to execute MDO in depth, including resupply of formations conducting independent maneuver to extend time and reach of protracted operations. (TRADOC Pam 525-3-1)

**resilience\***

(1) The ability for Army formations and systems at all echelons to operate in contested spaces against a capable adversary. (2) The ability of people, households, communities, countries, and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability and facilitates inclusive growth. (TRADOC Pam 525-3-1). Also, the mental, physical, emotional, and behavioral ability to face and cope with adversity, adapt to change, recover, learn, and grow from setbacks. (AR 350-53)

**returned to duty**

A patient disposition which, after medical evaluation and treatment when necessary, returns a Soldier for duty in his unit. (FM 4-02)

**roles of medical care**

The characterization of health support for the distribution of medical resources and capabilities. a. Role 1. Provides medical treatment, initial trauma care, and forward resuscitation, not including surgical care. Also known as unit-level medical care. b. Role 2. Provides medical treatment, advanced trauma management, emergency surgery, and resuscitative care. c. Role 3. Provides emergency and specialty surgery, intensive care, medical specialty care, and extended holding capacity and capability augmented by robust ancillary support. d. Role 4. Provides the full range of preventive, acute, restorative, curative, rehabilitative, and convalescent care found in U.S. base hospitals and robust overseas facilities. (JP 4-02)

**stand-off\***

The physical, cognitive, and informational separation that enables freedom of action in any, some, or all domains, the EMS, and information environment to achieve strategic and/or operational objectives before an adversary can adequately respond. It is achieved with both political and military capabilities. (TRADOC Pam 525-3-1)

**strategic support area\***

The area of cross-combatant command coordination, strategic sea and air lines of communications, and the homeland. (TRADOC Pam 525-3-1)

**tactical support area\***

The area that directly enables decisive tactical operations in the close area and extension of capabilities into the deep maneuver and deep fires areas. (TRADOC Pam 525-3-1)

**telemaintenance\***

Medical telemaintenance and consultation provides biomedical equipment specialists the capability to contact medical device subject matter experts outside the AO using existing military internet, phone, video, satellite and radio communication systems in support of LSCO. (MTTS CONOP)

**theater evacuation policy**

A command decision indicating the length in days of the maximum period of non-effectiveness that patients may be held within the command for treatment, and the medical determination of patients that cannot be RTD status within the period prescribed requiring evacuation by the first available means, provided the travel involved will not aggravate their disabilities or medical condition. (ATP 4-02.2)

**triage**

The process of sorting casualties based on need for treatment, evacuation, and available resources. (FM 4-02)

**unified action**

A comprehensive approach that focuses on coordination and cooperation of the US military and other inter-organizational participants toward common objectives, even if the participants are not necessarily part of the same command or organization. (JP 3-0)

\*Proposed definition.

## Endnotes

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<sup>1</sup> Central Idea, TRADOC Pam 525-3-1, *The U.S. Army in Multi-Domain Operations 2028*, 06 December 2018, pg. vii.

<sup>2</sup> Protection as described in ADP 3-37, *Protection*, 31 July 2019, pg. 1-1.

<sup>3</sup> FHP as described in FM 4-02, *Army Health System*, 17 November 2020, pg. 1-4.

<sup>4</sup> Operational reach as described in ADP 4-0, *Sustainment*, 31 July 2019, pg. 3-4.

<sup>5</sup> TRADOC Pam 525-3-1, *The U.S. Army in Multi-Domain Operations 2028*, 06 December 2018, pg. 6.

<sup>6</sup> TRADOC Pam 525-92, *The Operational Environment and the Changing Character of Warfare*, 07 October 2019, pg. 11.

<sup>7</sup> U.S. Congress Senate, Subcommittee on Emerging Threats and Capabilities, Committee on Armed Services, “*Leap Ahead Technologies and Transformation Initiatives Within the Defense Science and Technology Program*”, 107<sup>th</sup> Cong., 1<sup>st</sup> sess., 2009, S. Rep 107-340, pdf 78-260, <https://bookstore.gpo.gov>.