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## Initial Capabilities Document (ICD) for Combat Casualty Care (C3) Support for Future Operations

5 January 2021

Version 1.0

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This document contains pre-decisional information for deliberative use during the C3 Capabilities-Based Assessment sponsored by OASD(HA). As such, the information in this report is exempt from public disclosure in accordance with Title 5 USC § 552(b) (5) (Freedom of Information Act Exemption (b) (5)).

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THE JOINT STAFF  
WASHINGTON, DC 20318-9999

JROCM 060-21  
26 August 2021

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Initial Capability Document for Combat Casualty Care for Future Operations

1. The Joint Capabilities Board (JCB) reviewed and approved the Initial Capability Document (ICD) for Combat Casualty Care for Future Operations. The J8 Gatekeeper, in concurrence with the Logistics Force Capability Board (FCB), assigned the ICD for Combat Casualty Care for Future Operations the Joint Staffing Designator of "JROC Interest". The JCB requests the Director of Research and Development Policy & Oversight, OASD (HA) as the lead component.
2. The Combat Casualty Care for Future Operations ICD documents the capability requirements, shortfalls, and recommended materiel solution approaches to improve the Joint Force's ability to conduct combat casualty care. The primary gap addressed in the ICD is that the DoD lacks sufficient ability to effectively optimize the readiness and health of the Joint Force.
3. The JCB requests that the Director of Research and Development Policy & Oversight, OASD(HA) provide a semi-annual update to the Health Services WG and an annual update to the Logistics Functional Capabilities Board regarding the status of addressing the research solutions outlined in the ICD.

A handwritten signature in blue ink, appearing to read "R. A. Boxall", is positioned above the typed name.

R. A. BOXALL  
VADM, USN  
Chair, Joint Capabilities Board

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## Summary of Changes

### Revision History

Draft Version	Date	Purpose	Person Entering Change
0.1	5 January 2021	Initial KM/DS Draft	
0.2	31 March 2021	Post - KM/DS Draft Review and Revisions	Joshua Elliott for CDR Travis Polk, Director, CCCRP
0.3	25 May 2021	Post – FCB Staffing Review and Revisions	Joshua Elliott for CDR Travis Polk, Director, CCCRP

### Record of Changes

Paragraph	Page	Change Description

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## Executive Summary

The Office of the Assistant Secretary of Defense for Health Affairs developed this Initial Capabilities Document (ICD) to propose research and development (R&D) efforts to develop solutions to improve the Joint Force's ability to conduct combat casualty care (C3). This ICD complements, but does not replace, the 2015 Joint Requirements Oversight Council Memorandum 026-15, *ICD for C3 Devices and Products*. The primary focus of this ICD is C3 support for future operations, especially prolonged care.

Analysis identified several high-level shortfalls, including:

- The Joint Force has limited capability and capacity to provide sustained damage control surgery and resuscitative care throughout the continuum of care.
- The Joint Force lacks surgical capabilities at point of injury and in prolonged care.
- The Joint Force lacks sufficient pain management and medical intervention approaches that allow for preservation of combat effectiveness.
- The Joint Force lacks the ability to assess, monitor, and enhance C3 provider performance and effectiveness.
- The Joint Force lacks the capability to provide sufficient blood products to far-forward areas during future operations.
- The Joint Force lacks the capability and capacity to provide sufficient wounded, ill, and injured warfighter evacuation in future operating scenarios across land and maritime domains.

This ICD identifies materiel areas of focus to support effective C3 in future operating spaces defined by large-scale combat operations, extended evacuation timelines, prolonged care, and austere environments. Some of the high-level R&D recommendations include:

- Conduct research on ways to reduce the Class VIII(B) burden on tactical organizations (e.g., shelf-stable blood substitute) in a prolonged or austere environment.
- Develop solutions for treatment of neurosensory and other unique/complex organ system injuries resulting from conventional; chemical, biological, radiological, and nuclear; and emerging weapons systems.
- Develop non-surgical solutions to provide support to specific organ systems (e.g., renal, respiratory, cardiac, and digestive).
- Develop solutions to provide pain management under prolonged care and prolonged evacuation timelines in the presence or absence of care providers.
- Conduct research to understand why, how, and when C3 care providers' performance changes to develop solutions to predict, detect, and mitigate performance degradation.

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1. Operational Context. The Office of the Assistant Secretary of Defense for Health Affairs (OASD[HA]) developed this Initial Capabilities Document (ICD) to document capability requirements, shortfalls, and recommended materiel solution approaches to improve the Joint Force's (JF) ability to conduct combat casualty care (C3).

a. Background. The JF must provide effective C3 to maximize the combat effectiveness and survivability of warfighters in all operational environments. The future battlespace will be characterized by: dispersed and multi-domain operations; austere environments; contested communications; emerging weaponry that may result in high volumes of wounded, ill, and injured (WII) warfighters and/or new injury patterns; and anti-access/area denial that will delay WII warfighter movement. The JF must have the ability to mitigate the impact of injuries and rapidly adapt or develop new C3 capabilities to preserve operational power, regardless of the environment. To support these requirements, the Department of Defense (DoD) must assess and prioritize research and development (R&D) efforts to account for the medical burden, namely prolonged care (PC), of combat operations with limited medical resources and delayed or unavailable WII warfighter movement.

In recognition of the significant challenges associated with executing C3 in the projected future operating environment, the Deputy Assistant Secretary of Defense for Health Readiness Policy & Oversight directed the conduct of a C3 CBA to identify a full suite of recommendations to mitigate the impact of WII warfighters on the combat effectiveness of the JF. Additional solution approaches resulting from the C3 CBA can be found in the corresponding Joint Doctrine, Organization, Training, materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTmLPF-P) Change Recommendations (DCR) and ICD: *Joint DCR for Autonomous Care and Evacuation (ACE) Support of C3*, *Joint DCR for C3 Support for Future Operations*, and *ICD for ACE Support of C3*. The C3 CBA and follow-on requirements documents complement, but do not replace, the 2015 Joint Requirements Oversight Council Memorandum (JROCM) 026-15, *ICD for C3 Devices and Products*.

## b. Strategic Guidance

(1) National Security Strategy (NSS), 2017. To meet future military requirements, the *NSS* calls for restoration of the ability to produce innovative capabilities and readiness for major war. This includes the preservation of combat power through the ability to deliver quality health care in all future combat environments and operations. As such, the medical community must continue to be innovative and develop programs that meet future military requirements.

(2) National Defense Strategy (NDS), 2018. The *NDS* provides guidance for competing, deterring, and winning in a security environment marked by long-term strategic competition, rapid technology dispersion, and new concepts of warfare and competition that span the spectrum of conflict. This future operating environment poses challenges to current C3 activities, including providing care and holding capabilities at or near point of injury (POI) for longer periods of time than in recent conflicts. DoD must continue to improve C3 capabilities to maximize force capabilities, restore combat effectiveness, and improve warfighter performance.

(3) National Military Strategy (NMS), 2018. The *NMS* provides the JF a framework for protecting and advancing U.S. national interests, including the notion of joint combined arms. The JF and its leaders must be as comfortable fighting in space or cyberspace as

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they are in land, sea, or air. To achieve success across all domains and environments, the JF must be medically ready to operate anywhere, any time, and against any force or type of attack.

(4) Department of Defense Directive (DoDD) 6200.04, *Force Health Protection (FHP)*, 2007. This DoDD establishes policy and assigns responsibility for implementing FHP measures, encompassing the full spectrum of missions, responsibilities, and actions of DoD Components in establishing, sustaining, restoring, and improving the health of their forces. To prevent injury and illness, Military Departments should employ flexible, adaptive, modular, scalable, and interchangeable medical capabilities, logistics systems, and information management to ensure a medically ready force and a ready medical force.

(5) Department of Defense Instruction (DoDI) 6000.18, *Medical Modeling and Simulation (MM&S) Requirements Management*, 2018. This DoDI outlines the roles and responsibilities to form and maintain a DoD MM&S capability that supports planning, decision-making, and education and training programs across DoD. It establishes that medical technologies and knowledge products must be advanced through research, development, testing, and evaluation to enhance MM&S capabilities.

(6) DoDI 1322.24, *Medical Readiness Training (MRT)*, 2018. This DoDI states that all Service members will receive role-based (i.e., all Service members, Combat Lifesaver, Combat Medic/Corpsmen, Aerospace Medicine Technician, and Combat Paramedic/Provider) tactical combat casualty care (TCCC) training and certification as outlined in the Joint Trauma System's TCCC Skills List. All DoD expeditionary civilian personnel will conduct initial TCCC training and certification prior to deployment. DoD expeditionary civilian personnel certify in TCCC when they successfully complete the appropriate role-based TCCC training course in accordance with their skill level. Certification in TCCC requires use of the current, standardized curricula developed by the Joint Trauma System in accordance with DoDI 6040.47, *Joint Trauma System*. TCCC training will replace the core trauma skills taught in Service-specific first aid, self aid, and buddy care courses. Services may also have additional medical training requirements.

## c. Concepts

(1) *Capstone Concept for Joint Operations: Joint Force 2030 (CCJO)*, 2019. The *CCJO* describes the future operating environment and an approach for future JF operations in that environment. Specifically, the outlined approach necessitates a globally postured JF capable of quickly combining capabilities with mission partners across domains, echelons, geographic boundaries, and organizational affiliations. These networks of forces and partners must form, evolve, dissolve, and reform in different arrangements in time and space. To support globally integrated operations (GIO), the JF must have a medically ready force and a ready medical force equipped with standardized and interoperable materiel.

(2) *Joint Concept for Health Services (JCHS)*, 2015. The *JCHS* describes a vision for what the collective medical enterprise must provide to support GIO. It addresses and outlines how to provide health services to deployed forces in an operational environment characterized by highly distributed operations and minimal, if any, pre-established health service infrastructure. Specifically, it notes that the JF requires advanced technologies, improved diagnostic tools, innovative treatment protocols, and increased specialization in each role of care to mitigate the possible negative impacts of delayed movement. Additionally, the *JCHS* describes an operating

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environment with varied medical challenges, including weapons of mass destruction (WMD) creating mass effects and new types of wounds from evolving weapons. To mitigate these challenges, DoD requires prioritized and streamlined advanced medical component development efforts with reduced timelines to expedite technology transition from the laboratory to operational use.

(3) *Operational Medicine (OpMed) Concept of Operations (CONOPS), 2018*. The *OpMed CONOPS* addresses the challenge of providing comprehensive health services to the JF and its mission partners conducting highly distributed operations. It describes an end state for OpMed capabilities where the JF maintains sufficient operational capability and capacity by minimizing the impacts of environmental threats and consequences of wounds, injuries, illness, and psychological stressors on the JF and individual warfighters. Highly dispersed operations will require the Joint medical force to be sufficiently trained and equipped to conduct POI through Role 2 treatment in more self-sufficient modes, potentially without advanced diagnostics, surgical technologies, communications, and/or rapid evacuation. Mitigating the risks associated with delayed evacuation while maintaining survivability requires the development of supporting technologies, medical materiel, and increased skill training.

d. **C3 Operational Viewpoint-1 (OV-1)**. The C3 OV-1 (Figure 1) provides the overarching vision for C3, as defined for the C3 CBA. It brings together the ends, ways, and means outlined for addressing the military challenge C3 seeks to solve or mitigate. It links all aspects of the C3 process that support the desired C3 outcomes. The C3 OV-1 also served to guide focused research during the literature analysis and development of the C3 Operational Viewpoint-5a (OV-5a), also known as an Activity Decomposition Tree. The C3 OV-1 was developed for, and refined by, a discussion with the key personnel that defined the scope of the C3 CBA.



Figure 1. C3 OV-1

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2. Threat Summary. The C3 capability is not intended to address a particular Defense Intelligence Agency (DIA) adversary threat but pertains to the following threat modules: Land Warfare TTP/OE - Future Operational Environment Overview, Nuclear and Radiological Warfare, Biological Warfare, Chemical Warfare, Land Warfare TTP/OE - Near-Peer Offense (Russia), Land Warfare TTP/OE - Near-Peer Defense (Russia), and Land Warfare TTP/OE - Nonstate Threats to Blue Stability Operations: Fragile State.

Providing effective C3, including PC, in all environments is a significant challenge for the JF, affecting its ability to preserve operational power and effectiveness. While great strides were made in recent decades and current mortality rates are at an unprecedented low, the future operational environment is expected to strain caregivers, resources, and systems. The *Joint Operating Environment (JOE) 2040* describes the future security environment, characterized by competition, conflict, and contested communication across all domains, along with the implications for change so the JF can project and prepare for future conflicts from a common baseline. It is intelligence-driven, oriented on the 2 + 3 threats, and focused by the Chairman of the Joint Chiefs of Staff's direction to the force. Projections for the near/mid-term are that the post-World War II international system will be under increasing strain amid continuing WMD (new technologies across the chemical, biological, radiological, and nuclear [CBRN]) spectrum proliferation threats and that contested norms will feature progressively intense, peer adversaries that pose serious threats to information and homeland security, as outlined in DIA CBRN threat analyses. Additionally, threats will expand and diversify, driven by adversary use of hybrid strategies as well as multi-domain, dispersed, and fluid operations. Furthermore, competition in space, the electromagnetic spectrum (EMS) operational environment, and regional conflicts will cut across all domains.

Critical Intelligence Parameters related to C3-related devices include cyber concerns related to cybersecurity, supply chain, or EMS threats that affect JF freedom of action. The Adversary Threat Tier for the future capabilities this ICD is expected to produce is a level 3; further information is available in Appendix E. The research recommendations identified below do not, by their nature, create more vulnerabilities to threats, but C3 diagnostic devices may require connection to networks and platforms that must be protected. Capability development documents based off this ICD will submit a Validated Online Lifecycle Threat report request to their supporting intelligence staff/organization.

These issues will result in conditions that affect medical operations, such as limited freedom of access and maneuverability, uncontrolled spread of WMD, disrupted flow of medical information, and adversaries' increased use of mass effect weaponry. Additionally, foreign intelligence entities could jeopardize the EMS integrity of C3 capabilities through technology targeting, interruption of supply chain operations, or the use of trusted insiders. These conditions may decrease the JF's operational capabilities and capacities for supporting national security objectives, which in turn will increase requirements to develop and field capabilities to manage and treat combat trauma and maintain the readiness and health of the operational force.

Additional information related to the threat summary can be found in the Defense Intelligence Threat Library at: <https://threatlibrary.dodis.ic.gov/modules> (JWICS) or <https://threatlibrary.dse.dia.smil.mil/home> (SIPRNET).

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## 3. Capability Requirements and Gaps/Overlaps

a. Challenge. How will the JF preserve operational capabilities through the management of WII warfighters during the conduct of highly mobile and distributed operations in an extended and increasingly lethal battlespace capable of producing high volumes of WII warfighters?

b. Required Capability. Conduct C3.

(1) Description. The ability to optimize the readiness and health of the JF by managing and treating combat injuries.

(2) Desired Effect. The JF maintains readiness and preserves operational capabilities through the provision of C3 interventions that maximize warfighter survivability and return to combat effectiveness.

c. Capability Gap Summary. The required capability to conduct C3 is summarized in Table 1 below.

Table 1. C3 Required Capability: Conduct C3

Capability Requirements		Current Capabilities		Significant Gap(s)/Overlap(s)
Operational Attribute <sup>1</sup>	Initial Objective Value	Source/System	Current Performance	
1. Conduct C3		Joint Capability Area (JCA) 4.8: Logistics/Health Services		
Persistence 1.1	95% of medical protocols/treatments are designed to support WII warfighters on the future battlefield	Fielded protocols/treatments	80% of medical protocols/treatments are designed to support WII warfighters on the future battlefield	<ul style="list-style-type: none"> <li>The JF has limited capability and capacity to provide sustained damage control surgery and resuscitative care throughout the continuum of care</li> <li>DoD lacks a unified framework to examine needs and opportunities for autonomous and unmanned systems in C3 across the JF mission sets</li> </ul>
Precision 1.2	Less than 3% of WII warfighters develop unintended outcomes from receiving untimely/inappropriate care due to misidentification and prioritization	Fielded protocols/treatments	5% of WII warfighters develop unintended outcomes from receiving untimely/inappropriate care due to misidentification and prioritization	<ul style="list-style-type: none"> <li>The JF lacks sufficient understanding of the short- and long-term consequences of wound and polytrauma patterns caused by emerging weapons systems</li> </ul>
Adaptability 1.3	More than 95% of medical treatment products can be tailored to meet changing requirements, including	Current medical treatment products	Less than 10% of medical treatment products are currently scalable or tailorable for	<ul style="list-style-type: none"> <li>The JF lacks surgical capabilities at POI and in PC</li> <li>The JF lacks standardized and validated psychological and physiological return-to-duty assessment criteria that encompass the spectrum of</li> </ul>

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Capability Requirements		Current Capabilities		Significant Gap(s)/Overlap(s)
Operational Attribute <sup>1</sup>	Initial Objective Value	Source/System	Current Performance	
1. Conduct C3		Joint Capability Area (JCA) 4.8: Logistics/Health Services		injury and disease experienced by WII warfighters <ul style="list-style-type: none"> <li>• The JF lacks sufficient pain management and medical intervention approaches that allow for preservation of combat effectiveness</li> </ul>
	anticipated/predicted needs of different environments over time		emerging mission sets	
Note: <sup>1</sup> Attribute information is located in the C3 CBA Study Report				

d. System Survivability. The majority of recommendations in this ICD are expected to drive development and modification of C3 products, including treatments, medical tools, and knowledge products. Recommended products may be affected by cybersecurity, EMS, and CBRN issues differently.

(1) EMS Survivability. The majority of recommended capabilities are not EMS-reliant but may contain components that are potentially susceptible to the negative effects from EMS interference. Those recommended capabilities that are, or may be, EMS-reliant require R&D to determine the technological approach. System developers should ensure compliance with electromagnetic environmental effects/electromagnetic capability requirements, in accordance with the *Manual for the Operations of the Joint Capabilities Integration and Development System*, when developing future capability development documents. Accordingly, recommended technologies, products, and mechanisms must be developed and deployed with due consideration of protective and mitigation methods for system survivability and, by extension, the safety and integrity of C3, including providers and WII warfighters.

(2) Cyber Survivability. In accordance with Defense Health Administration (DHA) Administrative Instruction 77, *Security Categorization and Control Selection for Information Technology (IT)*, 28 May 2015, the IT system described in this ICD handles Health Care Delivery Services information. These health care delivery services provide and support the delivery of health care to its beneficiaries including assessing health status, planning health services, ensuring quality of services and continuity of care, and managing clinical information and documentation. The potential impact resulting from loss of confidentiality, integrity, and availability for health care delivery services information that contains personally identifiable information/protected health information is as follows: loss of confidentiality, moderate impact; loss of integrity, high impact; and loss of availability, moderate impact. Information about the capability's Cyber Survivability Risk Category is in Appendix E.

(3) CBRN Survivability. CBRN survivability must be considered when developing follow-on requirements documents since some of the C3 products will be essential in

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saving WII warfighters. A determination of CBRN mission criticality, in accordance with DoDI 3150.09, is required in any follow-on requirements documents related to this ICD.

c. Intelligence Supportability. The recommendations outlined in this capability document will have little to no effect on intelligence supportability requirements. While the recommendations outlined in this report do not discuss the extent to which supportability will or will not be met, advanced developers must ensure their product development processes and solution sets meet DoD and intelligence community supportability requirements. Such requirements will include at least counterintelligence and security support to evaluate foreign intelligence entity threats that could jeopardize the integrity of C3 capabilities through technology targeting, interruption of supply chain operations, or the use of trusted insiders. Follow-on C3 capabilities should also consider intelligence interoperability and intelligence planning and operations support for likely CBRN and medical intelligence support requirements.

## 4. Final Recommendations

u. R&D Solutions. DHA, in coordination with OASD(HA), Combat Casualty Care Research Program, and other joint and Service organizations, developed R&D solutions to mitigate shortfalls in the JF's ability to conduct C3. Table 2 identifies R&D actions binned by key C3 categories. The table is not prioritized as R&D organizations prioritize funding and activities within their program management responsibilities, per command guidance. The table is also divided into two columns: applied research and basic research, indicating the current level of science best applied to the issue. While these recommendations are initially aligned to either applied research or basic research, the recommendations can move between columns based on progress towards meeting the requirement.

(1) Basic Research. These topics identify issues that require basic research, which includes fundamental research for the generation of new ideas, knowledge, hypotheses, or preliminary data to support applied research.

(2) Applied Research. These topics identify issues that require applied research. Applied research includes using basic research findings to develop materiel and knowledge products to enable C3. Applied research outcomes can drive materiel acquisition activities, knowledge product development, or further research needs. Materiel research seeks to translate basic research into useful products, both knowledge and materiel.

Table 2. C3 R&D Solutions

<b>R&amp;D Solutions Area</b>	<b>Applied Research: Devices and Products</b>	<b>Basic Research: Analysis, Understanding &amp; Education</b>
Managing Blood	<ol style="list-style-type: none"><li>1. Develop blood/blood product cooling systems that allow for transport and storage in far forward-deployed settings (both land and maritime environments).</li><li>2. Develop blood/blood product warming systems (both land and maritime-based systems) for rapid transfusion in far forward-deployed settings while addressing core body temperature issues.</li></ol>	<ol style="list-style-type: none"><li>6. Conduct research on ways to reduce the Class VIII(B) burden on tactical organizations (e.g., shelf-stable blood substitute) in a prolonged, austere, or maritime environment.</li></ol>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
	<ol style="list-style-type: none"> <li>3. Develop, or improve existing, pathogen reduction technologies to eliminate pathogens, reduce risk of transfusion-transmitted infections, and ensure a safer blood supply in a deployed environment.</li> <li>4. Develop materiel needed to support the walking blood bank, including consumables needed for transfusion, rapid testing for transfusion-transmitted infections, and appropriate medical information system(s) to support blood management, including tracking donor testing and recipient transfusion.</li> <li>5. Develop interface capabilities between information systems to support the tracking of donor prescreening testing results.</li> </ol>	
Treating CBRN	<ol style="list-style-type: none"> <li>7. Develop medical C3 solutions that will enable care for combined CBRN and polytrauma injury patterns.</li> </ol>	<ol style="list-style-type: none"> <li>8. Conduct research on personal protective equipment (PPE) across the continuum of care for providing C3 to WII warfighters in CBRN environments.</li> <li>9. Conduct research on the implications of CBRN environments on the provision of C3 in prolonged and austere CBRN-affected environments (especially in cases complicated by polytrauma and disease non-battle injuries).</li> </ol>
Optimizing Care for the Warfighter	<ol style="list-style-type: none"> <li>10. Design POI procedures that limit iatrogenic effects.</li> <li>11. Develop smaller, lighter, and less energy-intensive medical technologies for use in far-forward and maritime environments (POI to Role 3).</li> <li>12. Develop solutions that can generate C3 materiel in prolonged and austere environments (e.g., energy-efficient three-dimensional printers).</li> <li>13. Develop solutions for treatment of neurosensory and other unique/complex organ system injuries resulting from conventional, CBRN, and emerging weapons systems.</li> <li>14. Develop solutions suited to the prolonged holding of severely WII warfighters, including in austere environments.</li> </ol>	<ol style="list-style-type: none"> <li>18. Conduct research to understand why, how, and when C3 care providers' performance changes to develop solutions to predict, detect, and mitigate performance degradation, particularly in austere, PC, maritime, and large-scale combat operations conditions.</li> <li>19. Conduct research on the impacts of novel and emerging weapons systems on C3 and evacuation over extended timeframes.</li> <li>20. Conduct research to understand and develop medical countermeasures to novel and emerging weapons systems.</li> <li>21. Conduct research to determine appropriate medical standards for</li> </ol>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
	<ul style="list-style-type: none"> <li>15. Develop PPE solutions with improved ability to prevent and mitigate genitourinary trauma and preserve reproductive function.</li> <li>16. Develop appropriate benchmarks to evaluate short- and long-term outcomes in polytrauma and traumatic brain injury (TBI) for use in quality improvement.</li> <li>17. Develop a hands-free pre-hospital/en route care data collection tool including integration with non-medical/tactical systems.</li> </ul>	<ul style="list-style-type: none"> <li>conducting C3 in the space domain.</li> <li>22. Conduct research on the impacts of extreme cold weather on C3 and evacuation.</li> <li>23. Conduct research to better understand and quantify the impact of undersea evacuation on critically injured WII warfighters.</li> <li>24. Conduct research to determine effective pharmacological and non-pharmacological interventions to maintain care provider effectiveness and enhance performance.</li> <li>25. Conduct research to establish correct provider-WII warfighter ratios.</li> </ul>
<p>Treating Physiological Injuries</p>	<ul style="list-style-type: none"> <li>26. Develop a system capable of early recognition of hemorrhage/hypovolemic shock.</li> <li>27. Develop non-surgical solutions to arrest hemorrhage, maintain perfusion to critical end-organs, and extend the window of time for intervention or evacuation in a pre-hospital environment.</li> <li>28. Establish the ability to monitor and determine adequacy of resuscitation including integration with non-medical/tactical systems.</li> <li>29. Develop portable, lightweight devices and products for pre-hospital and en route providers to store, produce, and administer supplemental oxygen (e.g., oxygen concentrator, oxygen dense fluids).</li> <li>30. Develop portable, lightweight devices and products for forward surgical care including improved techniques for instrument sterilization in austere or maritime environments.</li> <li>31. Develop field-deployable solutions for kidney, lung, heart, and liver support.</li> <li>32. Refine solutions used to detect and treat tension pneumothorax (including hemothorax) in prolonged and austere environments.</li> <li>33. Develop capabilities to support early burn wound debridement.</li> </ul>	<ul style="list-style-type: none"> <li>50. Conduct research to address consequences of wound and polytrauma patterns caused by emerging weapons systems (e.g., directed energy and kinetic).</li> <li>51. Develop fluid resuscitation technologies and methodologies to support burn care management.</li> <li>52. Conduct research on options for analgesics and antibiotics to improve management of acute and chronic injuries while supporting long-term outcomes.</li> <li>53. Conduct research and develop oxygen saturation, end-tidal carbon dioxide, electrocardiogram, non-invasive hemodynamic monitoring, etc. to ensure availability in the PC environment at each role of care.</li> <li>54. Conduct research to improve methods for treatment of smoke inhalation and thermal damage to the respiratory system.</li> <li>55. Conduct R&amp;D for interventions to improve long-term limb viability and functionality following musculoskeletal and orthopedic injuries.</li> <li>56. Conduct R&amp;D that supports advanced life-saving interventions and improved outcomes in a</li> </ul>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
	<p>34. Develop solutions (including but not limited to pharmacologic interventions) to prevent or mitigate multiorgan failure post-burn injury.</p> <p>35. Develop non-surgical solutions to measure tissue and end-organ perfusion to inform diagnosis and treatment and extend the window of time for intervention or evacuation without undue logistical burden.</p> <p>36. Develop solutions to assess and stabilize fractures (e.g., limb-stabilization) and extremity injuries that enable WII warfighters to continue the mission or endure extended wait or evacuation times.</p> <p>37. Develop field-deployable solutions for early diagnosis and treatment of sepsis and/or wound infection that can be used in both the pre-hospital and hospital environment.</p> <p>38. Develop field-deployable solutions and algorithms for the empiric treatment of suspected wound infection during PC.</p> <p>39. Develop field-deployable solutions to assess, treat, and prevent biofilm formation and wound infections in order to maintain physiological status and wound tissue viability.</p> <p>40. Develop solutions to prevent, assess, and treat organ damage related to reperfusion injury across the continuum of care that can be used in prolonged and austere environments.</p> <p>41. Develop solutions to prevent, assess, and treat organ failure secondary to infection across the continuum of care that can be used in prolonged, austere, and maritime environments.</p> <p>42. Develop solutions to prevent, assess, and treat acute respiratory distress syndromes across the continuum of care that can be used in prolonged, austere, and maritime environments.</p> <p>43. Develop solutions to prevent, assess, and treat secondary sequelae of traumatic injury in PC (rhabdomyolysis, deep vein thrombosis, pulmonary embolism, etc.).</p> <p>44. Develop non-invasive solutions to detect, diagnose, treat, and manage compartment syndrome.</p>	<p>prolonged or austere environment.</p> <p>57. Conduct R&amp;D on solutions to treat non-compressible bleeding, including intracavitary, junctional, and hemorrhage caused by complex pelvic fracture in an austere environment.</p> <p>58. Conduct R&amp;D for tourniquet-related ischemia injuries.</p> <p>59. Conduct R&amp;D for limb restoration in the deployed environment.</p>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
	<p>45. Develop non-surgical solutions to provide support to specific organ systems (e.g., renal, respiratory, cardiac, digestive).</p> <p>46. Develop improved solutions for shipboard WII warfighters, including: industrial burns, near-drowning and hypothermia related to prolonged saltwater immersion, contact with harmful marine life, extensive sunburn, contact with fuel and other hazardous materials, and other injury modalities.</p> <p>47. Develop solutions to diagnose, stabilize, and treat peripheral nerve and spinal cord damage across the continuum of care.</p> <p>48. Develop smart tourniquets that record and display application time and pressure and improve effectiveness.</p> <p>49. Develop solutions to identify, treat, and prevent physiological effects of blast exposure injuries.</p>	
Treating Psychological Injuries	<p>60. Develop mechanisms to screen/identify individuals that may be more susceptible to mental health emergencies.</p> <p>61. Develop solutions to provide far-forward (both land and sea) medical interventions for psychological injuries.</p> <p>62. Develop therapeutic (pharmacological and non-pharmacological) solutions to preserve psychological functionality.</p> <p>63. Develop solutions to evaluate and mitigate the psychological impact of PC on WII warfighters.</p>	<p>64. Conduct research to understand the effects of behavioral and mental health challenges in C3 and develop appropriate mitigations strategies.</p> <p>65. Develop solutions to facilitate diagnosis of psychiatric conditions resulting in neurological dysfunction.</p>
Supporting Return-to-Duty	<p>66. Develop tools to assess risk of return-to-duty for WII warfighters that experienced burns.</p>	<p>67. Develop decision-support solutions that enable medical personnel to objectively apply return-to-duty standards for physiological, musculoskeletal, sensory organ, and behavioral (psychological) health.</p> <p>68. Develop knowledge products to support return-to-duty risk matrices and modeling.</p>
Minimizing Warfighter Suffering	<p>69. Develop solutions to provide pain management under PC and prolonged evacuation timelines in the presence or absence of care providers.</p>	<p>70. Conduct research on pain management in concussed individuals in order to manage pain while not negatively affecting concussion symptoms and outcomes.</p>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
		71. Conduct research to determine the relationship between pain management and psychological injury in order to mitigate the psychological impact of pain.
Treating TBI	<p>72. Develop monitoring and treatment solutions for TBI that can be used during WII warfighter movement.</p> <p>73. Develop solutions for the pre-hospital environment to assess mild and moderate TBI and related decrements in cognitive performance that could affect operational effectiveness.</p> <p>74. Develop solutions to objectively diagnose and treat TBI (e.g., reduce intracranial pressure) in prolonged and austere environments.</p> <p>75. Develop solutions to reduce secondary sequelae of brain injuries.</p> <p>76. Develop biomarker tests and devices to assess and diagnose mild TBI/concussion and monitor recovery after injury.</p> <p>77. Develop biosensor and biomarker solutions to support WII warfighter location, triage, and physiological monitoring during future operations (including integration with non-medical/tactical systems).</p>	<p>78. Conduct research to determine a more effective diagnostic classification for brain injuries beyond mild, moderate, and severe as well as classification for brain injuries based on mechanism.</p> <p>79. Conduct research to determine objective measures of TBI/concussion immediately following a traumatic event through minimal or non-invasive techniques.</p> <p>80. Conduct research in neurocognitive performance to determine the implications of brain injury on performance of critical occupational tasks and facilitate return-to-duty in the field.</p>
Managing Triage	81. Develop scalable triage solutions that integrate available medical and non-medical sensors to identify, locate, and detect status changes in WII warfighters in order to support battlefield care and evacuation decision-making.	82. Conduct research on non-invasive tools for triage and assessment of occult fracture injuries.
Supporting Movement	<p>83. Develop safe, interoperable WII warfighter movement equipment using joint en route care certification equipment testing standards.</p> <p>84. Develop products to assist C3 provider evacuation from any available platform.</p> <p>85. Develop en route care restraint systems that enable providers to continue to perform care and maintain safety.</p> <p>86. Develop unique PPE, WII warfighter movement items, and safety procedures for care providers and WII warfighters in future WII warfighter movement environments.</p>	<p>87. Conduct research to determine the impact of prolonged evacuation on C3 tasks and outcomes.</p> <p>88. Conduct research on the impact of WII warfighter movement (pressure, temperature, noise, vibration, hypobaria, humidity, timing, mode of transport) on brain health and polytraumatic injuries.</p> <p>89. Conduct research addressing optimal time to move WII warfighters based on distance, severity of injury, and evacuation platform.</p> <p>90. Conduct research to identify en route care skill sets that maintain</p>

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R&D Solutions Area	Applied Research: Devices and Products	Basic Research: Analysis, Understanding & Education
		<p>or improve WII Warfighter outcomes.</p> <p>91. Conduct research in order to determine causes of WII warfighter/provider injuries in the event of a WII warfighter movement platform crash.</p>

b. DOTmLPF-P Approach. The C3 CBA identified several DOTmLPF-P approaches that support the ability to optimize the readiness and health of the JF by managing and treating combat injuries. Specific non-materiel approaches separate from C3 R&D are identified in a supporting DCR. As knowledge or physical products based on the above R&D recommendations will affect other DOTmLPF-P domains, some potential generalized solution approaches following their development and fielding are:

(1) Doctrine. DoD must update and/or develop relevant doctrine; guidelines; and tactics, techniques, and procedures for C3 personnel and other end users.

(2) Doctrine. DoD must update and improve laboratory technicians' and flight medics' guidelines that support blood-related medical evacuation operations.

(3) Training. DoD must update and/or develop training to facilitate proper use of new products.

(4) Materiel. DoD must update and/or develop change management mechanisms to facilitate product adoption and integration. DoD must also create the physical and knowledge products required to sustain the employment of said products and assess their effectiveness against intended outcomes and operational requirements.

(5) Policy. DoD must update and/or develop policies that inappropriately restrict the use of certain technologies by personnel in future operating environments.

c. Affordability. All recommendations within this ICD reside within current C3 R&D allocations and priorities. Periodic requests for unprogrammed funds or Program Objective Memorandum recommendations will be made to close any of the solutions.

## 5. Appendices

Appendix A. References

Appendix B. Acronyms

Appendix C. Glossary

Appendix D. Classified (Not Used)

Appendix E. Cyber Survivability Risk Categories

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## Appendix B. Acronyms

<b>ATT</b>	Adversary Threat Tier
<b>C3</b>	Combat Casualty Care
<b>CBA</b>	Capabilities-Based Assessment
<b>CBRN</b>	Chemical, Biological, Radiological and Nuclear
<b>CCJO</b>	Capstone Concept for Joint Operations
<b>CDL</b>	Cyber Dependency Level
<b>CIP</b>	Critical Intelligence Parameters
<b>CONOPS</b>	Concept of Operations
<b>CSA</b>	Cyber Survivability Attribute
<b>CSE</b>	Cyber Survivability Endorsement
<b>CSRC</b>	Cyber Survivability Risk Category
<b>CSRP</b>	Cyber Survivability Risk Posture
<b>DHA</b>	Defense Health Agency
<b>DIA</b>	Defense Intelligence Agency
<b>DoD</b>	Department of Defense
<b>DoDD</b>	Department of Defense Directive
<b>DoDI</b>	Department of Defense Instruction
<b>DOTmLPPF-P</b>	Doctrine, Organization, Training, materiel, Leadership and Education, Personnel, Facilities, and Policy
<b>EMS</b>	Electromagnetic Spectrum
<b>FHP</b>	Force Health Protection
<b>GIO</b>	Globally Integrated Operations
<b>ICD</b>	Initial Capabilities Document
<b>IL</b>	Impact Level

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<b>IT</b>	Information Technology
<b>JCA</b>	Joint Capability Area
<b>JCB</b>	Joint Capabilities Board
<b>JCHS</b>	Joint Concept for Health Services
<b>JF</b>	Joint Force
<b>JOE</b>	Joint Operating Environment
<b>JROCM</b>	Joint Requirements Oversight Council Memorandum
<b>MM&amp;S</b>	Medical Modeling and Simulation
<b>MRT</b>	Medical Readiness Training
<b>MT</b>	Mission Type
<b>NDS</b>	National Defense Strategy
<b>NMS</b>	National Military Strategy
<b>NSS</b>	National Security Strategy
<b>OASD(HA)</b>	Office of the Assistant Secretary of Defense for Health Affairs
<b>OpMed</b>	Operational Medicine
<b>OV-1</b>	Operational Viewpoint- 1
<b>PC</b>	Prolonged Care
<b>POI</b>	Point of Injury
<b>PPE</b>	Personal Protective Equipment
<b>R&amp;D</b>	Research and Development
<b>TBI</b>	Traumatic Brain Injury
<b>TCCC</b>	Tactical Combat Casualty Care
<b>U.S.</b>	United States
<b>VOLT</b>	Validated Online Lifecycle Threat

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**WII**

Wounded, Ill, and Injured

**WMD**

Weapons of Mass Destruction

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## Appendix C. Glossary

**Artificial Intelligence.** Also known as AI. AI refers to the ability of machines to perform tasks that normally require human intelligence – for example, recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action – whether digitally or as the smart software behind autonomous physical systems. [Source: DoD AI Strategy, 2018]

**Autonomous Care.** Autonomous care is the provision of care for a specific injury or illness through medical devices, tools, and technologies using AI to diagnose and/or treat trauma, either by assisting a human provider or autonomously without human involvement. Autonomous care has the potential to reduce the time spent by qualified medical personnel on diagnosing and treating casualties, especially in a MASCAL situation. Autonomous care may also allow for personnel not normally qualified to make a specific medical decision to determine the treatment action needed and guide the accomplishment of the treatment action, or in the case of fully autonomous medical devices, perform the treatment action without human involvement. [Source: Study Team]

**Capability.** The ability to complete a task or execute a course of action under specified conditions and level of performance. [Source: CJCSI 5123.01H]

**Capability Requirements.** A capability required to meet an organization’s roles, functions, and missions in current or future operations. To the greatest extent possible, capability requirements are described in relation to tasks, standards, and conditions in accordance with the Universal Joint Task List or equivalent DoD component task list. If a capability requirement is not satisfied by a capability solution, then there is also an associated capability gap. A requirement is considered to be ‘draft’ or ‘proposed’ until validated by the appropriate authority. [Source: CJCSI 5123.01H]

**Caregiver.** The person, platform, system, or device, to include autonomous or AI providers, that is administering treatment to a WII warfighter. [Source: Study Team]

**Combat Casualty Care.** Also known as C3. The preservation of operational capabilities through medical interventions that maximize warfighter survivability and return to combat effectiveness. [Source: Study Team]

**Combat Effectiveness.** The ability of an individual to perform assigned missions or functions. [Source: Derived from AAP-06, NATO Glossary of Terms and Definitions (English and French), 2019 Edition]

**Health Services.** Medical capabilities designed to perform, provide, or arrange the promotion, improvement, conservation, or restoration of human mental and physical well-being that may be used to support the NMS and the readiness of the Joint Force. [Source: JCHS]

**Health Services Support.** All services performed, provided, or arranged to promote, improve, conserve, or restore the mental or physical well-being of personnel, which include, but are not limited to, the management of Health Services resources, such as manpower, monies, and facilities; preventive and curative health measures; evacuation of the wounded, injured, or sick; selection of the medically fit and disposition of the medically unfit; blood management; medical supply, equipment, and maintenance thereof; combat and operational stress control; and medical, dental, veterinary, laboratory, optometric, nutrition therapy, and medical intelligence services. [Source: JP 4-02]

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**Injury.** For the purposes of this ICD, the term “Injury” is inclusive of conditions such as fractures, wounds, sprains, strains, dislocations, concussions, compressions, and psychological trauma. Injury also includes conditions resulting from extremes of temperature or prolonged exposure, acute poisonings (except those due to contaminated food) resulting from exposure to a toxic or poisonous substance, and Disease and Nonbattle Injuries, which are all illnesses and injuries not resulting from hostile action or terrorist activity or caused by conflict. [Source: Derived from JP 4-02]

**Pre-hospital Care (For this Study).** Any care received prior to admission into a Role 2 military treatment facility. [Source: Study Team]

**Prolonged Care.** Also known as PC. Field medical care applied beyond “doctrinal planning timelines” by warfighters IOT decrease patient mortality and morbidity and return warfighters to combat effectiveness. PC uses limited resources and is sustained until the patient arrives at the next appropriate level of care or is returned to combat. [Source: Derived from the NATO definition of Prolonged Field Care]

**Warfighter.** For the purposes of this ICD, the term "warfighter" is inclusive of the military members of all Services (Army, Air Force, Space Force, Navy, Marine Corps), as well as those activated under appropriate authorities and policies (e.g., Coast Guard, National Oceanic and Atmospheric Administration, Public Health Service). Warfighter also includes all military working animals, Allied Forces and U.S. partners. When deployed, civilians (DoD Expeditionary Civilians) and contractors requiring protection and sustainment, or others authorized medical care are also considered warfighters for treatment purposes. [Source: Study Team]

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Appendix D. Classified (Not Used)

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## Appendix E. Cyber Survivability Risk Categories

1. Mission Type (MT). The MT for the C3 capability is assessed as MT 3, Operational/Tactical. By definition, degradation of the capability would result in high risks to mission completion and therefore require unique DoD protections for the high levels of Confidentiality, Integrity, and Availability (C, I, & A) and a focus on survivability and resiliency requirements that will ensure their continuous operation.

2. Adversary Threat Tier (ATT). Based on the threat described in the above Threat Summary, the ATT is 3, moderate. By definition, ATT 3 means that adversaries are able to use customized malware to conduct wide-ranging intelligence collection operations, gain access to more isolated networks, and in some cases creates limited effects against defense critical infrastructure networks.

### 3. Cyber Survivability Risk Category (CSRC)

a. CSRC Rationale. The system's CSRC-3, high, was determined by assessing its MT of 3, and an ATT of 3.

b. CSRC-3 Summary Statement. The system's mission criticality and impact of system compromise requires the capability must survive and operate in a high risk cyber-contested environment against the span of anticipated adversaries ranging from amateurs to very sophisticated, persistent, and well-resourced adversaries at a nation state level. Adversaries are capable of advanced cyber trade craft using publicly available and customized tools to exploit known and unknown vulnerabilities, as well as the ability to develop and stealthily implant malware/vulnerabilities to conduct wide-ranging intelligence collection operations for identifying/targeting espionage/attack on both unencrypted and isolated networks, and in some cases create limited effects against defense critical infrastructure networks. Recognizing the adversaries' current/projected cyber threat capabilities, the system must prevent or mitigate the effects of cyber events to maintain minimum functionality to complete the mission or return to base for recovery of sufficient capability to fight another day. Mitigations must ensure Confidentiality, Integrity, & Availability for trusted availability of internal and external information flows; must implement a defense in depth architecture, with no single points of failure; must leverage available DoD-developed cyber protection technologies (including consideration of protections inherited from the intended operational environment); and as required, must build specific custom protections, countermeasures and technologies to actively manage the system's configuration to achieve and maintain an operationally relevant Cyber Survivability Risk Posture (CSRP).

c. Cyber Survivability Attributes (CSA). The following ten CSAs must be considered and assessed for each assessment of alternatives to understand the resource and mission risk implications if the capability itself, the hosting system or enterprise services are unable to provide the CSA's intent:

(1) Prevent cyber-attacks effects. CSA-01 Control Access; CSA-02 Reduce Cyber Detectability; CSA-03 Secure Transmissions and Communications; CSA-04 Protect Information from Exploitation; CSA-05 Partition and Ensure Critical Functions at Mission Completion Performance Levels; CSA-06 Minimize & Harden Cyber Attack Surfaces.

(2) Mitigate the effects of cyber-attacks. CSA-07 Baseline & Monitor Systems and Detect Anomalies; CSA-08 Manage System Performance if Degraded by Cyber Events.

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(3) Recover from cyber-attacks. CSA-09 Recover System Capabilities.

(4) Support DevOps throughout the system's lifecycle. CSA-10 Actively Manage System's Configuration to Achieve and Maintain an Operationally Relevant CSRP throughout the system's lifecycle.