INSTITUTE FOR DEFENSE ANALYSES

Countering Biological Warfare (BW) Pathogens Concept Pt. 1

Mark Bohannon
Catherine Shuster
William Smedley
Stephanie Wiseman
Jeffrey H. Grotte

February 2019
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IDA Paper P-10398
Log: H 19-000062

INSTITUTE FOR DEFENSE ANALYSES
4850 Mark Center Drive
Alexandria, Virginia 22311-1882

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About This Publication
This work was conducted by the Institute for Defense Analyses (IDA) under contract HQ0034-14-D-0001, project CA-6-4423, "Capabilities Based Assessment (CBA) for Countering Biological Warfare (BW) Pathogens," for the Joint Staff, Joint Requirements Office (JRO) for Chemical, Biological, Radiological and Nuclear (CBRN) Defense (J-8/JRO). The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or the sponsoring organization.

For more information:
Dr. Mark E. Bohannon, Project Leader
mbohanno@ida.org, 703-575-6642
ADM John C. Harvey, Jr. USN (Ret), Director, SFRD
jharvey@ida.org, 703-575-4530

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Executive Summary

The Joint Requirements Office for Chemical, Biological, and Radiological (CBRN) Defense (JRO-CBRND) identifies and documents required capabilities for the Joint Force to operate in a CBRN environment. The foundational documents, developed from 2004-2007, established required capabilities for medical countermeasures (MCMs) and reflect threat and risk assessments performed up until that point. They are not well integrated into overall CBRN concepts or future concepts for the military health system.

A mixture of adversary capabilities, including the use of traditional pathogenic agents, newly discovered and emerging pathogens, and combinations of agents and advanced delivery methods, will contribute to the threat of pathogens used as biological weapons. The expected growth in genetic engineering knowledge and technology over the next 15 to 20 years, coupled with the natural selection of pathogens and the possibility of emerging and re-emerging diseases, presents the potential for a more complex biological warfare (BW) threat over the period of this concept. Novel pathogens, or traditional pathogens that have been genetically modified or selected for traits, such as antimicrobial resistance, non-response to diagnostic tests, or immunization breakthrough, will present challenges to traditional countermeasure development.

This concept establishes an operational framework for addressing pathogens used as biological weapons, and the integration of that framework into the military health system, the CBRN defense system, and the critical dependencies with those capabilities. This concept identifies necessary tasks to perform and capabilities required for the Joint Force to operate successfully in an environment where pathogens may be used in biological weapons. This concept is specifically designed to support a subsequent Capabilities Based Assessment (CBA).

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Contents

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1. Introduction

A. Background

A mixture of capabilities, including the use of traditional pathogenic agents, newly discovered and emerging pathogens, and combinations of agents and advanced delivery methods, will contribute to the threat of pathogens used as biological weapons. The expected growth in genetic engineering knowledge and technology over the next 15 to 20 years, coupled with the natural selection of pathogens and the possibility of emerging and re-emerging diseases, presents the potential for a more complex biological warfare (BW) threat over the period of this concept. Novel pathogens, or traditional pathogens that have been genetically modified or selected for traits, such as antimicrobial resistance, non-response to diagnostic tests, or immunization breakthrough, will present challenges to traditional countermeasure development.

Although most traditional biological warfare threats are non-communicable and only intended to impact the force attacked, communicable agents pose a risk to others away from the initial attack, from in-theater forces not at the attack location to logistics nodes in and out of theater, and potentially to forward-stationed forces and even the United States. A few pathogens can persist within the environment and may pose a hazard well after the initial event.

B. Purpose

The purpose of this concept is to ensure the Joint Force's freedom of operation. It describes a methodology to accomplish that goal by preventing disruption of missions through preventing and mitigating infection and casualties. This concept is the first phase in a Capabilities Based Assessment (CBA) to assess the ability of the Joint Force to operate in an environment where pathogens may be used within biological weapons.

C. Scope

Joint Publication 3-11[1] (reflecting the elements of the National Response Framework[2]) describes a model of "Prepare, Prevent, Protect, Respond, and Recover." This concept does not directly follow this five-part framework; although it supports the actions necessary from the "prepare" phase through the "recover" phase, it does not include the full spectrum of activities to counter weapons of mass destruction. It describes the importance of hazard awareness and recognition, and the role of both physical and physiological protection.[3] It includes the medical response and the military health system (MHS) only to the extent that they directly influence the choice and use of medical countermeasures (MCMs), and does not address recuperative care beyond the theater of operation. These elements take this concept from prepare and prevent (hazard awareness) to protect (physical and physiological protection) to respond and recover (medical response and treatment).

D. Countering Pathogens and the Future Operating Environment

1. Strategic Context

Combatants have used biological weapons for as long as people have fought wars. Even without understanding the mechanisms of disease or how they spread, armies in antiquity recognized that introducing contagions was an effective method of weakening the enemy. Contaminating water sources proved so successful at disrupting an enemy's capacity to fight that this method continued to be used into the 20th century.[4]

U.S. strategic guidance recognizes that pathogens, whether naturally occurring or deliberately released from biological weapons, "have the potential to cause catastrophic loss of life."[5] These weapons provide a uniquely disruptive threat. If used covertly and with delayed effects, the source of a bio-attack and its perpetrator can be difficult to identify. In

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1 Joint Chiefs of Staff, *Operations in Chemical, Biological, Radiological, and Nuclear Environments,* JP 3-11 (Washington, DC: Joint Chiefs of Staff, 4 October 2013).

2 Department of Homeland Security, *National Response Framework, Third Edition* (Washington, DC: Department of Homeland Security, June 2016), 1, accessed April 6, 2018, https://www.fema.gov/media-library-data/1466014682982-9bcf8245ba4c60c120aa915abe74e15d/National_Response_Framework3rd.pdf.

3 As used in this concept, physiological protection refers primarily to those actions taken to increase resistance of the body to the effects of pathogens and may include medical actions, such as immunization, as well as health-promotion activities, such as proper nutrition and sleep cycles.

4 Stefan Riedel, "Biological warfare and bioterrorism: a historical review," *Proceedings (Dallas, TX: Baylor University Medical Center)* 17, no. 4 (2004), 400, accessed April 9, 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200679/pdf/bumc0017-0400.pdf.

5 The White House, *National Security Strategy of the United States of America*, (Washington, DC: Government Printing Office, December 2017), 9.

addition to the initially exposed victims, some pathogens have the potential to continue to spread, putting contacts of initial victims and medical responders at risk of infection. Bioweapons can also cause fear, panic, and uncertainty in the wider population.[6]

Since the 1972 Biological Weapons Convention, there has been no overt, large-scale use of biological weapons by a state actor. However, that is not to say the threat has gone away. Biological weapons have been used for covert assassinations[7] and "[r]ogue regimes…continue to seek out or develop weapons of mass destruction (WMD) – nuclear, chemical, and biological – as well as long range missile capabilities,"[8] which leaves open the potential for large, state-sponsored attacks.

As non-state actors have become more prominent in modern conflicts, the threat posed by biological weapons has evolved. The *Joint Operating Environment (JOE) 2035* states that "[i]t is likely that terrorist, insurgent, or criminal groups will eventually obtain chemical, biological, radiological, or even nuclear weapons within the next two decades."[9] Small, politically motivated groups have already demonstrated the capacity to employ bioweapons, such as the 1985 *Salmonella enterica* Typhimurium attack by the Rajneeshee cult in the U.S. and multiple failed bioattacks committed by the Japanese group Aum Shinrikyo before their 1995 sarin attack and subsequent arrests.[10]

As science continues to advance and becomes more accessible to individual or small group actors, the risks posed by pathogens continue to evolve. This is most clearly demonstrated by the still-unsolved Amerithrax attacks; however, the risk is not limited to known bioagents, such as *Bacillus anthracis*. As stated in the JOE 2035, "[n]ew techniques to edit and modify the genome may allow scientists to harness organisms or biological systems as weapons…"[11] This may allow future pathogens to be modified to circumvent existing countermeasures and detection and identification capabilities. In a recent report, the National Academies of Science noted:

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6 Riedel, "Biological warfare and bioterrorism: a historical review," 405.

7 Ibid. 404.

8 Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America,* (Washington, DC: Department of Defense, 2018), 3.

9 Joint Chiefs of Staff, *Joint Operating Environment 2035: The Joint Force in a Contested and Disordered World*, (Washington, DC: Joint Chiefs of Staff, July 2016), 9.

10 H.J. Jansen, F.J. Breeveld, C. Stijnis, and M.P. Grobusch, "Biological Warfare, Bioterrorism, and Biocrime," *Clinical Microbiology and Infection* 20, no. 6 (June 2014), 491-492.

11 Joint Chiefs of Staff, *Joint Operating Environment 2035: The Joint Force in a Contested and Disordered World*, 16.

> *Scientific advances over the past several decades have rapidly accelerated the ability to engineer existing living organisms and potentially create novel ones not found in nature. Technologies to modify or create organisms or biological components—activities known collectively as synthetic biology—are being pursued for a variety of purposes, from reducing the burden of disease to improving agricultural yields to remediating pollution.*[12]

2. Operational Context

The *Capstone Concept for Joint Operations (CCJO)* describes how the Joint Force will operate between now and 2020. The CCJO describes globally integrated operations and envisions a future force that that can "form, evolve, dissolve, and reform in different arrangements in time and space with significantly greater fluidity than today's Joint Force."[13] Complicating this vision of the future forces described in the CCJO, the *Joint Operating Environment 2035*[14] describes a future security environment where:

- fragile and failing states may contribute to the uncontrolled spread of weapons of mass destruction;
- advances in scientific research may provide adversaries with opportunities for novel chemical or biological weapons or ease their production; and
- the Joint Force may be required to mitigate intentional or accidental chemical or biological (CB) releases within the United States or abroad.

The expectation that the Joint Force will act with agility in a future environment that includes the potential for both well-known and novel BW pathogen threats requires that future countermeasures, including MCMs, be effective against a broad range of potential threats and suitable for use across the range of military operations, including "military engagement, security cooperation, and deterrence; crisis response and limited contingency operations; and large-scale combat operations."[15]

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[12] National Academies of Sciences, Engineering, and Medicine, *A Proposed Framework for Identifying Potential Biodefense Vulnerabilities Posed by Synthetic Biology: Interim Report,* (Washington, DC: The National Academies Press, 2017). doi: https://doi.org/10.17226/24832.

[13] Joint Chiefs of Staff, *Capstone Concept for Joint Operations: Joint Force 2020*, (Washington, DC: Joint Chiefs of Staff, 10 September 2012), 4.

[14] Joint Chiefs of Staff, *Joint Operating Environment (JOE) 2035: The Joint Force in a Contested and Disordered World*.

[15] Joint Chiefs of Staff, *Joint Operations*, JP 3-0 (Washington, DC: Joint Chiefs of Staff, 17 January 2017).

2. The Military Challenge[16]

A. Problem Being Addressed: Pathogen Challenges

The Joint Force conducts a variety of missions in all environments, and the use of pathogens in biological weapons must be considered in those environments. The Joint Force faces a complex situation that poses risks of kinetic and non-kinetic effects and environmental extremes, as well as the risks posed by naturally occurring disease; for example, the background disease environment may disguise the intentional weaponized use of a pathogen. An adversary will likely use a biological weapon, including the pathogen, some recipe of enhancers and stabilizers, and a delivery system, as one of many weapon systems. Recognizing an attack in this combat setting may be difficult, so the Joint Force must prepare to apply a variety of capabilities to ensure freedom of operation and mitigate the effects of pathogenic organisms used as biological weapons.

Following pathogen release, if both physical and physiological protection are unsuccessful or not fully successful, the Joint Force must be prepared to respond to and mitigate the effects of the pathogen. This is largely the role of the military health system, which is mostly out of the scope of this concept.

Exposure is the process of the pathogen gaining entry to the body; for pathogens in a biological weapons context, this typically occurs through breathing. Once the pathogen enters the respiratory system and encounters a favorable location for reproduction, infection occurs.

Several processes occur within the body during pathogenesis or disease development that can provide different opportunities to gain awareness and increase knowledge of the disease event, including pathogen type, timing, and dose. These processes also present opportunities to intervene in the disease development, depending on the healthcare system's level of knowledge of the pathogen and the available medical capabilities. These processes can be considered as five phases of infection.

[16] The major subtopics of this chapter are the areas that must be described for a concept supporting a capabilities-based assessment, in accordance with the "Manual for the Operation of the Joint Capabilities Integration and Development System (JCIDS)" (12 February 2015, including errata as of 18 December 2015), C-B-7.

Most pathogens undergo a period of initial reproduction within the body and generally have an asymptomatic incubation period, or latency phase. Following the latency phase, there is usually a period of fever and non-specific symptoms, known as the prodrome phase. At this point, with knowledge that exposure has potentially occurred, it is possible that a diagnostic test could identify the causative agent if the correct specimen is tested. If the pathogen cannot be identified or a specific countermeasure is not available or effective, non-specific countermeasures and supportive care at this stage may terminate the disease process, or the individual may progress into a disease syndrome characteristic of the causative pathogen. This is another opportunity for diagnostic testing or a clinical diagnosis to improve understanding, or to begin non-specific syndrome-based treatments. In some instances, the individual may progress to sepsis, a life-threatening organ dysfunction that necessitates intensive medical management for survival; a variety of pathogens can lead to this phase.[17]

Infection Phases

1 – Exposure phase

2 – Latency phase

3 – Prodrome phase

4 – Syndrome phase

5 – Sepsis phase

If an individual progresses through latency and into prodrome, they will likely become a casualty and a loss to the Joint Force. To prevent casualties, medical intervention, including countermeasures, must prevent the development of the specific syndrome phase. According to doctrine, a casualty is "any person who is lost to the organization by having been wounded, ill, or injured," while a patient is a casualty who has entered the medical stream.[18]

Some pathogens are transmissible from one person to another during the course of a disease. Transmission normally occurs in symptomatic people beginning in either the prodromal phase or syndrome phase discussed above, but may occur in the latency phase. Effective treatment at this phase may not only be beneficial to the patient, but may help reduce the spread of the pathogen in the force and reduce mission degradation.

B. Mission Expected to be Performed

The Joint Force conducts missions across the range of military operations. During its missions, such as offensive operations, defensive operations, or peacekeeping, the Joint

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[17] North Atlantic Treaty Organization, "Medical Management of CBRN Casualties," AMedP-7.1, Edition A Version 1 (Ratification Draft), (Brussels, Belgium: Headquarters, North Atlantic Treaty Organization).

[18] Headquarters, Department of the Army, "Multi-Service Tactics, Techniques, and Procedures for Health Service Support in a Chemical, Biological, Radiological, and Nuclear Environment," ATP 4-02.7/MCRP 4-11.1F/NTTP 4-02.7/AFTTP3-42.3 (Washington, DC: Headquarters, Department of the Army, March 2016).

Force may encounter pathogens used as biological weapons or pathogens endemic within its environment and must be prepared to:

- protect itself against pathogenic organisms used as a biological weapon through awareness, physical protection, and MCMs; and
- respond to exposure and mitigate the effects of pathogenic organisms used as a biological weapon, including through the treatment and management of casualties.

The risks posed by pathogenic organisms used as biological weapons occur across the range of military operations. To minimize the operational impact, it is necessary to consider elements of defense and how diverse capabilities, such as biological detection and identification, physical protection, physiological protection, and treatment, combine to reduce casualties and maintain operational effectiveness.

C. Commander's Intent

The commander's intent is to apply all appropriate capabilities, including MCMs, before and after the use of pathogenic organisms as biological weapons to minimize exposure, prevent infection, and control the spread or transmission of pathogens to minimize casualties and maintain operational effectiveness of the Joint Force.

D. Operational Overview across the Full Range of Military Operations

Defense against pathogens is needed across the range of military operations. This operational overview considers some basic principles of defense. It discusses the need for awareness and understanding of the pathogen and its use, the use and limitations of physiological protection in providing protection against pathogens, and response and mitigation following an event. Most aspects of post-event recovery are beyond the scope of this concept. This overview concludes with a discussion of the roles of care within the military healthcare system and how those roles impact the ability to deliver and use MCMs. An OV-1 detailing the strategic and operational elements can be found in Appendix D.

1. Principles of Defense against BW Pathogens

The defense against pathogens requires significant interaction between the elements of the general military health system and the chemical, biological, radiological, and nuclear (CBRN) protection and response systems. Post-exposure prophylaxis, as discussed in Section 2.D.1.b, can effectively prevent casualties for some pathogens but requires a trigger to begin administration; that trigger is likely to be detection and identification of a pathogen

through environmental monitoring (i.e., biodetection).[19] Preventing exposure through physical protection[20] is the most effective means of preventing casualties; however, physical protection can be cumbersome and requires prior warning that may not be timely or available. MCMs are a necessary element of casualty treatment, but are unlikely to be effective without integration into the normal military health system. This concept revolves around the major task elements of providing awareness of pathogen risk, protecting against and avoiding pathogen hazards, responding to and mitigating hazards, and recovering from and containing hazards. Many of these tasks involve significant contributions from outside the medical system, and many medically focused tasks extend far beyond the application and delivery of MCMs. This concept emphasizes MCMs, but the effective use of MCMs requires tasks and capabilities that share the responsibility for reducing casualties, including intelligence, environmental detection and identification, warning and reporting, and comprehensive health surveillance.

a. The Importance of Awareness and Knowledge

Awareness of the pathogen risk is key to strategic, operational, and tactical decisions. Awareness may arise from intelligence assessments, which may influence strategic decisions to produce specific countermeasures, as well as the operational decisions to employ them. It may arise tactically from environmental detection or identification of environmental samples, specific diagnostic testing of symptomatic or pre-symptomatic individuals, or clinical diagnosis of a representative syndrome. The specificity of the countermeasure that can be used will generally increase with greater understanding of the threat. However, the Joint Force must be prepared to respond to circumstances where awareness and understanding of the threat is at least initially limited; for example, even if the pathogen cannot be definitively identified, clinicians can nonetheless successfully treat casualties and manage patients.

Awareness changes following a recognized initial use (i.e., the Joint Force knows pathogen use has occurred and must adapt accordingly). This could include increased use of physical protection, more intensive sampling and identification efforts, or the increased use of physiological protection as described below. The Joint Force must also recognize that the response to an initial attack may not be the most appropriate or effective response to a subsequent attack if a different pathogen is used.

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[19] Post-exposure prophylaxis is most effective if initiated prior to the development of symptoms, which requires a trigger, such as biodetection and identification. Triggering post-exposure prophylaxis for asymptomatic personnel based on diagnosis of symptomatic personnel will largely miss the window during which the post-exposure prophylaxis would be most effective for most situations.

[20] In this concept, physical protection against pathogens refers primarily to the employment of chemical and biological personal protective equipment (PPE), including ocular, respiratory, and percutaneous protection, and the use of collective protection systems, such as filtered air systems in over-pressured shelters and buildings.

b. The Role and Limitations of Physiological Protection

For the purposes of this concept, physiological protection refers to actions taken to increase the body's resistance to the effects of pathogens. This may include medical actions, such as immunization, or health promotion activities, such as proper nutrition and sleep cycles. Physiological protection provides a large element of protection against pathogens and this concept will concentrate on the medical aspects of physiological protection. There are four primary methods of physiological protection to reduce susceptibility: active immunization, passive immunization, chemoprophylaxis, and increasing non-specific immunity.

Active immunization results in the production of antibodies after stimulating the immune system through vaccination.[21] The individual's immune system responds to one or more antigens, such that a subsequent exposure to the pathogen presenting that antigen results in an immune response that either prevents disease or reduces the severity of its impact.[22]

Passive immunization provides temporary immunity through the introduction of antibodies derived from serum or produced in cell culture.[23] These antibodies are typically injected into the recipient and confer temporary immunity until they are removed from the body by natural processes or exhausted by fighting infection with a pathogen.[24]

Chemoprophylaxis is the prevention of a disease (especially an infectious disease) by administering drugs.[25] The most common examples in typical military settings are the use of antivirals for influenza or antimalarials. Chemoprophylaxis may be administered

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21 Andrew T. Kroger, Alison C. Mawle, Larry K. Pickering, and Walter A. Orenstein, "Active Immunization," in Sarah S. Long, Larry K. Pickering, and Charles G. Prober, eds., *Principles and Practice of Pediatric Infectious Diseases*, 4th ed. (New York, NY: Elsevier, Inc., 2012), 44, accessed April 23, 2018, https://www.sciencedirect.com/science/article/pii/B9781437727029000064.

22 F.E. Andre, R. Booy, H.L. Bock, J. Clemens, S.K. Datta, T.J. John, B.W. Lee, S. Lolekha, H. Peltola, T.A. Ruff, M. Santosham, and H.J. Schmitt, "Vaccination Greatly Reduces Disease, Disability, Death and Inequity Worldwide," *Bulletin of the World Health Organization* 86, no. 2 (February 2008), accessed April 23, 2018, http://www.who.int/bulletin/volumes/86/2/07-040089/en/.

23 Kroger, Mawle, Pickering, and Orenstein, "Active Immunization," in Long, Pickering, and Prober, eds., *Principles and Practice of Pediatric Infectious Diseases*, 44.

24 Ron J. Keizer, Alwin D.R. Huitema, Jan H.M. Schellens, and Jos H. Beijnen, "Clinical Pharmacokinetics of Therapeutic Monoclonal Antibodies," *Clinical Pharmacokinetics* 49, no. 8 (August 2010), accessed April 23, 2018, https://www.ncbi.nlm.nih.gov/pubmed/20608753.

25 Oxford English Dictionary, "Chemoprophylaxis," accessed April 20, 2018, http://www.oed.com/view/Entry/31277?redirectedFrom=chemoprophylaxis#eid9675697.

following a known or likely exposure or, as with antimalarials, an exposure may be assumed based on the environment and other circumstances.

Reducing Susceptibility

Active Immunization

Passive Immunization

Chemoprophylaxis

Non-specific Immunity

Non-specific immunity refers to the innate actions of the body to resist a pathogen, such as the general barrier provided by intact skin, or the non-specific actions by cells, such as macrophages directed at "foreign" materials.[26] Methods to increase non-specific immunity still require additional research to prove their efficacy, but might involve processes as diverse as the use of nutraceuticals[27] for antioxidant properties, probiotics to competitively inhibit gastrointestinal pathogens, or intranasal products to alter the ability of a pathogen to bind to the nasal epithelium.

Prophylaxis can be characterized further by when it is employed relative to a potential exposure. The use of prophylaxis prior to exposure is considered pre-exposure prophylaxis. Post-exposure prophylaxis is the use of one or more of the above methods (active immunization, passive immunization, chemoprophylaxis, or enhancements to non-specific immunity) following a known or likely exposure, such as in response to identification of the pathogen in environmental samples, to prevent or minimize the progression of disease. Post-exposure prophylaxis is most effective during the incubation or latent period of infection, as discussed in section 2.D.1.c.

Each of these protection strategies has advantages and limitations. Any of these strategies could be overcome in personnel who are initially exposed to sufficiently high quantities of agent delivered by an adversary. In considering the role and limitations of these strategies, or combinations of strategies, it is important to recognize the difference in the challenge to target populations exposed during an initial attack, through secondary exposures to communicable disease, and through reaerosolization of persistent hazards.

Active immunization can provide the greatest advantage; however, it is limited only to threats of which we have prior knowledge and awareness. Furthermore, a vaccine is directed against a specific pathogen and may be limited in its effectiveness against some subtypes of the pathogen, which may exist due to regional differences, seasonal variation, or directed efforts by adversaries to select a resistant strain. Active immunization usually

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[26] "Immune Response," in Marie T. O'Toole, ed., *Mosby's Medical Dictionary*, 10th ed. (St. Louis, MO: Elsevier, Inc., 2017), 901-902, accessed April 23, 2018, https://ebookcentral.proquest.com/lib/tiso-ebooks/detail.action?docID=4747147.

[27] A nutraceutical is generally a fortified food or dietary supplement that provides health benefits, as well as nutritional value. See Merriam-Webster, "Nutraceutical," accessed March 20, 2018, https://www.merriam-webster.com/dictionary/nutraceutical?src=search-dict-box.

precedes an exposure, although some immunizations are used as a response to exposure (smallpox vaccination, for instance[28]) when the incubation period of the disease is sufficiently long for the vaccine to induce effective immunity.

Passive immunization has the primary advantage of inducing a near-immediate effect.[29] It has the same limitations as active immunization regarding specificity of hazard, with the further limitations that its effectiveness is dose-dependent and not long lasting. Although one theoretical advantage is that it may be possible for passive immunization to slow a disease process so that the body can mount its own active response, this may not occur soon enough to prevent the disease.

The effective use of chemoprophylaxis can dramatically reduce the incidence of disease caused by the pathogen.[30] An advantage, depending on the drug, is that chemoprophylaxis may be effective against multiple pathogens; for instance, current doctrine recommends administering doxycycline in high-threat environments for plague and suggests it may also be effective for tularemia.[31] However, this can be limited by the need for awareness of the threat and potential resistance to the specific drug. Greater knowledge of the threat allows selection of the most appropriate drug. Chemoprophylaxis for viral pathogens has been much more limited than for bacterial pathogens. Chemoprophylactic drugs may also have undesirable side effects that may limit their use, unless their negative effects are deemed acceptable, given the risk from the threat.

Post-exposure prophylaxis may involve any combination of the MCMs discussed above after a known or suspected exposure and before illness develops. Post-exposure recommendations for inhalational anthrax, for instance, have involved the use of antibiotics and immunization, with or without human monoclonal antibodies[32]. This approach allows for the antibiotics to attack the vegetative bacteria, the monoclonal antibodies to bind the bacterial toxins, and the vaccine to produce long-lasting immunity. This combined approach increases the likelihood of success in preventing the development of a highly fatal disease for which each individual element may fail. An advantage of post-exposure

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28 Centers for Disease Control and Prevention (CDC), "Smallpox: Prevention and Treatment," updated June 7, 2016, accessed April 23, 2018, https://www.cdc.gov/smallpox/prevention-treatment/index.html.

29 David Baxter, "Active and Passive Immunity, Vaccine Types, Excipients and Licensing," *Occupational Medicine* 57, no. 8 (December 2007), 552, accessed April 23, 2018, https://academic.oup.com/occmed/article/57/8/552/1474357.

30 CDC, "Achievements in Public Health, 1900-1999: Control of Infectious Diseases," *Morbidity and Mortality Weekly Report* 48, no. 29 (July 1999), accessed April 23, 2018, https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4829a1.htm.

31 Headquarters, Department of the Army, "Multiservice Tactics, Techniques, and Procedures for Treatment of Biological Warfare Agent Casualties," ATP 4-02.84/MCRP 4-11.1C/NTRP 4-02.23/AFMAN 44-156_IP (Washington, DC: Headquarters, Department of the Army, 25 March 2013).

32 CDC, "Anthrax: Prevention," updated February 14, 2018, accessed April 23, 2018, https://www.cdc.gov/anthrax/medical-care/prevention.html.

prophylaxis is that it can dramatically decrease casualties, despite being initiated after exposure. Post-exposure prophylaxis may have less impact on pathogens with very short incubation periods, as the illness may progress faster than post-exposure prophylaxis can be implemented. The use of post-exposure prophylaxis requires an identifiable "trigger," through biodetection and identification or timely diagnostics, to be most effective. Initiation of post-exposure prophylaxis following environmental detection and identification will generally prevent more casualties than implementing post-exposure prophylaxis following diagnosis of an index case, because information is available sooner via environmental samples.

Increasing non-specific immunity has the potential advantage of enhancing the body's ability to resist any pathogen and requires the least awareness. Much of the work in this area has involved selection of disease-resistant plants and animals;[33] its application to adult humans remains theoretical. Overstimulation of the specific immune system is an underlying process in autoimmune disorders and is associated with some types of cancer, which could be a potentially significant limitation in the implementation of non-specific immunity enhancement in humans. Since non-specific immunity capabilities are in the earliest stages of development, they will not be discussed further in this concept, but future versions should reassess their inclusion. Maintaining overall health, including nutrition and appropriate sleep cycles, facilitates general resistance to pathogens.

Lacking dramatic improvements in detect-to-warn capability for pathogens, or use of the near constant employment of physical protection,[34] physiological methods of protection will remain fundamental to defending against pathogens used as biological weapons throughout the timeframe of this concept.

c. Response and Mitigation

Effective response and mitigation of a BW pathogen (or combination of pathogens) event generally requires a combination of pathogen-specific and non-specific actions. Lacking awareness or sufficient understanding of a specific BW event through intelligence, environmental detection and identification, or other means, the initial cases will be

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[33] O. Yengkhom, K.S. Shalini, P.A. Subramani, R.D. Michael, "Non-Specific Immunity and Disease Resistance are Enhanced by the Polysaccharide Fraction of a Marine Chlorophycean Macroalga in *Oreochromis niloticus* (Linnaeus, 1758)," *Journal of Applied Ichthyology* 34, no. 3 (June 2018), accessed April 23, 2018, https://onlinelibrary.wiley.com/doi/pdf/10.1111/jai.13606; Shieh-Tsung Chiu, Ya-Li Shiu, Tsung-Meng Wu, Yu-Syuan Lin, and Chun-Hung Liu, "Improvement in Non-Specific Immunity and Disease Resistance of Barramundi, *Lates calcarifer* (Bloch), by Diets Containing *Daphnia similis* meal," *Fish & Shellfish Immunology* 44, no. 1 (May 2015), accessed April 23, 2018, https://www.sciencedirect.com/science/article/pii/S1050464815000546?via%3Dihub.

[34] In this concept, physical protection against pathogens refers primarily to the employment of chemical and biological personal protective equipment, including ocular, respiratory, and percutaneous protection, and the use of collective protection systems, such as filtered air systems in over-pressured shelters and buildings.

managed by treating symptoms at the lowest appropriate role of care (though this may remain appropriate even with more specific knowledge) and patients will be evacuated to higher roles of care (discussed in 2.D.2) as needed. Higher roles of care provide increasing levels of capability to diagnose and manage complex cases, as well as the logistic functions to maintain care. As understanding of the event increases and the identification and characterization (including drug sensitivities) of the causative agent occurs, more specific countermeasures can be applied as appropriate to manage casualties, if such countermeasures exist and are readily available.

The ideal system mixes syndrome-based management using available and potentially less specific drugs at lower roles of care for initial management with more focused therapies at higher roles of care, always considering the overall capability of the treating facility.[35] The overall medical management of the patient remains vital; for instance, pneumonia may require extensive respiratory support, regardless of the cause, in addition to antibiotics or antivirals. Another example is the use of antivirals, which prevent viral replication and tend to decrease in effectiveness fairly early in disease progression. Late administration of antivirals will not prevent the viral replication that may have already produced the underlying disease, at which point supportive care will be the most significant element of patient management.

d. Recovery

In this concept, recovery refers not only to the recovery of patients, but also the recovery of the Joint Force to continue or resume its underlying mission. Recovery of patients through definitive care is beyond the scope of this concept. Recovery of the Joint Force through hazard containment or personnel or unit replacement, other than mitigation of the immediate effects of pathogen use, is similarly beyond the scope of this concept.

2. Roles of Care

This concept considers the four levels or "roles" of medical care[36] within the military healthcare system that provide medical services, such as measures that prevent and treat disease and non-battle injuries, provide immediate lifesaving, or provide patient holding capacity. Roles of care are determined by functions and capability and include: First Responder Care (Role 1), Forward Resuscitative Care (Role 2), Theater Hospitalization (Role 3), and Definitive Care (Role 4).[37]

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[35] Early application of an effective, even non-specific, countermeasure at lower roles of care may reduce the need for care at higher roles and increase return to duty rate for casualties.

[36] Joint Chiefs of Staff, *Joint Health Services*, JP 4-02 (Washington, DC: Government Printing Office, 11 December 2017).

[37] Joint Chiefs of Staff, *Joint Health Services*, JP 4-02.

As stated in the *Operating in an Infectious Disease Environment Capabilities Based Assessment*,

> Medical capabilities increase with higher roles of care. Role 1 care is ordinarily unit-level, highly mobile, and most closely associated with support to maneuver units of the Army and Marines. Role 2 care is typically less mobile and includes Army medical companies within maneuver brigades or providing area support, as well as the Air Force Expeditionary Medical Support (EMEDS) and shipboard care within the Navy. Role 3 facilities are hospitals, such as the Army Combat Support Hospital or the Air Force EMEDS +25 (25-bed configuration), and are typically large and relatively immobile.[38]

Roles of Care

Self-Aid

Role 1 - First Responder

Role 2 – Forward Resuscitative Care

Role 3 – Theater Hospitalization

Role 4 – Definitive Care

Role 4 medical care is provided in U.S.-based hospitals or, less commonly, overseas in fixed hospital facilities.

Self-aid, also called buddy-aid, is a part of Role 1 care, but is treated separately here to distinguish prevention and care that can be provided by non-medical personnel from that provided by medical personnel and medical organizations.

E. Objectives

The purpose of this concept is to describe a layered defense of medically focused and non-medically focused capabilities, allowing the Joint Force to mitigate the impact of pathogenic organisms used as biological weapons while successfully continuing its primary mission. The Joint Force's objectives are to ensure that:

- pathogen risks are recognized, understood, and mitigated;
- personnel do not become casualties:
  - personnel are not exposed,
  - personnel are not infected,
  - personnel do not develop symptoms,
  - pathogens are not spread or transmitted; and
- operational effects from adversary pathogen use are prevented.

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[38] William Smedley, Mark Bohannon, Jeffrey Grotte, Larysa Murray, Scott Weinrich, and Stephanie Wiseman, *Operating in an Infectious Disease Environment (IDE) Capabilities Based Assessment (CBA)*, IDA Document D-1854 (Alexandria, VA: Institute for Defense Analyses, 2016), 26.

F. Roles and Responsibilities of Tasked Units

Following a pathogen event, each individual will have certain roles and tasks to complete to bring the Joint Force back to full operating strength. Certain roles and responsibilities fall to specific individuals or organization units, which are outlined below.

- **Commanders at all levels:** Ensure that unit is prepared to respond to a possible emergency, including a BW attack. Coordinate CBRN defense measures with area or base cluster commanders. Integrate unit, installation, and host nation emergency response capabilities in a way that sustains installation capabilities and readiness. Commanders are ultimately responsible for maintaining the health of their commands and their ability to complete their mission, even in the event of a BW attack.
- **Intelligence Organizations:** Collect and analyze information on CBRN threats and their effects to characterize hazards in different operating environments. Collect and analyze health-related information to understand the disease background in the operating environment.
- **Biological Detection Organizations:** Perform environmental monitoring, including air sampling, detection, and identification, to provide awareness and understanding of an attack.
- **Force Health Protection:** Perform 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.[39]
- **Medical Treatment Facilities:** Integrate care for casualties of pathogens used as biological weapons into the military health system.
- **Mortuary Affairs:** Provide disposition of human remains, including decontamination and management of fatalities from pathogens. [40]
- **Medical Evacuation:** The Commander of U.S. Transportation Command (TRANSCOM) establishes and operates the aeromedical evacuation system for both intra- and inter-theater patient movement and has the authority to stop the movement of contaminated or contagious patients.[41]

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[39] Joint Chiefs of Staff, *Operations in Chemical, Biological, Radiological, and Nuclear Environments,* JP 3-11 (Washington, DC: Joint Chiefs of Staff, 4 October 2013).

[40] Headquarters, Department of the Army, "Multi-Service Tactics, Techniques, and Procedures for Health Service Support in a Chemical, Biological, Radiological, and Nuclear Environment," ATP 4-02.7/MCRP 4-11.1F/NTTP 4-02.7/AFTTP3-42.3 (Washington, DC: Headquarters, Department of the Army, March 2016).

[41] Joint Chiefs of Staff, *Operations in Chemical, Biological, Radiological, and Nuclear Environments,* JP 3-11.

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3. Functions and Tasks

Certain tasks are required to maintain the layered defense necessary to protect the Joint Force from pathogens and allow freedom of operation in high-risk environments. This section outlines and defines the tasks to be completed as part of the layered pathogen defense strategy. An OV-1 detailing the strategic and operational context under which these tasks fall can be found in Appendix D.

- **Monitor, coordinate, and synchronize operations to manage pathogen defense activities:** Monitor operations for the purpose of coordinating and managing the pathogen defense activities of appropriate agencies, organizations, and units during mobilizations, deployment, employment, sustainment, redeployment, rotation, and demobilization. Monitoring efforts include changes in threat assessments, unit rotations, unit status, and other changes in the operational environment that could impact pathogen defense efforts; this also includes the dissemination of information to support operations and decision making. Monitoring focuses on progress toward accomplishing missions, creating effects, and achieving objectives.
    - **Conduct intelligence gathering and analysis:** The intelligence community collects and analyzes information about adversary CBRN capabilities and intentions, along with other potential sources of CBRN hazards.
    - **Conduct comprehensive health surveillance operations related to exposure to pathogen hazards:** Collect, analyze, document, and report medical health information, environmental monitoring, and exposure-related information to support operational decisions, medical support, and long-term health effects identification and mitigation. This includes occupational and environment health-hazard data; medical encounters and history; and food, water, vector, and animal health information.
    - **Conduct environmental sampling, detection, and identification:** Collect samples of air, soil, and water for testing and detect and identify pathogen hazards using biological detectors or monitoring and survey teams.
    - **Provide pathogen hazard warning:** Provide timely and accurate warning, based on pathogen detection, identification, indications, or effects, to units at risk from the hazard to enable protective measures that would reduce exposure and casualties.

  - **Diagnose pathogen effects:** Assess pathogen exposure or disease in military personnel and eligible civilians to support medical decisions. Includes identifying causative agents and their effects, as well as monitoring pre-symptomatic individuals.

- **Protect and avoid pathogen hazards:** Take actions at the individual or unit level to avoid hazards and protect against their effects.
  - **Provide pre-exposure prophylaxis:** Perform immunizations, administer passive immunization products, and initiate chemoprophylaxis before a potential exposure, as appropriate, to prevent or minimize the impact of disease.
  - **Provide physical protection:** Protect personnel from exposure to pathogen hazards using methods including individual and collective physical protection, and protection of casualties and patients from further exposure.
  - **Ensure proper hygiene:** Ensure that standards of hygiene, nutrition, and proper sleep cycles are maintained.
- **Respond to and mitigate hazards:** Respond to an incident by initially mitigating the effects and performing only those actions required to allow continuation of the mission and, within mission constraints, save lives.
  - **Address short-term effects:** Address the short-term, direct effects of an incident, including those actions taken to save lives, prevent human suffering, protect property, and establish control.
  - **Conduct appropriate patient triage:** Classify patients according to the type and severity of illness or injury. In a CBRN environment, triage must also consider the level of contamination of the patient to achieve the most orderly, timely, and efficient use of health service support (HSS) resources.
  - **Provide post-exposure prophylaxis:** Perform immunizations, administer passive immunization products, and initiate chemoprophylaxis after a known or suspected exposure, as appropriate, to prevent or minimize the impact of disease.
  - **Perform patient management:** Treat and manage patients affected by pathogens; this process is informed by task diagnoses and includes triage, assessment, treatment, and hospitalization, as required.
  - **Conduct initial decontamination:** Decontamination carried out by individuals immediately upon becoming contaminated to save lives, minimize casualties, and limit the spread or transfer of contamination.

Initial decontamination includes casualty decontamination prior to admission to a clean health care facility.

- **Recover from and contain hazards:** Take actions focusing on restoring mission capability and essential services interrupted by the incident. The recovery phase also includes completing the mitigation of the immediate hazard.
    - **Restore mission capability and essential services:** Take actions to accomplish unit's mission in a CBRN or unintentional-release environment.
    - **Perform public health interventions:** Perform basic public health interventions, including epidemiological investigations of potential outbreaks, contact tracing, and oversight of quarantine and isolation.
    - **Conduct decontamination:** Absorb, destroy, neutralize, make harmless, or remove biological pathogens that are around or clinging to a person, object, or area to make it safe.

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4. Capabilities Required by this Concept

To perform the tasks listed in section 3, the Joint Force must have the capability to carry out those tasks in a timely and efficient manner. The following section outlines the capabilities required to perform the tasks in this concept.

- **Intelligence Collection and Analysis:** The ability to collect, process, integrate, evaluate, analyze, and interpret available information concerning foreign nations, hostile or potentially hostile forces or elements, or areas of actual or potential operations.[42]
- **Hazard Prediction:** The ability to predict the movement of CB hazards over time and update to account for new or changing information.
- **Joint Theater Directed Coordination, Synchronization, and Medical Situational Awareness:** The ability to ensure unity of medical efforts in the joint operations area (JOA) through joint processes and tools that facilitate medical communication, collaboration, and coordination, as well as a common operating picture of health service capabilities and threats to enable a Joint Force Commander (JFC) to decide in real time.[43]
- **Medical Diagnosis:** The ability to analyze clinical specimens for the presence of infectious disease agents or their effects in humans.
- **CB Integrated Early Warning and Communications (CB IEW):** The component of CBRN awareness and understanding that provides timely and accurate warning to enable actions that prevent or reduce exposure, casualties, and impact to mission from CBRN attacks.
- **Respiratory and Ocular Protection:** The ability to protect personnel against the absorption of liquid, vapor, and aerosol hazards through the eyes or lungs.[44]

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[42] Department of Defense, *DOD Dictionary of Military and Associated Terms*, accessed March 16, 2018, http://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf?ver=2018-02-21-153603-643.

[43] Joint Chiefs of Staff, *Joint Concept for Health Services (JCHS)*, (Washington, DC: Joint Chiefs of Staff, 31 August 2015).

[44] Pathogens do not pose a vapor hazard, and are unlikely to pose a liquid hazard in most operational settings outside a clinical or laboratory setting. Most pose little ocular hazard outside those specific settings.

- **Percutaneous Protection:** The ability to protect personnel against the penetration of liquid, vapor, and aerosol hazards through skin contact or exposure.[45]
- **Collective Protection:** The ability to protect a group of individuals that permits relaxation of individual chemical, biological, radiological, and nuclear protection.
- **Sanitation and Hygiene:** The ability to promote conditions or practices conducive to health and prevention of disease by maintenance of sanitary conditions.[46]
- **Biological Prophylaxis:** The ability to provide protection to an individual against the adverse effects of biological and biologically derived hazards using medical countermeasures.
- **Biological Therapeutics:** The ability to treat an individual affected by biological and biologically derived hazards.
- **Medical Treatment Facilities (MTFs):** The ability to employ a continuum of healthcare delivery units tailored and scaled for different domains, operational environments, and spectrums of conflict in support of Joint Force operations.[47]
- **Isolation:** the ability to separate persons who have a specific infectious illness from a healthy population to provide specialized medical care while preventing other people from getting sick.
- **Patient Evacuation:** The ability to integrate transportation, medical treatment, logistics, and command, control, communications, computers, and intelligence to provide effective en-route care and efficient movement of patients to appropriate treatment facilities in support of Joint Force operations.
- **Patient Management:** The ability to effectively apply the required scope of health service capabilities for each casualty or injury accepted into care as a patient to achieve the lowest mortality and morbidity possible in support of Joint Force operations.

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[45] Pathogens do not pose a vapor hazard, and are unlikely to require percutaneous protection in most operational settings outside a clinical or laboratory setting.

[46] Merriam-Webster, "Hygiene," accessed March 20, 2018, https://www.merriam-webster.com/dictionary/hygiene; Merriam-Webster, "Sanitation," accessed March 20, 2018, https://www.merriam-webster.com/dictionary/sanitation.

[47] Joint Chiefs of Staff, *Joint Concept for Health Services (JCHS)*.

- **Materiel Contamination Mitigation:** The ability to remediate (absorb, destroy, neutralize, or remove) infectious hazards from sensitive/non-sensitive equipment and mission-critical facilities/infrastructure.
- **Medical Mitigation of the Environment:** The ability to execute preventive medicine, public health, health surveillance, and health risk assessment to enable the Joint Force to predict, prevent, and mitigate the effects of climate, environment, or other health threats.[48]

[48] Joint Chiefs of Staff, *Joint Concept for Health Services (JCHS)*.

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5. Risks of Adopting this Concept

This concept, as written, depends on integration of MCMs into the existing and future military health system, as well as the CBRN defense capabilities. Although that integration provides opportunity, it also presents the following potential risks:

- Intelligence and other warnings or indicators may not be specific enough to develop or implement pre-exposure prophylaxis.
- CBRN awareness and understanding resulting from warning and reporting, detection, diagnosis, and timely analytics may be insufficient to don personal protective equipment or implement post-exposure prophylaxis and prevent casualties.
- MCMs may be insufficient to manage the effects of pathogens used as biological weapons without significant supportive care from the MHS that may not be available at the necessary role of care.
- The focus of the MHS on combat trauma may limit its ability to respond to and manage patients resulting from pathogens used as biological weapons.

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Appendix A.
Terms and Definitions

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)

Collective protection (COLPRO) – the protection provided to a group of individuals that permits relaxation of individual chemical, biological, radiological, and nuclear protection. (JP 3-11)

Communicable disease – 1. A disease that can be transmitted from person to person. (JP 3-11) 2. An illness due to an infectious agent or its toxic product, which may be transmitted from a reservoir to a susceptible host either directly as from an infected person or animal or indirectly through an intermediate plant or animal host, vector, or the inanimate environment. (DODD 6200.3)

Contamination mitigation – the planning and actions taken to prepare for and recover from contamination associated with all CBRN hazards to contain the spread of CBRN contamination and prevent the loss of assets. (JP 3-11)

Decontamination – the process of making any person, object, or area safe by absorbing, destroying, neutralizing, making harmless, or removing chemical or biological agents, or by removing radioactive material clinging to or around it. (JP 3-11)

Detection – in chemical, biological, radiological, and nuclear environments, the act of locating chemical, biological, radiological, and nuclear hazards by use of chemical, biological, radiological, and nuclear detectors or monitoring and/or survey teams. (JP 3-11)

Endemic disease – a physical or mental disorder caused by health conditions usually present within a community. It usually describes an infection that is transmitted directly or indirectly between humans and is occurring at the usual expected rate. (Mosby's Dictionary of Medicine, Nursing & Health Professions)

Environmental sampling – the collection of samples from air, soil, water, food, or plants for analysis to facilitate identification of BW agents. (ATP 4-02.84)

Environmental surveillance – the regular or repeated collection, analysis, archiving, interpretation, and dissemination of occupational and environmental health-related data (such as air monitoring for the detection of contaminants) that may impact the health of a population. (FM 3-11)

Identification – the act of determining the taxonomic position of a biological specimen. (Merriam-Webster Medical Dictionary)

- *Presumptive identification* – the employment of technologies with limited specificity and sensitivity, by conventional forces in a field environment to determine the presence of a CBRN hazard with a low level of confidence and the degree of certainty necessary to support immediate tactical decisions. (JP 3-11)
- *Field confirmatory identification* – the employment of technologies with increased specificity and sensitivity by technical forces in a field environment to identify CBRN hazards with a moderate level of confidence and the degree of certainty necessary to support follow-on tactical decisions. (ATP 3-11.37)
- *Theater validation* – the employment of multiple independent, established protocols and technologies by scientific experts in the controlled environment of a fixed or mobile/transportable laboratory to characterize a CBRN hazard with a high level of confidence and the degree of certainty necessary to support operational-level decisions. (JP 3-11/ATP 3-11.37)
- *Definitive identification* – the employment of multiple independent, established protocols and technologies by scientific experts in a nationally recognized laboratory to determine the unambiguous identity of a CBRN hazard with the highest level of confidence and degree of certainty necessary to support strategic-level decisions. (ATP 3-11.37)

Isolation – The separation of a person or group of persons infected with a communicable disease while such disease is in a communicable stage from other people to prevent the spread of infection. (DODD 6200.3)

Latency period – the time between contact with a pathogen and development of symptoms. Also called incubation period. (Mosby's Dictionary of Medicine, Nursing & Health Professions)

Medical countermeasures – products (biologics, drugs, devices) that may be used in the event of a potential public health emergency stemming from a terrorist attack with a biological, chemical, or radiological/nuclear material, or a naturally occurring emerging disease. (FDA)[49]

Medical surveillance – the ongoing, systematic collection, analysis, and interpretation of data derived from instances of medical care or medical evaluation, and the reporting of population-based information for characterizing and countering threats to a population's health, well-being, and performance. (JP 1-02. Source: JP 4-02)

Mission-oriented protective posture (MOPP) – a flexible system of protection against chemical, biological, radiological, and nuclear contamination in which personnel are required to wear only that protective clothing and equipment appropriate to the threat level, work rate imposed by the mission, temperature, and humidity. (JP 3-11)

Non-persistent agent – a chemical agent that when released dissipates and/or loses its ability to cause casualties after 10 to 15 minutes. (JP 3-11)

Patient – a casualty who has entered the military medical system. (ATP 4-02.7)

Persistent agent – a chemical agent that, when released, remains able to cause casualties for more than 24 hours to several days or weeks. (JP 3-11)

Personal protective equipment (PPE) – the protective clothing and equipment provided to shield or isolate a person from the chemical, biological, physical, or thermal hazards that can be encountered at a hazardous materials incident. (JP 3-11)

Physiological protection – those actions taken to increase resistance of the body to the effects of pathogens and may include medical actions such as immunization as well as health promotion activities such as proper nutrition and sleep cycles. (Term introduced in this paper, Section 1.C)

[49] U.S. Food & Drug Administration (FDA), "What are Medical Countermeasures?" updated March 16, 2018, accessed April 20, 2018, https://www.fda.gov/emergencypreparedness/counterterrorism/medicalcountermeasures/aboutmcmi/ucm431268.htm.

Prophylaxis – prevention of or protection against disease, often involving the use of a biological, chemical, or mechanical agent to destroy or prevent the entry of infectious organisms. (Mosby's Dictionary of Medicine, Nursing & Health Professions)

- *Pre-exposure prophylaxis* – prevention of disease by administering a medical countermeasure before exposure to a pathogen
- *Post-exposure prophylaxis* – prevention of disease by administering a medical countermeasure after exposure to a pathogen. PEP is different from therapy/treatment in that symptoms have not yet manifested when PEP is given.

Quarantine – Compulsory detention or other similar restriction, including isolation, for purposes of preventing or limiting the spread of disease, of individuals or groups reasonably believed to be infected with a communicable disease while such disease is in a communicable stage, or is in a pre-communicable stage if the disease would be likely to cause a public health emergency if transmitted to other individuals. (DODD 6200.3)

Response – actions that address the short-term, direct effects of an incident; response measures initiated by the response unit include those actions taken to save lives, prevent human suffering, protect property, and establish control. (FM 3-11)

Threat – ongoing or potential enemy actions; adverse environmental, meteorological, and geographical conditions; endemic diseases. (FM 3-11)

Treatment – the care and management of a patient to combat, ameliorate, or prevent a disease, disorder, or injury. (Mosby's Dictionary of Medicine, Nursing & Health Professions)

Vulnerability – 1. The susceptibility of a nation or military force to any action by any means through which its war potential or combat effectiveness may be reduced or its will to fight diminished. (JP 3-01) 2. The characteristics of a system that cause it to suffer a definite degradation (incapability to perform the designated mission) as a result of having been subjected to a certain level of effects in an unnatural (man-made) hostile environment. (JP 3-60)

Appendix B.
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Appendix C.
Abbreviations and Acronyms

AFMAN	Air Force Manual
BW	biological warfare
CB	chemical and biological
CBA	Capabilities Based Assessment
CBRN	chemical, biological, radiological, and nuclear
CCJO	Capstone Concept for Joint Operations
CDC	Centers for Disease Control and Prevention
COLPRO	collective protection
DOD	Department of Defense
DODAF	DOD Architecture Framework
EMEDS	Expeditionary Medical Support System
FDA	Food & Drug Administration
HSS	Health Service Support
JCIDS	Joint Capabilities Integration and Development System
JCHS	Joint Concept for Health Services
JFC	Joint Force Commander
JOA	Joint Operations Area
JOE	Joint Operating Environment
JRO-CBRND	Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense
MCM	medical countermeasures
MHS	military health system
MOPP	mission-oriented protective posture
MTF	medical treatment facility
NBCC	nuclear, biological, chemical, and conventional
PPE	personal protective equipment
TRANSCOM	United States Transportation Command
WMD	weapons of mass destruction

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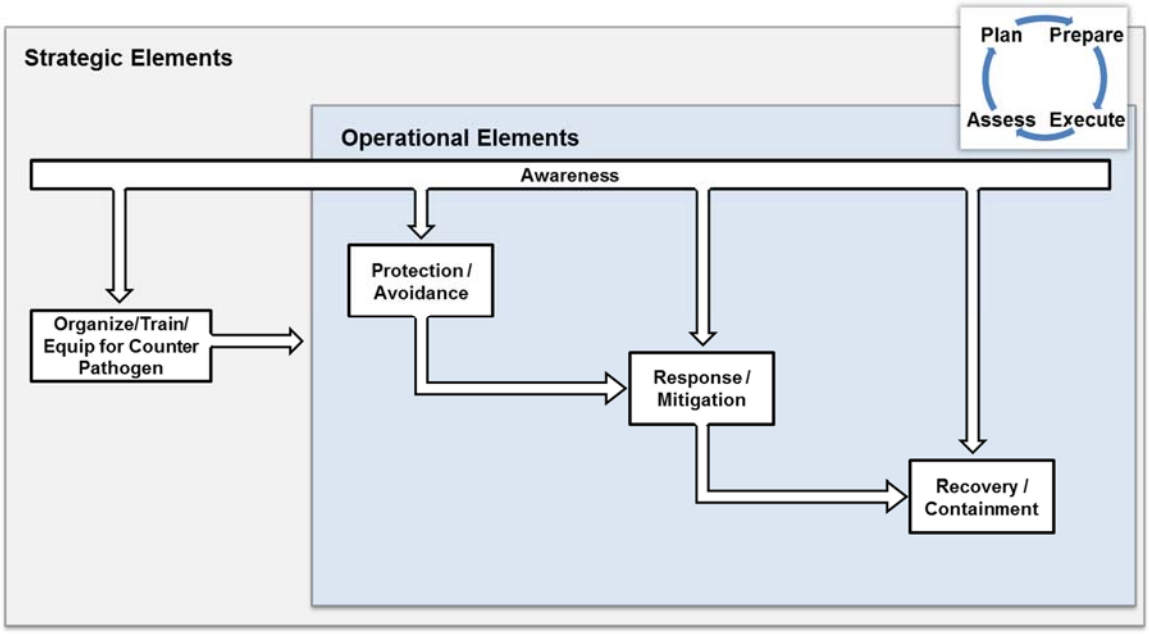
Appendix D.
Application (OV-1)



This graphic ties the strategic elements of countering pathogens as biological weapons to the operational and tactical elements. Awareness at the strategic level, gained through intelligence, disease surveillance, agent research, and international partnerships enables the efforts to organize, train, and equip the force, including the development and fielding of medical countermeasures (MCMs). Awareness extends into the operational and tactical setting and enables the functions of protection and avoidance, response and mitigation, and recovery and containment. Each of these functions and their supporting tasks require the operational processes for planning, preparation, execution, and assessment.

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YYYY)	2. REPORT TYPE	3. DATES COVERED (From – To)
XX-02-2019	Final	

4. TITLE AND SUBTITLE	5a. CONTRACT NO.
Countering Biological Warfare (BW) Pathogens Concept Pt. 1	HQ0034-14-D-0001
	5b. GRANT NO.
	5c. PROGRAM ELEMENT NO(S).

6. AUTHOR(S)	5d. PROJECT NO.
Mark Bohannon Catherine Shuster William Smedley Stephanie Wiseman Jeffrey H. Grotte	5e. TASK NO. CA-6-4423
	5f. WORK UNIT NO.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NO.
Institute for Defense Analyses Strategy, Forces and Resources Division 4850 Mark Center Drive Alexandria, VA 22311-1882	IDA Paper P-10398 Log: H 19-000062

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR'S / MONITOR'S ACRONYM(S)
Joint Chiefs of Staff, J8 - Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense Pentagon, Arlington, VA	J-8/JRO CBRND
	11. SPONSOR'S / MONITOR'S REPORT NO(S).

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This document presents a capabilities based assessment (CBA) of the Department of Defense's future requirements to mitigate the risk of DOD personnel contracting an infectious disease of operational significance due to the intentional release of a pathogen via biological weapons. The Institute for Defense Analyses (IDA) based this CBA on the IDA-written "Countering Biological Warfare (BW) Pathogens Concept" concept of operations, as well as a pilot study and wargame with various stakeholders. The specific capabilities necessary to perform defending and mitigating tasks were analyzed to identify gaps and propose materiel and non-materiel solutions.

15. SUBJECT TERMS

Capabilities based assessment (CBA), Pathogens, Biological warfare, Biodefense, Joint Capabilities Development and Integration System (JCIDS), Capability Requirements, Medical countermeasures, Medical diagnosis

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NO. OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Dr. Ralph Kerr
U	U	U	U	50	19b. TELEPHONE NUMBER (Include Area Code) (571) 616-6074

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