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Medical Staff Guide for Biological Defense

Sean M. Oxford
Julia K. Burr
Ted J. Cieslak
Doug P. Schultz

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INSTITUTE FOR DEFENSE ANALYSES
730 East Glebe Road
Alexandria, Virginia 22305-3086

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For More Information

Dr. Sean Oxford, Project Leader
soxford@ida.org, 703-575-6348

Ms. Jessica L. Stewart, Director, SFRD
jstewart@ida.org, 703-575-4530

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Vignette

Over a five-day period in late August 1998, 99 Soldiers from a single Air Defense Artillery Training Battalion were admitted to William Beaumont Army Medical Center (WBAMC) at Fort Bliss, Texas for acute gastroenteritis (AGE), with the vast majority admitted on the 27th or 28th. The fact that 12 percent of the Battalion's strength of 835 required inpatient care over such a short timeframe was especially remarkable when one considers that WBAMC typically admits five such patients in an average month.

The first step in conducting an epidemiologic investigation is establishing whether, in fact, an epidemic has occurred in the first place. In this case, astute battalion and post commanders rapidly came to such a conclusion and contacted Army Public Health (PH) authorities. Moreover, these leaders had reason to believe that the outbreak may have been the result of sinister activity. In addition to the unexpectedly high morbidity (as reflected in the hospitalization rate) and compressed epidemiologic curve,[*] these leaders noted that Fort Bliss was located within a mile of the volatile Mexican border, that there were active labor grievances on base, and that nebulous terror threats had been made against the base.

An investigative team from the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) was brought in to investigate further. It was quickly established that the outbreak was caused by a novel *Norovirus* and that it originated from a point source.[*] Affected Soldiers consumed their meals in one of two dining facilities. Armed with knowledge of the disease's incubation period, PH investigators zeroed in on the exposure time frame and deduced that all affected Soldiers had consumed their lunch in one of the two facilities on one specific day within that timeframe. A menu from that meal was obtained from dining facility personnel and Soldiers were then asked to circle menu items that they believed they may have consumed at that meal. Consumption of pastries and soda correlated with risk of hospitalization for *Norovirus* AGE.

Pastries consumed at the dining facility in question were prepared by a baker who worked alone from midnight until 4:00 a.m. each day, at which time he was joined by additional breakfast shift kitchen personnel. The USACHPPM investigation determined that this baker was the index case, having become ill with diarrhea a few days before any Soldiers were affected. Coincidentally, the day Soldiers were seemingly exposed was the baker's final duty day prior to retirement. As such, and with the fear of adverse consequences minimized, he took the opportunity to settle a score with his kitchen supervisor by making fortuitous use of his diarrheal illness and defecating in her office and on her desk. He had not intended to infect "his" Soldiers and was mortified to learn of his causative role in the outbreak. However, carelessness likely caused him to contaminate the pastries he baked, and dehydration from vomiting and diarrhea may have led him to make many trips to the soda fountain, where he contaminated the dispenser nozzles with soiled hands.

This outbreak halted critical Air Defense training. Although it was not the result of biological warfare or terrorism (as it is usually defined), neither was it a random naturally occurring event. Alertness on the part of astute line commanders, informed by sound medical advice, led to a rapid response to the outbreak and its swift containment.[†] This document has been prepared to assist medical staff officers in providing similar well-reasoned advice during future operations.

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[*] See *Clues to the Intentional Nature of an Infectious Disease Outbreak*, in Section 4.C.

[†] For more information on this incident, see MAJ Mark Arness, MC, USAF et al., "Norwalk-like Viral Gastroenteritis Outbreak Among US Army Trainees, Fort Bliss, Texas," *Medical Surveillance Monthly Report* 4, no. 7 (1998), 2, 3, 8, 9. https://apps.dtic.mil/sti/pdfs/ADA497198.pdf.

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1. Introduction

A. Purpose and Applicability

1-1. Purpose: provide reference material and technical information to assist Army medical staffs in supporting the commander in response to an outbreak of operational significance. An *outbreak of operational significance* is defined as the spread of infectious disease that could degrade readiness such that it impacts a commander's decision-making process and potentially alters a chosen course of action or plans, increases risk, and/or results in a potentially overwhelming increase in requests for U.S. military assistance. The outbreak could occur in humans, animals, or agriculture, and could be deliberate, accidental, or natural.[1] Focusing on the context of an outbreak of operational significance and associated biological defense[2] during large-scale combat operations (LSCO),[3] this document will discuss:

- Anticipated decision types,[4]
- Medical staff contributions to identifying, anticipating, and satisfying information requirements (IRs),[5]
- Potential medical-related Essential Elements of Friendly Information (EEFIs) for protection,
- Medical staff actions supporting decisions, information collection, and potential changes in plans, and
- Technical and medical information to assist medical staffs with biological defense tasks.

1-2. Applicability: Army medical staffs at echelons ranging from battalion to Army Service Component Command. Accordingly, the document covers a range of information that has different applicability at different echelons. Judgment is required to determine if and how each item applies to the echelon and situation.

B. Background

1-3. The Army Biological Defense Strategy (ABDS) describes a strategic environment in which "biological threats and hazards will confront the Army in every operation and at all times."[6] Biological weapon (BW) attacks and natural outbreaks of contagious disease can result in an outbreak of operational significance. Examples include:

- BW attacks can disable key logistics nodes and command and control (C2) centers and/or cause mass casualties that simultaneously reduce "combat power" (e.g., personnel and force effectiveness[7]) in units at critical phases of conflict and overwhelm the medical system.[8]

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1 See Appendix B Acronyms and Glossary for additional definitions.

2 In this document, biological defense includes defense against outbreaks of operational significance.

3 The focus is on LSCO because it is the most challenging situation and also the situation with the greatest gap in guidance. However, the content is also applicable to phases leading up to LSCO. Note that many elements will differ for humanitarian missions, where the military might be supporting another organization such as the Department of State or the Federal Emergency Management Agency.

4 This guide frequently discusses decisions. Decisions can be made by the commander or delegated by the commander to others.

5 For simplicity and because situations, sources, and criticality vary, this document discusses IRs generally. It does not specify different types of IR (e.g., commander's critical information requirement, priority intelligence requirement, friendly force information requirement).

6 ABDS, 3.

7 Disease can reduce personnel and force effectiveness even when personnel do not become casualties or require hospitalization.

8 ABDS, 3 and 5.

- As coronavirus disease 2019 (COVID-19) illustrated, natural outbreaks of contagious disease and the associated protective responses can cause restrictions on logistics, personnel movement, and tactical maneuver, and can also degrade readiness and combat power.[9]

1-4. Medical capabilities and functions, by their nature, are critical to gaining biological defense situational awareness and responding to outbreaks of operational significance. Examples of relevant medical capabilities include health surveillance, epidemiology, diagnosis (clinical and laboratory), medical treatment, and public health communication.

1-5. Current doctrine and military education and training provide insufficient technical information and reference material to assist medical staffs in their role in biological defense. Existing material is scattered across many different publications.

C. Key References

1-6. This section lists key references for medical staffs addressing biological defense. For full citations, see Appendix A.

- Biological defense documents
  - AMedP-7.6, *Commander's Guide on Medical Support to Chemical, Biological, Radiological, and Nuclear (CBRN) Defensive Operations*, February 2018. https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.6_EDA_V1_E_2873.pdf.
  - *Concept of Operations (CONOPS) for Bio-Response*, January 2020. https://apps.dtic.mil/sti/pdfs/AD1113565.pdf.
    - Particularly useful elements include Appendix B Outbreak Identification Checklist; Appendix C Medical Advisor Checklist; Appendix D First Contact Checklist; and Appendix E Force Health Protection Template.
  - *Department of Defense Functional Campaign Plan for Pandemics and Infectious Diseases (FCP-P&ID). Washington DC: Secretary of Defense 04 October 2021.* Contact USNORTHCOM Plans Division, Civil Support Plans Branch (NC/J553) for access.
  - The "Blue Book," formally known as *Medical Management of Biological Casualties Handbook* 2020). Newer editions may be available at https://usamriid.health.mil/index.cfm/training/resources.
  - *Medical Aspects of Biological Warfare*, Textbooks of Military Medicine, 2018. https://medcoe.army.mil/borden-tb-medical-aspects-bio-war.
  - TM 4-02.33, also known as the *Control of Communicable Diseases Handbook* (CCDM). https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=85720.
  - ATP 4-02.84, *Multi-Service Tactics, Techniques, and Procedures for Treatment of Biological Warfare Agent Casualties*, November 2019. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1008190.
- General medical documents
  - JP 4-02, *Joint Health Services*, August 2023. https://jdeis.js.mil/jdeis/index.jsp?pindex=27&pubId=840.
  - FM 4-02, *Army Health System*, November 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1021296.
  - *Army Health System (AHS) Doctrine Smart Book*, 16 March 2022. https://www.milsuite.mil/book/docs/DOC-609342. Or the most recent version available at https://www.milsuite.mil/book/groups/army-medical-department-doctrine-review-panel.

[9] ABDS, iv, 4, and 6.

    - Particularly, see Appendix C, "Surgeon at Echelon."
  - DA PAM 40-11, *Army Public Health Program*, May 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1006884.
  - ATP 4-02.55, *Army Health System Support Planning*, March 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1008962.
  - DODI 6200.03, *Public Health Emergency Management (PHEM) within the DOD*, March 2019. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/620003p.pdf.
  - DODI 6490.03, *Deployment Health*, June 2019. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/649003p.pdf.
  - DODD 6200.04, *Force Health Protection*, October 2004. https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/620004p.pdf.
- Staff References
  - *Staff Officer's Quick Reference Guide Version 2*, May 2013. https://call2.army.mil/toc.aspx?document=7031&filename=/docs/doc7031/13-11.pdf.
  - *Medical Planning Tactics, Techniques, and Procedures (CALL Medical Planning Newsletter)*, undated, https://call2.army.mil/toc.aspx?document=226.
  - FM 5-0, *Planning and Orders Production*, May 2022. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1024908
    - Chapter 6 is of particular importance because it assumes units are executing a previously established plan (see assumptions, below).
  - FM 6-0, *Commander and Staff Organization and Operations*, May 2022. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1024909.
  - ATP 5-0.2-1, *Staff Reference Guide Volume I Unclassified Resources*, December 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1021331.
  - ATP 5-0.2-2, *Staff Reference Guide Volume II: Appendix O Distribution D Resources*, December 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1021332.
  - ATP 5-0.3, *MTTP for Operation Assessment*, February 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1008615.
  - ADP 3-37, *Protection*, January 2024. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1028217.

D. Scope & Assumptions

1-6. The scope of this document is medical staff contributions to Army defense against an outbreak of operational significance. This document is applicable to the range of military operations (ROMO). This document does not address the treatment of individual biological or disease casualties.[10] This document reflects the following assumptions:

- Units will have performed routine and appropriate pre-deployment activities, such as:
  - Satisfying combatant command (CCMD), Army service component command (ASCC), and/or region/country-specific medical requirements like vaccination[11] and chemoprophylaxis.

[10] For guidance on treatment of casualties, see the Blue Book, NATO Standard AMedP-7.1, and ATP 4-02.84.

[11] "Vaccine Recommendations by AOR," Military Health System, last updated April 2022, https://www.health.mil/Military-Health-Topics/Health-Readiness/Immunization-Healthcare/Vaccine-Recommendations/Vaccine-Recommendations-by-AOR.

  - Appropriate education, training on, and exercise of, biological defense activities.
- Units will have appropriately created plans for and/or begun executing elements of the Army Public Health Program as described in AR 40-5 and DA PAM 40-11, particularly:
  - A health risk assessment (DA PAM 40-11, Chapter 4 and Appendix D).
  - Public health communication (DA PAM 40-11, Chapter 5 and Appendix E)
  - Health surveillance (DA PAM 40-11, Chapter 6 and Appendix F)
  - Veterinary public health (DA PAM 40-11, Chapter 9)
  - Operational public health (DA PAM 40-11, Chapter 10)
  - Clinical public health (DA PAM 40-11, Chapter 11)
  - Public health laboratory support (DA PAM 40-11, Chapter 14)
- Units and military treatment facilities (MTFs) will have established and rehearsed mass casualty plans.
- Units are conducting LSCO[12] accordingly to a previously established plan.
- The commander and staff will receive indicators of a potential outbreak of operational significance (see Section 1.F, Context, for potential indicators).

E. Organization

1-7. Section F of this chapter defines the assumed context for the medical staff by briefly describing the future operational environment and the disease environment. The following three chapters comprise the remainder of the document.

- **Medical Staff Support to Anticipated Decision Types (Chapter 2)**. Lists anticipated decision types and actions that require medical staff input. Identifies potential IRs and EEFIs relevant to medical staffs, and discusses IRs and other factors for medical staff consideration in support of each listed anticipated decision type.
- **Medical Staff Actions (Chapter 3)**. Discusses medical staff actions that contribute to satisfying IRs, to medical input on changes to operational plans, and/or to changing medical plans.
- **Supporting Technical Information (Chapter 4)**. Provides technical and medical information to assist medical staffs with the IRs, questions, tasks, and considerations discussed in Chapters 2 and 3.

F. Context

1-8. The context for this document is ongoing LSCO in which the commander and staff unexpectedly receive indicators of an outbreak of operational significance or an outbreak of *potential* operational significance, which in turn triggers response actions. Indicators include:

- Disease in the military force[13] (whether caused by a BW attack or a natural outbreak);
- Results from an environmental detection system;

[12] As noted previously, the focus is on LSCO because it is the most challenging situation and also the situation with the greatest gap in guidance. However, the content is also applicable to phases leading up to LSCO.

[13] The military force also includes supporting civilians, contractors, and military working animals.

- Other signs of an outbreak, such as disease in local civilian populations, livestock, or wildlife, or warning from (medical) intelligence or civilian public health, veterinary, or agricultural organizations (One Health).[14]

1-9. Biological defense is unlikely to be the main effort at the time that indicators of an outbreak are recognized. Biological defense actions will seek to minimize the extent to which the outbreak interferes with readiness and operations. However, it is possible for the impact of an outbreak to become so large that biological defense must become the main effort.

1. Future Operating Environment (OE)

1-10. Several characteristics of the future OE and LSCO are listed below.[15] Although most characteristics are broader than biological defense, they nevertheless require consideration by medical staff in relation to biological defense.

- A broader range and greater magnitude of kinetic and non-kinetic all-domain threats to unit survivability.
- Contested airspace resulting in localized and changing areas of adversary air superiority, air parity, and friendly air superiority.
- Adversary capabilities will impose limitations on supplies and support.
- Increased scale, tempo, and distribution of casualties across the depth and breadth of the operational area (OA), plus novel clinical presentations (e.g., chemical, biological, directed energy).
- Longer evacuation distances plus restrictions on patient evacuation (by air, ground, and sea) due to adversary capabilities and potential disease prevention measures imposed by host nation, allies, and partners.
- Increased emphasis on mobility and maneuver and increased frequency of friendly unit repositioning, including medical units.
- A more distributed and expeditionary presence (less massing of forces and use of large fixed bases) that will require semi-independent operations for extended periods.
- More compressed decision cycles will necessitate greater attention on decisional aspects of planning.
- Ethical asymmetries will manifest as battlefield advantages for our adversaries. Examples include adversary willingness to employ autonomous lethal AI, to use BWs, or to otherwise act contrary to the laws and norms of war.
- Increased likelihood of enemy use of CBRN weapons.
- Impacts of information warfare,[16] such as: destruction of trust and confidence in the Army Health System (AHS); degraded, disrupted, and/or compromised command, control, and communications (C3); increased difficulty of attributing hostile activities to nation-states; and increased difficulty of gaining and maintaining shared situational understanding.
- Disruptions in global medical supply chains will intermittently impact the AHS.
- The risk to operational readiness from contagious endemic, emerging, or re-emerging disease will continue to increase.

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[14] "One Health is a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment." https://www.cdc.gov/onehealth/index.html.

[15] Based on the following sources: (1) AFC Concept for Medical 2028; (2) JOE 2035; (3) AHS Doctrine Smart Book, Part 4 (174–226); (4) ABDS, 4; (5) AHS ISO MDO, 2–11; (6) FM 3-0, 1-3–1-5; (7) https://madsciblog.tradoc.army.mil/290-character-of-warfare-2035/.

[16] FM 3-0, 2-7–2-8.

- The risk to operational readiness from specially designed biological agents will continue to increase.

1-11. The following two subsections will provide additional context on biological weapons and contagious disease.

2. Overview of the Disease Environment

1-12. Disease outbreaks are attributes of the OE. Disease will "confront the Army in every operation and at all times."[17] These can involve bacteria, viruses, fungi, parasites, or combinations of the above. Outbreaks can directly affect humans, animals, and/or plants, and can affect humans and the military indirectly through impacts on animals and plants. Outbreaks can be exacerbated by other conditions of the OE, such as radiation or chemical exposures that increase susceptibility of Army personnel to disease or complicate diagnosis and treatment.

1-13. Outbreaks can occur naturally, because of a BW attack, or because of an accidental occupational exposure. Adversaries can manipulate the progress of an outbreak, regardless of how it began. Plausible deniability will influence an adversary's decision to employ BWs. It will typically be difficult to determine how an outbreak began and to detect manipulation of an outbreak. Outbreaks often present unknowns about the disease, its impacts, and the best way to respond.

1-14. The operational impact and outbreak control requirements of any given outbreak will vary with circumstances, disease properties, and available control measures. The Army's public health program and health system have the capability, capacity, and competence to ensure many outbreaks are only a minor hindrance to operations. However, certain disease properties increase the chance that an outbreak will become operationally significant, such as:

- unfamiliarity (novel and emerging infectious disease will be unfamiliar),
- morbidity and mortality (high rates of serious illness, hospitalization, and/or death), and
- contagiousness.

1-15. Outbreaks can expose AHS capability gaps. Disease patients require different kinds of care than the typical LSCO casualty stream. For example, few disease patients will require surgery, but disease outbreaks likely require more rapid health surveillance data fusion and analysis than is typical. In addition, contagious diseases present an ongoing risk to personnel who avoided infection initially.

1-16. Large outbreaks can also stress or overwhelm AHS capacity, particularly for low-density units and capabilities. As examples, diagnostic capabilities can be overwhelmed with testing requests, and MTFs can be overwhelmed with patients and forced to keep human remains longer than planned due to shortages in mortuary capacity. Even a moderately contagious disease can spread rapidly through military populations,[18] leading to stressed medical capacity. Capacity challenges will be made worse when medical personnel become ill. Further, if a disease overwhelms U.S. military medical capacity, it could also overwhelm the host nation (HN) medical system, such that host nation support (HNS) is not available. Finally, disruptions in the medical supply chain, as occurred globally with COVID-19, can negatively impact the AHS and require advanced planning.

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17 ABDS, 3.

18 This can occur for a number of reasons, including working in close quarters and the impact of deployments on diet, sleep, and exercise patterns.

a. Biological Weapons (BWs)[19]

1-17. Our most concerning nation-state adversaries—Russia, China, North Korea, and Iran—are thought to possess BWs.[20] These nation-states have access to advanced technologies, and could weaponize not only traditional biological agents, but also new natural variants or engineered biological agents that circumvent U.S. defensive capabilities. There is uncertainty about their intent and specific capabilities. BW use will likely be unexpected and occur without warning, and can be designed to mimic natural outbreaks to delay response and/or avoid attribution.

1-18. Terrorists, state proxies, violent extremists, and similar non-state actors can also produce and employ BWs. Despite the expected lesser sophistication of any such BWs, they could still cause considerable disruption. These adversaries' capabilities are expected to improve over time.

1-19. The effects and impacts of BWs can vary widely. BWs may be anti-personnel, anti-agriculture, or anti-materiel. Anti-personnel weapons can produce illness ranging from mild to life-threatening. They can produce contagious disease, which brings a host of additional complications (see next section). They can also affect the surrounding community, even if the attacker was targeting military forces with a non-contagious disease. Anti-agriculture and anti-materiel weapons can interfere with force deployment and consumables.

1-20. Human disease outbreaks caused by BWs have a range of potential characteristics that present different challenges. Examples of challenging characteristics include:

- a narrowly distributed incubation period (many cases in a short time),
- rapid progression to severe illness,
- contagiousness,[21]
- long period of illness,
- requirement for low-density medical resources like ventilators, sometimes for a significant time (e.g., botulism), and
- severe illness (though an adversary may prefer low mortality, to tie up medical assets longer).

1-21. If an adversary's goal is maximum disruption over a short time, a BW attack can affect an entire base or brigade or larger footprint (including organic medical units)—see Section 4.B for examples from real tests. Such a BW attack using an agent with a short and narrowly distributed incubation period can cause an enormous spike in casualties over a span of hours (toxins, such as Staphylococcal enterotoxin B (SEB)) or a few days (certain pathogens, such as Venezuelan equine encephalitis (VEE) virus). The effects can rapidly overwhelm an operation, not only medically, but also logistically and in terms of lost personnel. Medical personnel will also become casualties, further stressing capacity. A narrowly distributed incubation period ensures that there is little time for the medical system to provide countermeasures or to prepare for the peak in casualties. In this situation, it is relatively obvious that a BW attack occurred, but that awareness will not significantly ease the burden of its effects.

1-22. Conversely, diseases with long or variable incubation periods (e.g., brucellosis, Q-fever) can challenge the medical system for a prolonged period of time at a lower intensity. An attack of this type would also cause

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19 Section contains paraphrases from ABDS, 3.

20 Raymond A. Zilinskas, *The Soviet Biological Weapons Program and Its Legacy in Today's Russia*, Occasional Paper 11 (Center for the Study of Weapons of Mass Destruction, National Defense University: Washington, DC, July 2016), https://inss.ndu.edu/Portals/68/Documents/occasional/cswmd/CSWMD_OccasionalPaper-11.pdf.

Danny Shoham, "China's Biological Warfare Programme: An Integrative Study with Special Reference to Biological Weapons Capabilities," *Journal of Defence Studies* 9, no. 2 (2015): 131–156, http://idsa.in/jds/9_2_2015_ChinasBiologicalWarfareProgramme.html.

Elisa D. Harris, *North Korea and Biological Weapons: Assessing the Evidence*, 38 North Special Report (Washington, DC: Stimson Center 38 North Program, November 2020), https://www.38north.org/reports/2020/11/eharris110620/.

W. Seth Carus, "Iran and Weapons of Mass Destruction," *Middle East Review of International Affairs* 4, no. 3 (2000), https://www.taylorfrancis.com/chapters/edit/10.4324/9781315039183-11/iran-weapons-mass-destruction-seth-carus.

21 Most diseases typically associated with BW are not contagious. Exceptions are plague, smallpox, and some viral hemorrhagic fevers.

illness in some medical personnel and could create logistic challenges. In this situation it is not very obvious that a BW attack occurred.

1-23. If an adversary prefers to avoid attribution or has limited BW capability, a BW attack can be smaller and difficult to distinguish from a natural outbreak. In this situation, gaining awareness early should facilitate response, which is doubly important if the disease is contagious. However, an adversary intent on avoiding attribution can use misinformation or disinformation campaigns, or design the weapon (e.g., genetic engineering or combining multiple agents) to defeat U.S. and allied capabilities to generate awareness. An engineered BW could also defeat diagnostic, therapeutic, or other capabilities, such that a small outbreak still has large operational impacts.

b. Contagious Disease Outbreaks[22]

1-24. Contagious disease outbreaks can occur in many potential operating areas. Endemic diseases like Ebola can impact operations in multiple ways. More common diseases, such as influenza, can at times also reach operationally significant levels of incidence and morbidity. Of particular concern are emerging infectious diseases and engineered BWs. The increased uncertainty of resultant outbreaks increases the difficulty of planning, preparation, and response.

1-25. The likelihood that emerging diseases with epidemic or pandemic potential will actually become an epidemic or pandemic is increased by several factors beyond military control. These include urbanization, globalization, increased and faster travel, habitat encroachment, ecosystem disruption, climate change, weak national health systems, antimicrobial resistance, and vaccine hesitancy.

1-26. In a contagious disease outbreak caused by a large BW attack, primary casualties will dominate the immediate effects and response. However, control measures to minimize disease spread within and outside the attack area will also be necessary. Fortunately, many infectious diseases posing a viable BW threat are not contagious; notable exceptions include plague, smallpox, and certain viral hemorrhagic fevers like Ebola.

1-27. Contagious disease outbreaks, whether natural or caused by a BW attack, can evolve over weeks to months or even years, providing time for reactions to minimize impact. An outbreak might not initially look like it will be operationally significant. However, as observed with COVID-19, evolution slower than a BW attack does not guarantee a lesser impact. Similarly, outbreaks in animals or plants might initially appear unimportant, but ultimately influence operations by affecting food supplies or causing nations to restrict movement of military vehicles and equipment.

1-31. Contagious disease outbreaks can impact readiness and operations in many ways beyond lost personnel (including medical personnel) and the requirements to treat patients. Multiple waves of infection/disease present challenges for linear, phased planning constructs. Second and third order effects, ranging from localized to global, can occur but are not all predictable or within military control. Examples include food supply challenges, shipping backlogs at major ports, social unrest (which can be influenced by misunderstanding or disinformation and by adversary psychological operations), and other national governments or even state and local authorities within the United States limiting the movement of personnel, equipment, materiel, or patients. Within the Department of Defense (DOD), Transportation Command (TRANSCOM) policy "discourages movement of personnel infected or suspected of being infected with highly contagious disease except for index cases."[23] There are good reasons for limiting movement of such personnel. However, inability to evacuate will impact medical operations and possibly the overall operation if large numbers of casualties cannot be evacuated. Other protective measures, such as quarantine and restriction of movement (ROM) can also hinder readiness and operations.

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22 Section contains paraphrases from ABDS, 3–4.

23 *Department of Defense Functional Campaign Plan for Pandemics and Infectious Diseases (FCP-P&ID)*, 72, (Washington DC: Secretary of Defense, 04 October 2021). Contact USNORTHCOM Plans Division, Civil Support Plans Branch (NC/J553) for access.

1-28. Examples of characteristics that make a contagious disease outbreak difficult to control are listed below.[24] Any one of these characteristics increases the difficulty of controlling an outbreak; the more characteristics are present, the more difficult outbreak control will be.

- high contagiousness,
- spread through the respiratory route,
- asymptomatic and/or pre-symptomatic spread,
- long environmental persistence in an infectious/live state,[25]
- high infectivity,
- high virulence,
- long or variable incubation period (prolonged uncertainty and casualties),
- short and consistent incubation period (spikes in casualties),
- long period of contagiousness,
- long period of illness,
- not detected in routine surveillance,
- lack of effective medical countermeasures, and
- novelty—that is, a variant or pathogen that is unfamiliar or has changed in some way (e.g., infects a new species or expands its geographic range).

1-29. Figure 1 illustrates where several well-known contagious diseases sit on a continuum of two key characteristics—case fatality rate and contagiousness.

1-30. Table 1 provides the data used to construct Figure 1 so that a reader can construct new versions of Figure 1; for example, to add a new disease as a quick way to understand and to communicate how a new disease compares with known diseases. The figure can also be modified to show other characteristics of interest for a particular situation.

[24] The list is not from any one source, but is consistent with several relevant sources, such as the ABDS, the FCP-P&ID (p. 13–16), NATO's Dirty Dozen methodology, and the WHO's R&D Blueprint Prioritization methodology.

[25] Biological agent in the environment is degraded in multiple ways—see Section 4.B.1. Most detection and diagnostic capabilities cannot distinguish between viable (live, infectious) and non-viable (dead, non-infectious) agent—see Sections 4.B.5 and 4.D.

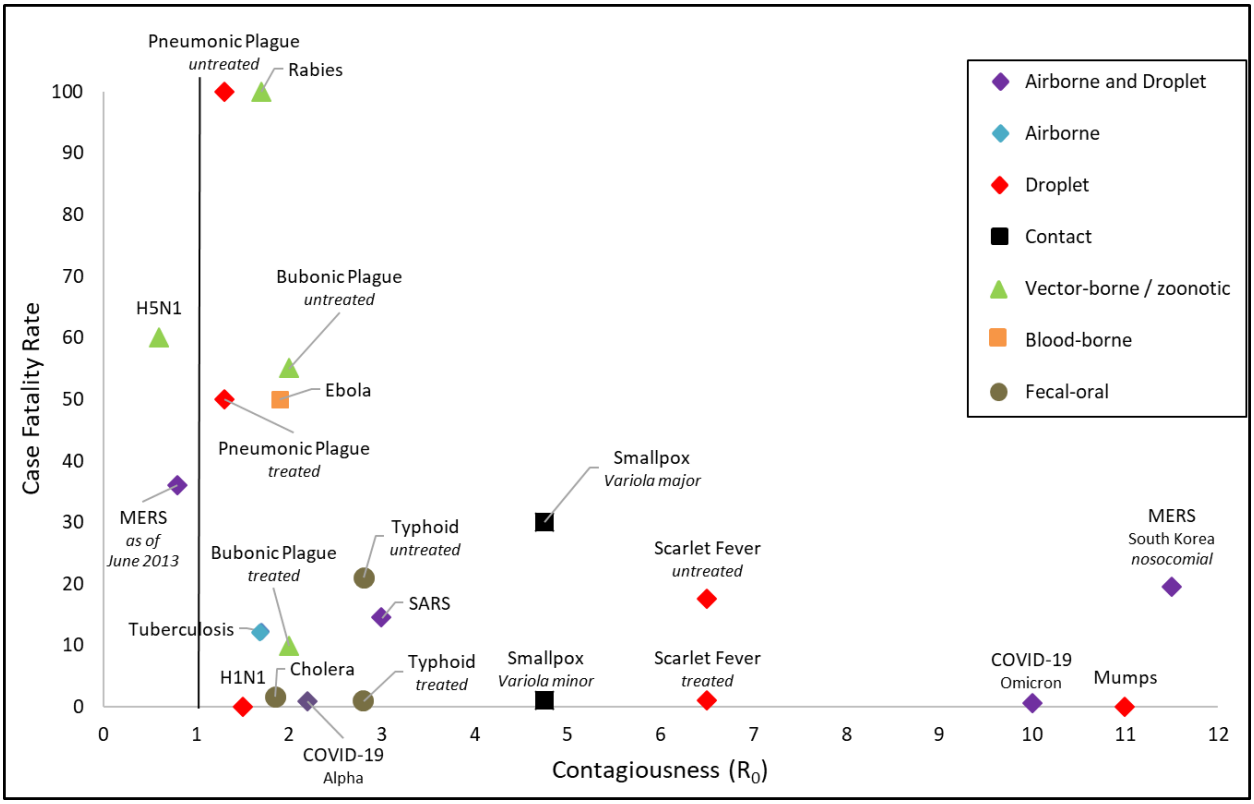

Figure 1. Quick Infectious Disease Comparison (Case Fatality Rate and Contagiousness)

Table 1. Data for Figure 1[26]

Disease	Contagiousness (R_0)	Case Fatality Rate %	Transmission Method[a]
Cholera	1.85	1.7	Fecal-oral
COVID-19 Alpha	2.2	1	Airborne and droplet
COVID-19 Omicron	10	0.7	Airborne and droplet
Ebola	1.9	50	Blood-borne
H1N1	1.5	0.02	Droplet
H5N1	0.6	60	Zoonotic
Malaria (*not plotted in Figure 1*)	15+	0.4	Vector-borne
MERS	0.8	36	Airborne and droplet
MERS South Korea (nosocomial)	11.5	19.4	Airborne and droplet
Mumps	11	0	Droplet
Plague (Bubonic) *untreated*	2	55	Vector-borne
Plague (Bubonic) *treated*	2	10	Vector-borne

[26] Adapted from W. Smedley, M. Bohannon, J. Grotte, L. Murray, S. Weinrich, and S. Wiseman. *Operating in an Infectious Disease Environment (IDE) Capabilities Based Assessment (CBA)*. IDA Document D-8154. Alexandria, VA: Institute for Defense Analyses, September 2016, Figure 2, accessible at https://search.dtic.mil/ under "AD1164776." Note: (1) in several cases, Figure 1 uses rough estimates that one could reasonably disagree with, so it should be treated as illustrative rather than definitive; (2) R_0 and case fatality rate may vary by strain, location, and other factors.

Disease	Contagiousness (R_0)	Case Fatality Rate %	Transmission Method[a]
Plague (Pneumonic) *untreated*	1.3	100	Droplet
Plague (Pneumonic) *treated*	1.3	50	Droplet
Rabies	1.7	100	Zoonotic
SARS	3	14.5	Airborne and droplet
Scarlet Fever *untreated*	6.5	17.5	Droplet
Scarlet Fever *treated*	6.5	1	Droplet
Smallpox (*variola major)*	4.75	30	Airborne and contact
Smallpox *(variola minor)*	4.75	1	Airborne and contact
Typhoid *untreated*	2.8	21	Fecal-oral
Typhoid *treated*	2.8	1	Fecal-oral
Tuberculosis	1.7	12.3	Airborne

a Some respiratory diseases appear to exist on a spectrum and can be transmitted by both droplets (coughed or sneezed out) and aerosolized droplet nuclei (breathed out), the latter often referred to as airborne transmission. As R_0 increases, the importance of the relative contribution from aerosolized droplet nuclei to overall contagiousness likely increases.

2. Medical Staff Support to Anticipated Decision Types

2-1. Section A of this chapter is a list of potential decision types, or actions that require a decision to execute. Medical staffs should anticipate and support these types of decisions after receiving indicators of an outbreak or potential outbreak of operational significance. Section B identifies potential IRs that support the decision types, and lists EEFIs that require medical staff input. Section C expands upon the IRs by providing additional questions and factors for medical staff consideration in support of each specific anticipated decision type, plus an example mapping of IRs to decision types. This information is intended as a reference, so there is some duplication of medical staff considerations across decision types.

2-2. Given the evolving nature of military operations and the Army's lack of experience facing any BW attack or an operationally significant disease outbreak during LSCO, the lists of decision types, IRs, EEFIs, and other factors are not all-inclusive. Decisions actually made, and the information and actions required to support those decisions, will change with mission, enemy, terrain and weather, troops available, time available, and civilian considerations (METT-TC). The timing and sequence of decisions can also be unpredictable, particularly for outbreaks with multiple waves of disease. Some of the decisions require actions primarily within the AHS while others are unit- or force-wide.

A. Anticipated Decision Types

2-3. Table 2 lists potential types of decisions that require medical staff input as a starting point that requires adjustment to suit the unit and situation. In some cases the medical staff will have a prominent role in advising, and in other cases the medical role will be small.

Table 2. Anticipated Decision Types

Serial	Decision Type
1	Establish or revise prioritization of MCMs and/or PPE
2	Report a suspected BW attack to higher
3	Initiate or recommend initiation of attribution effort
4	Implement or alter FHP measures
5	Modify medical or other support priorities
6	Alter operational and medical plans
7	Execute a pandemic and infectious disease (P&ID) plan

B. Potential IRs and EEFIs for Medical Staff Consideration

2-4. Note that this document discusses IRs but does not attempt to categorize them using the different types of IR specified in doctrine (such as JP 3-0). Staffs should recommend the appropriate labeling based on sources used and criticality to decisions.

2-5. This section lists potential IRs (Table 3) and EEFIs (Table 4) requiring medical staff input or analysis. In some cases, the medical staff can significantly contribute to satisfying the IR, and in others the medical staff might have a minor or advisory role only. The tables are a starting point; they require adjustment to suit the specific unit, echelon, and situation.

Table 3. Potential IRs Requiring Medical Staff Input or Analysis

Serial	Potential IRs
IR 1	What indicators of a potential operationally significant disease have been observed within the OA?
IR 2	What indicators of an imminent or recent BW attack have been observed within the OA?
IR 3	How is the outbreak affecting the operating environment (OE)?
IR 4	How have disease spread and outbreak response affected readiness and operations? How could disease spread and outbreak response affect future readiness and operations?
IR 5	How has the outbreak affected demand for and provision of medical services? How would the forecasted evolution of the outbreak affect demand for and provision of medical services?
IR 6	How effective are the MCMs and PPE organically available to the force? What other MCMs and PPE could be made available, and how effective are they?
IR 7	What is the impact of current patient movement policy and how could it be changed to improve outbreak response?

2-6. Potential EEFIs related to the medical aspects of biological defense (Table 4) focus on preventing adversaries from fully or accurately assessing the impact of a BW attack or outbreak on U.S. forces. Most items are not uniquely EEFI in the context of biological defense.

2-7. Some information listed in Table 4 must be shared with the HN, to properly coordinate. Judgment of the specific situation will be required to resolve the tension between protecting and sharing information.

Table 4. Potential EEFIs Related to Medical Biological Defense

Serial	Potential EEFI
EEFI 1	Unit location or movement history, or identity of units that were in the (estimated) downwind hazard area of a BW attack
EEFI 2	Casualty reports and future casualty estimates
EEFI 3	Impacts of the outbreak or of outbreak response on readiness (personnel, equipment, or training)
EEFI 4	Alert notification plans for BW attacks or other outbreaks
EEFI 5	Time delays or other weaknesses in environmental detection of a BW attack, including laboratory support for confirmatory results
EEFI 6	Time delays or other weaknesses in the health surveillance system
EEFI 7	Time delays or other weaknesses in implementation of outbreak response measures, including low effectiveness of medical countermeasures
EEFI 8	Gaps in medical capability or capacity, whether prior to an outbreak or caused by an outbreak; consider the following categories • Prevention: (1) PPE; (2) disinfection; (3) infectious waste management (4) quarantine and isolation; (5) food and water protection; (6) field hygiene and sanitation; (7) vector and pest control; (8) combat and operational stress control (COSC) • Diagnostics: (1) personnel; (2) consumables; (3) equipment; (4) throughput rates • Treatment: (1) beds—minimal, ward, ICU; (2) personnel—by function; (3) key equipment—for example, ventilators, oxygen generators, infusion pumps; (4) consumables including MCMs, blood products, medical gases, and parts and consumables for key equipment • Evacuation: (1) capacities by type including for transport isolation; (2) personnel; (3) consumables; (4) equipment • Mutual support agreements with HN, allies, and partners

C. Medical Staff Considerations for Each Decision Type

2-8. This section augments Section A and Table 3 by providing an example of how IRs might be matched to expected decision types, and listing sub-questions or notes that apply to each IR. There is some duplication of medical staff considerations across decision types.

2-9. The following subsections are starting points to aid medical staffs in knowing what to consider. Current or anticipated circumstances can require elements of the subsections below to be elevated or decreased in priority, or ignored altogether. Similarly, additional IRs not mentioned here may be required.

1. Establish or Revise Prioritization of MCMs and/or PPE

2-10. Note that PPE refers to protective equipment used in medical settings, and IPE refers to protective ensembles worn as part of mission oriented protective posture (MOPP).

2-11. Situations like a pandemic may be required before civilian medical authorities invoke Crisis Standards of Care, but the battlefield is a crisis setting by definition. Prioritization of assets thus becomes an ongoing requirement. It is prudent to develop priorities once sufficient information is available to enable planning. Priorities must be tuned to the specific disease, outbreak, mission, and operational plans. Any prioritization that is developed must be appropriately published.

2-12. The following is an initial list of IRs to help inform the decision about *whether* to establish or revise prioritization. IRs 3, 4, and 6 can also inform *how* that prioritization should be done, so they are addressed last.

- IR 1: What indicators of a potential operationally significant disease have been observed within the OA?
  - What disease has been identified and what is the causative agent?
  - In what population(s) has the disease been observed? (U.S., foreign, plant, animal)
  - In what locations has the causative agent been detected by environmental surveillance? (coordinate with chemical staff and labs)
  - Is it transmissible from person-to-person and if so, how is it transmitted?
- IR 2: What indicators of a recent BW attack have been observed within the OA?
  - What locations, areas, or units have been affected or are expected to be affected?
  - Note: if there are indicators, consider accelerated decision-making to stay ahead of the timelines depicted in Section 4.B.6.
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.
- IR 5: How has the outbreak affected demand for and provision of medical services?
  - How has the outbreak affected availability of MCMs and PPE?
  - Has there been a spike in hospitalization, sick call visits, or other demands on the medical system? If so, how have (lack of) MCM and PPE availability affected ability to satisfy demand?
- IR 3: How is the outbreak affecting the OE?
  - Given operational plans, how could MCMs or PPE be used to minimize the impact of foreign actions on friendly operations (e.g., rules for access, basing, overflight, quarantine, or other ROM)?
- IR 4: How have disease spread and outbreak response affected readiness and operations? How could they affect future readiness and operations?
  - Which populations have been affected with higher frequency or severity than others? Consider age, ethnic origin, sex, comorbidities, rank, occupation/function, unit, and location.
  - Given operational plans and any population-related differences observed, which specific units require higher priority for MCMs or PPEs to minimize risk to force and mission?

  - How can MCMs and PPE best be used to increase readiness and what other advantages and disadvantages apply if using MCMs and PPE in that way?

- IR 6: How effective are the MCMs and PPE organically available to the force unit? What other MCMs and PPE could be made available, and how effective are they?
  - For MCMs, what clinical indicators can be used to inform prioritization?
  - How do concepts for use and logistical considerations (e.g., time required to distribute, storage and administration requirements) impact prioritization?
  - What regulatory approvals do MCMs have and how does that impact their utility? Consider not only FDA, but also foreign nation and international organizations.
  - For PPE, what occupational, ergonomic, engineering, or mission-related factors can be used to inform prioritization? Examples: What functions or missions preclude effective use of PPE? Can PPE be replaced in some situations by engineering controls (e.g., airflow) or spacing between personnel?

2. Report a Suspected BW Attack to Higher

2-13. BW attacks can have major tactical, operational, and strategic consequences. Quickly recognizing an attack is critical to mounting an effective medical, operational, and attribution response. Unless a person witnesses a potential attack in progress and files a CBRN-1 report—which is unlikely—rapid recognition likely depends on collation of medical and environmental surveillance information. Given the difficulties associated with environmental detection of disseminated biological agents (see Section 4.B.5), medical capabilities are likely to provide the earliest warning, as casualties present days after the attack. In such cases, alternatives to the CBRN Warning and Reporting System are required.

2-14. Following is an initial list of IRs that require medical input and inform the decision to report a suspected BW attack.

- IR 2: What indicators of an imminent or recent BW attack have been observed within the OA?
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.
- IR 5: How has the outbreak affected demand for and provision of medical services?
  - If demand has increased, to which (if any) known BW disease incubation period does the evolution of cases align? (See charts in Section 4.B.6 and Table 6 sources). What is the threat assessment for that BW disease in the OA?
- IR 6: How effective are the MCMs and PPE organically available to the force?
  - Have MCMs proven less effective in this outbreak than is expected for this disease?
  - If so, what laboratory support is available to analyze the pathogen or toxin? What conclusions can they reach about whether the reduced MCM effectiveness is natural or engineered?

3. Initiate or Recommend Initiation of Attribution Effort

2-15. Infectious disease outbreaks occur frequently during war and have done so throughout history. This frequency can serve to obscure the intentional nature of a BW attack. Plausible deniability is one factor that influences an enemy's decisions to use a BW. This reality makes attribution difficult, but also imperative.

2-16. The following is an initial list of IRs that require medical input and inform the decision to initiate or recommend initiating attribution efforts.

- IR 2: What indicators of an imminent or recent BW attack have been observed within the OA?
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.

- IR 3: How is the outbreak affecting the OE?
  - Do reconnaissance assets have access to locations to collect necessary samples? See Section 4.B.5 for information on biological reconnaissance assets.
  - If not, what resources would need to be diverted to gain access to key locations, and how would that impact other efforts?
- IR 6: How effective are the MCMs and PPE organically available to the force?
  - Have MCMs proven less effective in this outbreak than is expected for this disease?
  - If so, what laboratory support is available to analyze the pathogen or toxin? What conclusions can they reach about whether the reduced MCM effectiveness is natural or engineered?
- Other potential IRs
  - What forces are available that can conduct appropriate sampling and chain of custody procedures? How would using them for this purpose affect other missions?

4. Implement or Alter Force Health Protection (FHP) Measures

2-17. A broad range of FHP measures are available, and must be tuned to the situation. Time is of the essence when implementing FHP measures, especially for human-to-human contagious diseases, which grow exponentially over time if unmitigated. As a result, decisions might have to be made based on rough estimates rather than based on a detailed analysis. In other cases outbreaks will grow more slowly, affording more time for analysis. However, in the early stages of an outbreak, it is often difficult to know how fast it is growing.

2-18. Example FHP measures include prophylaxis, increased PPE, health protection condition (HPCON[29]) (for installations) or other public health guidance, canceling non-essential travel and activities (approval case-by-case), distributed work operations, alternate work schedules and telework, protective isolation for key personnel, other types of ROM, disease screening, and contact tracing and quarantine.

2-19. The following is an initial list of IRs that require medical input and inform FHP measure changes.

- IR 1: What indicators of a potential operationally significant disease have been observed within the OA?
  - What disease has been identified and what is the causative agent?
  - In what population(s) has the disease been observed? (U.S., foreign, plant, animal).
  - In what location(s) has the causative agent been detected by environmental surveillance? (Coordinate with chemical staff and labs.)
  - Is it human-to-human contagious and if so, how is it transmitted?
  - Based on the previous answers, which FHP measures are most appropriate?
- IR 2: What indicators of an imminent or recent BW attack have been observed within the OA?
  - What locations, areas, or units require increased FHP measures, based on the indicators?
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.
  - Note: the gravity of the observations and other relevant circumstances (e.g., adversary threats to use BW or history of BW) may warrant proactive measures such as enhanced hygiene, controlled monitoring, use of prophylaxis, disease screening, or changing the HPCON.
- IR 3: How is the outbreak affecting the OE?
  - What FHP measures are imposed by the host nation (HN) or higher DOD authority?

[29] See DODI 6200.03 for information about HPCON as part of DOD public health emergency management.

  - How can FHP measures reduce movement restrictions imposed on the force (e.g., border closure, overflight restrictions, limitations on movement of personnel, patients, or equipment)?
  - How can FHP measures reduce the impact of foreign outbreak response on friendly operations (e.g., rules for access, basing, overflight, vector control, disinfection, quarantine, ROM)?
  - What mis- or disinformation must be countered to effectively implement FHP measures?
  - How can FHP measures be used to mitigate perceived U.S., partner, or ally vulnerabilities that adversaries might exploit?
- IR 4: How have disease spread and outbreak response affected readiness and operations? How could disease spread and outbreak response affect future readiness and operations?
  - Note: where possible, it is important to distinguish between impacts of the disease and negative impacts of FHP measures (e.g., movement restrictions).
  - What FHP measures could limit spread and preserve readiness?
  - If FHP measures negatively impact readiness or operations, how can they be adapted with time and mission to flexibly balance disease risk against mission risk?
  - How would estimated future casualties impact the force's ability to conduct planned operations?
    - How will the casualty estimate and impact change if FHP measures are altered?
- IR 5: How has the outbreak affected demand for and provision of medical services? How would the forecasted evolution of the outbreak affect demand for and provision of medical services?
  - In what ways has the medical system struggled to cope with increased hospitalization, sick call visits, or other demands? Given the outbreak forecast, how is the situation expected to evolve?
  - How could FHP measures decrease demand or maintain or improve personnel, equipment, or consumables readiness?
  - Has the outbreak affected ability to evacuate casualties or return personnel to duty? How could FHP measures improve or worsen ability to evacuate casualties or return personnel to duty?
- IR 6: How effective are the MCMs and PPE organically available to the force? What other MCMs and PPE could be made available, and how effective are they?
  - To what degree can MCMs and PPE "buy down" risk such that more burdensome control measures can be avoided?
  - For prophylactic MCMs, what is the estimated window of opportunity? (Consult Table 6 sources and Section 4.B.6.)
  - How do concepts for use and logistical considerations (e.g., time required to distribute, storage and administration requirements) impact the effectiveness of MCMs or PPE?
  - Are MCMs specific to the disease or generic/broad spectrum? If specific to the disease, is the preferred MCM influenced by the pathogen/toxin strain or variant? What work must be done to establish pathogen/toxin vulnerability to available and/or acquirable MCMs?
  - What MCM side effects and side effect rates are expected?
  - What regulatory approvals do MCMs have, compared to what they require, and how does that impact their utility? Consider not only FDA, but also foreign nation and international organizations.
- Other potential IRs
  - Will the use of MCMs or PPE deplete stockpiles needed for other uses? (Consider opportunity cost.)
  - For contact tracing and quarantine, what resources are required to execute and what other function or mission would they have to be diverted from?

  - What are the political, moral, ethical, and morale considerations of using and not using MCMs and PPE, given available information? (Coordinate with Chaplain, POLAD, and potentially the DOD Medical Ethics Center.)

5. Modify Medical or Other Support Priorities

2-20. This decision type is intended to address changes required by an outbreak that is operationally significant, but not so large or impactful that it has overwhelmed the original mission or become the main effort. Rather, it is affecting decision-making during execution of the established plan (see FM 5-0, Chapter 6, particularly the top half of Table 6-1).

2-21. Note: this decision type is not intended to address routine medical adjustments unrelated to an outbreak (e.g., to maintain proximity to the supported force or typical updates to medical logistics (MEDLOG) requirements over the course of an operation).

2-22. The following is an initial list of IRs that require medical input and inform the decision to modify medical or other support priorities.

- IR 2: What indicators of an imminent or recent BW attack have been observed within the OA?
  - What locations, areas, or units are expected to be affected? What medical other support adjustments are required to address direct effects on medical capabilities or to appropriately support other units?
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.
  - Note: if there are indicators, consider accelerated decision-making to stay ahead of the timelines depicted in Section 4.B.6.
  - Note: the gravity of the observations and other relevant circumstances (e.g., adversary threats to use BW or history of BW) may warrant proactive measures to adjust medical or logistics support.
- IR 3: How is the outbreak affecting the OE?
  - How does disease risk vary across the OA, and what are the potential impacts on medical and other support plans?
    - Consider risk from any potential source of infection, including civilians, animals, and vectors.
  - How do movement restrictions and other outbreak control measures vary across the OA, and what changes to medical and other support plans are required as a result?
    - Consider border closure, overflight restrictions, limitations on movement of personnel, patients, or equipment, and rules for access, basing, vector control, disinfection, and quarantine.
- IRs 4–6: How do current and estimated future demand for medical support compare to current and planned medical capability and capacity? Consider estimated casualties, including among medical personnel. Accordingly, what medical changes are required? Assess using groupings such as the following:
  - Prevention: (1) PPE (effectiveness, quantities available); (2) disinfection; (3) infectious waste management; (4) specialty capabilities like transport isolation and isolation beds; (5) food and water protection; (6) field hygiene and sanitation; (7) vector and pest control; (8) COSC.
  - Diagnostics: (1) personnel; (2) consumables; (3) equipment; (4) throughput rates. Break down by type and quality; for example, X-ray, complete blood count (CBC), rapid antigen, polymerase chain reaction (PCR), and point of care vice in-theater laboratory vice reachback laboratory.
  - Treatment: (1) beds—minimal, ward, ICU; (2) personnel—by function; (3) key equipment—for example, ventilators, oxygen generators, infusion pumps; (4) consumables including MCMs, blood products, medical gases, and parts and consumables for key equipment.
  - Evacuation: (1) availability of evacuation assets (CASEVAC, MEDEVAC, ground, air, strategic); (2) availability of transport isolation capability; (3) personnel; (4) consumables; (5) equipment; (6)

turnaround times; (7) impact of theater patient movement policy and any disease-specific patient movement policies, limitations, or constraints (see also IR 7 below).

  - Medical support commitments to/from HN, allies, and partners. Note that support agreements with the HN can be invalidated by the outbreak; for example, if the HN is overwhelmed.

- IR 7: What is the impact of current patient movement policy and how could it be changed to improve outbreak response?
  - How does patient movement policy impact ability to provide required medical support to the main effort? What special considerations apply to this disease or the circumstances of this outbreak?
  - If current patient movement policy hinders the main effort, what policy changes could improve the situation?
  - What resources (e.g., transportation, evacuation, holding capacity) would need to be diverted to shorten or lengthen the patient movement policy? How would that diversion impact operations?
  - What medical and non-medical evacuation assets are available (organic in theater, HN, strategic)?

6. Alter Operational and Medical Plans

2-23. This decision type is intended to address an outbreak that has become so large or impactful that it significantly degrades the capability of the force, requiring a broad reassessment of plans at echelon. At some echelons, new courses of action that focus on outbreak response may be required (see FM 5-0, Chapter 6, particularly the bottom half of Table 6-1). Naturally, a change in operational decisions or plans can trigger changes in supporting medical decisions or plans.

2-24. Examples of operational alterations include reallocating units or capabilities to different missions, whole unit replacement, committing reserves, or a complete change in mission.

- Medical support to decisions of this magnitude will require the medical staff to define additional IRs and produce related information to support decisions. Two examples:
  a. In a contagious disease outbreak, how long can a specific brigade be combat-effective? This requires knowing the contagious disease impact on Soldiers, and how far and fast the disease will spread in the brigade.
  b. After a BW attack with a non-contagious agent, the medical staff (with other staff elements) must be able to explain the effects on Soldiers, time horizon of the disease, and the units/area covered by the attack.

2-25. Examples of medical alterations include: augmenting or reallocating medical capability (e.g., redistribute organic or subordinate medical assets; augment using organic or subordinate non-medical assets, request augmentation from higher); altering MEDLOG requirements or plans; moving patients to decompress MTFs or otherwise altering patient regulating including recommending a change in theater patient movement policy; assigning specific MTF(s) to handle disease patients; and employing alternate care strategies.

- IR 2: What indicators of an imminent or recent BW attack have been observed within the OA?
  - What locations, areas, or units have been affected are expected to be affected? How do these areas, units, and expected effects overlap with and affect the main effort?
  - Note: indicators might include epidemiologic clues (see Section 4.C), environmental detection (see Section 4.B.5), intelligence reports, and unusual munition sightings.
  - Note: if there are indicators, consider accelerated decision-making to stay ahead of the timelines depicted in Section 4.B.6.

- IR 3: How is the outbreak affecting the OE?
  - How does disease risk vary across the OA, and what are the potential impacts on operational and medical plans?

    - Consider risk from any potential source of infection, including civilians, animals, and vectors.
  - How do movement restrictions and other outbreak control measures vary across the OA, and what is the expected impact on the main effort?
    - Consider border closure, overflight restrictions, limitations on movement of personnel, patients, or equipment, and rules for access, basing, vector control, disinfection, and quarantine.
  - How do higher DOD, other U.S. government (USG), foreign, or international agency emergency declarations, warnings, or decisions to alter plans or execute P&ID plans affect the main effort?
    - Consider: higher headquarters, National Center for Medical Intelligence (NCMI[30]); Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), Department of State (DoS); World Health Organization (WHO) or a regional office (see "Regions" at top left); Pan American Health Organization (PAHO); European Centers for Disease Prevention and Control (ECDC); West African Health Organization (WAHO); International Association of National Public Health Institutes (IANPHI—set the Topic Filter to "Infectious Diseases")

- IR 4: How have disease spread and outbreak response affected readiness and operations? How could disease spread and outbreak response affect future readiness and operations?
  - How ready are the units required for the main effort (personnel, training and exercise, equipment)? What units are most heavily impacted by the outbreak and by outbreak response measures?
  - How do any readiness issues with the HN, partners, or allies impact plans for the main effort?
  - How long can the main effort continue, given current readiness and projected changes in readiness over time?
- IR 5: How has the outbreak affected demand for and provision of medical services? How would the forecasted evolution of the outbreak affect demand for and provision of medical services?
  - How has the outbreak affected availability of ally, partner, or HN medical support?
  - How has the outbreak affected demand for Army medical support to allies, partners, or the HN?
  - For how long will sufficient medical assets be available to support the main effort?
  - What impact do the outbreak and outbreak response have on ability to evacuate casualties?
  - What impact to the outbreak and outbreak response have on return to duty?
- IR 7: What is the impact of current patient movement policy and how could it be changed to improve outbreak response?
  - How does patient movement policy impact ability to provide required medical support to the main effort? What special considerations apply to this disease or the circumstances of this outbreak?
  - If current patient movement policy hinders the main effort, what policy changes could improve the situation?
  - What resources (e.g., transportation, evacuation, holding capacity) would need to be diverted to shorten or lengthen the patient movement policy? How would that diversion impact operations?
  - What medical and non-medical evacuation assets are available (organic in theater, HN, strategic)?

[30] In addition to the embedded NIPR link (https://www.ncmi.dodiis.mil/), see NCMI products on SIPR at https://dia.smil.mil/source/web/?topic=Medical.

7. Execute a Pandemic and Infectious Disease (P&ID) Plan

2-26. The purpose of P&ID plans is to ensure the force is prepared to mitigate the effects of P&ID, to sustain readiness of personnel, and to execute missions as directed, in response to a pandemic or outbreak.[31] Outbreaks of operational significance could warrant execution of a P&ID plans at echelon.

2-27. The following is an initial list of IRs that require medical input and inform the decision to execute the P&ID plan.

- IR 1: What indicators of a potential operationally significant disease have been observed within the OA?
  - What disease has been identified and what is the causative agent?
  - How contagious is the disease?
  - What potential does the disease have to produce a regional epidemic or pandemic? How could executing the P&ID plan reduce the potential for or severity of a regional epidemic or pandemic?
- IR 3: How is the outbreak affecting the OE?
  - In which phase of their respective P&ID plans are the WHO, USG, CDC, DOD, and higher headquarters?
  - How could the P&ID plan mitigate the impact of movement or other restrictions imposed by higher DOD or foreign authorities?
    - Consider border closure, overflight restrictions, limitations on movement of personnel, patients, or equipment, and rules for access, basing, vector control, disinfection, and quarantine.
  - What warnings or emergency declarations affecting the OA have been issued by DOD, other federal agencies, or international authorities? How do they impact the OE?
    - Consider: other nations, higher headquarters, NCMI,[32] DHHS, CDC, DoS, WHO or a regional office, PAHO, WAHO, ECDC, IANPHI (set the Topic Filter to "Infectious Diseases")
- IR 4: How have disease spread and outbreak response affected readiness and operations? How could disease spread and outbreak response affect future readiness and operations?
  - How ready are units required for the main effort (personnel, training and exercise, equipment)?
  - How would executing the P&ID plan affect readiness?
  - How long can the operation continue if the P&ID plan is not executed?
  - How could the P&ID plan mitigate future impacts on readiness or extend the duration the operation can continue?
- IR 5: How has the outbreak affected demand for and provision of medical services? How would the forecasted evolution of the outbreak affect demand for and provision of medical services?
  - How long can the medical system satisfy demand if the P&ID plan is not executed?
  - How would executing the P&ID plan affect medical demand and the medical system's ability to satisfy demand?
  - How would executing the P&ID plan affect ability to evacuate casualties and return personnel to duty?
- IR 6: How effective are the MCMs and PPE organically available to the force? What other MCMs and PPE could be made available, and how effective are they?

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31 FCP-P&ID, viii.

32 In addition to the embedded NIPR link (https://www.ncmi.dodiis.mil/), see NCMI products on SIPR at https://dia.smil.mil/source/web/?topic=Medical.

– How would executing the P&ID plan impact the availability or effectiveness of MCMs and PPE available to the force?

8. IRs Mapped to Decision Types

2-28. Table 5 provides an example mapping of IRs to decision types. Table 5 is not definitive. Staffs must judge whether circumstances warrant changes to decisions, IRs, and/or the mapping of IRs to decisions. This type of table can be used in several ways, for example:

- As a reference for the information needs for each decision type—which rows are marked?
- To understand the relevance of an IR across the decision space—which columns does it appear in?
- As an aid in prioritizing IRs for collection—higher priority for IRs that are marked in many columns.

Table 5. IRs Mapped to Decision Types

Serial	Collection Planning Comment	Decision Type						
		1	2	3	4	5	6	7
IR 1	Routinely check for updates to trigger outbreak awareness	X			X			X
IR 2		X	X	X	X	X	X	
IR 3	Cannot assess prior to a specific outbreak, but could establish a framework for assessing	X		X	X	X	X	X
IR 4		X			X	X	X	X
IR 5		X	X		X	X	X	X
IR 6	Once an outbreak begins, requires frequent updates	X	X	X	X	X		X
IR 7	Assess generically prior to an outbreak; update the assessment for specific outbreaks					X	X	

3. Medical Staff Actions

3-1. This chapter addresses actions the medical staff should consider, and supporting information to gather or assessments to perform. The actions, information, and assessments will inform medical staff input to: (1) anticipated decision types, (2) satisfying IRs, and (3) potential changes in operational plans. They will also help the medical staff maintain running estimates and alter medical plans.

3-2. The actions described in this chapter can be viewed as the "what," with Chapter 4's reference material addressing technical aspects of "how." Chapter 3 contains many pointers to related sections in Chapter 4.

3-3. Medical information and resulting estimates of the medical situation must be promulgated across and understood by other staff elements. Accordingly, coordination and communications channels with other staff elements (e.g., G1, G2, G3, G4, G9) must be pre-established to enable rapidly shared situational understanding. Coordination (practices through exercise) is particularly critical between medical personnel (who understand health impacts and health data), CBRN personnel (who understand operational defensive measures), and intel personnel (who understand threat intentions and capabilities). These are all necessary to understand the threat risk, identify protective measures, and prepare for mitigation. Communications plans should address the potential for denied, disrupted, intermittent, and limited (DDIL) communications, but DDIL communications are not addressed in this document.

3-4. Likewise, medical staffs must be familiar with staff organization, functions, planning, operations assessment, and support to potential changes in plans, particularly for the many aspects of LSCO. The Key References in Section 1.C include several publications addressing these topics.

3-4. This chapter is divided into five sections: Foundational Information, Situational Awareness (SA), Force Health Protection (FHP), Health Service Support (HSS), and Strategic Communications. As the name implies, foundational information is of cross-cutting relevance. The SA section focuses on two aspects of SA: (1) maintaining medical SA, and (2) medical contributions to broader staff and commander SA. The FHP and HSS sections address the two missions of the AHS. The strategic communication section addresses medical staff support to strategic communications led by public affairs.

A. Foundational Information

3-5. This section summarizes information medical staffs need as a foundation for many other potential actions and recommendations. Gathering the information will require coordination with other staff elements and/or units, potentially to include reachback organizations. Table 6 lists some potential sources.

3-6. The medical staff must have working knowledge of the capabilities of assets relevant to biological defense, whether medical or non-medical, and whether organic, at a higher echelon, or available via reachback. In particular, CBRN, FHP, and HSS capabilities must be considered. Best practice is to establish communications during routine operations before any incident or outbreak has occurred.

- CBRN asset examples include the 20th CBRNE command and its subordinate elements, and in-theater CBRN reconnaissance and detection assets.
- FHP asset examples include the Army Public Health Center (APHC), the Armed Forces Health Surveillance Division (AFHSD), the Global Medical Field Laboratory (GMFL),[33] and other in-theater preventive medicine, laboratory, veterinary, dental, and combat and operational stress control (COSC) assets.

[33] Formerly known as the 1st Area Medical Laboratory. For details on the GMFL, see the *AHS Doctrine Smart Book*, 157–160.

- HSS asset examples include all types of MTF (and reporting from MTFs), diagnostics performed initially for patient care but usable for broader SA, prophylaxis and treatment including therapy drugs, and MEDEVAC and aeromedical evacuation (AE).
- Reachback organizations that may be of assistance for multiple reasons include the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), U.S. Army Medical Research Institute of Chemical Defense (USAMRICD), Walter Reed Army Institute of Research (WRAIR), and the Defense Threat Reduction Agency's (DTRA's) Operations Center[34] (for technical reachback, including modeling).

3-7. Time is of the essence with any disease outbreak. However, even with help from the above sources and the broader information sources discussed in Section 3.B (Table 8), some of the information might not be available or not have a clear answer for a significant time (weeks, months, possibly even years). Information will likely trickle in at different times. Some information could be duplicative or even contradict earlier information as investigations continue over time.

- It can be tempting to "save time" by assuming that a new disease is similar to a known disease, for reasons such as genetic similarity. These assumptions can sometimes be useful, but can also be wrong, leading to unhelpful outbreak response. Consider that many medical authorities initially assumed that COVID-19 would be similar to SARS because both are caused by coronaviruses, only to discover later that the two diseases are different and require different outbreak response measures.

Table 6. Key References for Information on Known Diseases

Source	Description
Control of Communicable Diseases Manual (CCDM) (TM 4-02.33)	Widely recognized reference book on infectious disease, published by the American Public Health Association; contains comprehensive scientific data with emphasis on epidemiology, identification, reporting, control, and prevention
ATP 4-02.84	Joint doctrine on treatment of BW casualties; also addresses topics like recognition and outbreak control
TM 3-11.91 Appendix D	For select pathogens and toxins of military significance, summarizes agent characteristics, disease characteristics, IPE/PPE, first aid, and decontamination
Blue Book (9th edition, 2020)	Provides concise supplemental reading material to assist healthcare providers in the management of biological casualties
USAMRIID Biodefense Tool (smartphone app)	Distills key information presented in USAMRIID's training and education courses on biological threat agents of concern and serves as a quick reference for the identification of these agents in the field
Medical Aspects of Biological Warfare	Addresses many facets of biological defense preparedness and consequence management, and disease progression and management
Infectious Disease Risk Assessments (IDRA)[a] from NCMI	"Provides a prioritized disease-by-disease estimate of the endemic infectious disease threats in the operational environment and the potential operational impacts to support force health protection decisions. The IDRAs also serve as a baseline of expected diseases, enabling early detection of anomalies, including emerging infectious diseases"
Defense Intelligence Agency Threat Library	Provides foundational threat assessments by subject matter experts in the Intelligence Community that project threat capabilities in specific threat sectors out 20 years and serve as the primary sources of threat content supporting requirements, acquisition, and test professionals in the defense acquisition system.

a Choose a country in the dropdown under "List of IDRA Countries"

[34] Or on SIPRNet, go to https://opscenter.dtra.smil.mil.

3-8. Table 7 shows tasks and information for medical staff consideration in gathering foundational information. In any given situation, elements of this list might not be applicable, and/or other elements might need to be added. Table 7 also lists potential information sources and elements the medical staff should coordinate with. Staffs should proactively build relationships and mechanisms for information flow, regularly assess the flow of information, and be prepared to report in command updates on connectivity to information sources and whether alternative means are required to ensure information flow.

Table 7. Biological Defense Foundational Information for Medical Staffs

Tasks or Information to Consider	Sources or Coordination
Identify the causative agent and disease, and determine key characteristics (note that many characteristics could vary with demographics and/or with variants of the agent)	
What is the causative agent?	Table 6 sources, public health authorities
What are the typical geographical range and seasonal variation of this disease?	
What is the case definition (probable, suspected, confirmed)?	CDC, WHO
How is the incubation period distributed over time? • See Section 4.B.6 for information on approximate timing of disease onset for several BW-associated diseases • For BW, what is the dependence on dose, if known?	Table 6 sources
How serious is the illness? Consider morbidity, hospitalization rate, mortality rate, recovery time (particularly time to RTD)	Table 6 sources, public health authorities, MTFs
How can infection or illness be diagnosed (clinical, laboratory)? How does diagnostic performance vary during the course of infection/disease? • See Section 4.D for additional discussion of diagnosis	Table 6 sources, public health authorities, MTFs, LAB
What is the treatment protocol? At what roles of care can it be executed? • Are low-volume resources required? To what degree? • What therapy drugs are effective? Are they available where needed and in the quantities needed?	Table 6 sources, public health authorities, MTFs
• Are the required resources affected by any supply chain limitations?	MEDINTEL
Is environmental persistence of the causative agent an operational threat? • See Section 4.B for discussion of environmental persistence for BW agents • For plant and animal diseases, the main military operational/tactical concern is that it can lead to restrictions on movement, intended to prevent military equipment and vehicles from spreading disease	Table 6 sources, public health authorities, LAB, OPH
Is the disease contagious? If yes: • How is it transmitted? Which routes of transmission post a threat to troops? • How contagious is it? How does contagiousness vary over the course of disease? • What is the observed serial interval? • What is the latent period (time from exposure to contagiousness)? Can infected personnel spread disease before having symptoms? • Are there cases of asymptomatic or pre-symptomatic infection that can spread disease? If so, what fraction of cases? How does their contagiousness (overall, over time) compare with symptomatic cases? • See Section 4.E for supporting technical discussion	Table 6 sources, public health authorities
• What FHP measures are effective for reducing transmission?	Public health authorities, OPH, VET

Tasks or Information to Consider	Sources or Coordination
• What equipment and procedures are effective for isolating ill personnel? What roles of care and evacuation platforms can execute?	MTFs, MEDEVAC
• What limitations exist on evacuation of patients? What special resources or authorizations are required to evacuate patients?	Policy, higher Surgeons, PAD, MRO
Estimate number, timing, and geographic distribution of patients • See Sections 4.B.7 and 4.E.2 for discussion of casualty estimation	G1

B. Situational Awareness (SA)

3-9. This section focuses on gathering and sharing of SA across the staff and with lower, higher, and adjacent units.[35]

3-10. There are two SA considerations that are unique to outbreaks of operational significance and bear directly on medical staff roles and responsibilities:

- Unlike conventional, chemical, and nuclear weapons, which produce casualties instantaneously, the inherent incubation periods of biological agents dictate that casualties will occur hours to days later, depending on the agent. Given the difficulties with tactical detection of biological agents, the AHS will likely provide the earliest warning and SA about an outbreak that could have significant impact across the OA.[36]
- Producing and using that AHS-generated SA requires medical staffs to collate multiple information feeds, analyze them, and rapidly disseminate findings to higher and lower echelons within the medical and operational chains of command.

3-11. The importance of speed of action in outbreak response cannot be overstated. Opportunity to blunt the outbreak curve is highest at the start, and decreases over time. Situational awareness is critical for initiating timely and effective actions.

3-12. Accordingly, it is important that medical staffs have established sources and mechanisms to gain SA about outbreaks. Consider the following types of sources, some of which are already routinely handled within the AHS but are not always be applied for the purpose biological defense.

- Casualty and other routine medical reports. Collect and analyze reports from both HSS and FHP sources. Coordinate particularly with preventive medicine and veterinary (for both animal disease and food information) when comparing to normal disease rates.
- Environmental detection results. Coordinate with chemical staff and with laboratory assets, whether medical or non-medical.
- Non-medical intelligence indicators. Indicators of adversary use or intention to use, such as through intercepted communications, attempts to access food or water supplies, or sprays of unknown substances upwind of friendly forces. These and other indicators might not identify agents, but could assist in focusing other situational awareness efforts.
- Assessments or reports relevant to outbreak detection by DOD or non-DOD sources. In addition to organic and available FHP assets, CDC, WHO, allies, partners, and local health authorities, consider the sources in Table 8.

[35] Note that Section 3.E discusses Strategic Communications, which focuses on communication to the force in general and to external audiences.

[36] For BW attacks, intelligence or tactical environmental detection could be earlier, but there are many hurdles; see Section 4.B.5.

Table 8. Potential Information Sources for Infectious Disease Outbreak Detection

Source	Description
Armed Forces Health Surveillance Division (AFHSD)	Provides DOD-level comprehensive military health surveillance information
Health Surveillance Explorer[a] (from AFHSD)	Dynamic CAC-enabled mapping application showing global health threats and disease outbreaks in near-real time; integrates information from other sources including AFHSD's Global Emerging Infections Surveillance
Electronic Surveillance System for Early Notification of Community-Based Epidemics (ESSENCE)	Global and military health system (MHS) monitoring capability for early detection of imminent health threats impacting force readiness
Army Public Health Center (APHC)	Identifies and assesses current and emerging health threats, develops and communicates public health solutions, and assures the quality and effectiveness of the Army's Public Health Enterprise
APHC Information Products for Risk Assessments	Provides links to existing sources of information on disease vectors, entomological and zoonotic risk assessment, infectious disease risk assessment, and possible causes of nonspecific fever
Disease Reporting System Internet (DRSi)	Official repository for reportable medical events
National Center for Medical Intelligence (NCMI)[b]	Produces finished intelligence on a wide range of topics relevant to medical aspects of biological defense
Centers for Disease Control and Prevention (CDC)	National public health agency of the United States
European Centre for Disease Prevention and Control (ECDC)	Public health agency of the European Union
World Health Organization (WHO)	International public health agency of the United Nations; see also its regional offices, which cover all combatant commands
West African Health Organization (WAHO)	Public health institution of the Economic Community of West African States
Program for Monitoring Emerging Diseases (ProMED)	Free, publicly available service to identify unusual health events related to emerging and re-emerging infectious diseases and toxins affecting humans, animals and plants.
United States Agency for International Development (USAID) HealthMap	Mapping application showing global surveillance of public health threats, including diseases affecting animals
World Animal Health Information System (WAHIS)	Comprehensive database on worldwide animal health

a Click on "Defense Health Agency AFHSD Health Surveillance Explorer."

b Particularly, see the IDRAs (choose a country in the dropdown under "List of IDRA Countries"), HORIZON, and the Risk and Severity Assessments (go to https://dia.smil.mil/source/web/?topic=Medical on SIPRNET and search for the disease name. For background on NCMI's process on SIPRNET, see https://www.dia.smil.mil/intel/DIA/16/1302/955/DIA-16-1302-955.pdf and https://www.dia.smil.mil/intel/DIA/16/1204/533/DIA-16-1204-533.pdf).

3-13. Table 9 shows tasks, information, and assessments for medical staff consideration in relation to gathering and sharing SA. Depending on the situation, some items might be irrelevant and additional items might be necessary; user judgment is required.

Table 9. Biological Defense SA Considerations for Medical Staffs

Tasks or Information to Consider	Sources or Coordination
Maintain awareness of contagious disease outbreaks in and near the AO	Table 8 sources, OPH
Contribute medical perspective, informed by analysis of MEDINTEL, to BW vulnerability analysis	G2/CHEM (lead), MEDINTEL
Recommend reporting a potential public health emergency of international concern (PHEIC), as warranted (see DODI 6200.03, pp. 27–29)	
Share "Foundational Information" and medical assessments as appropriate with other staff elements; some SA-focused examples are below	
Indications from diagnostic results and/or medical, veterinary, or environmental health reports that an outbreak has begun, and what to watch for to identify cases	Table 8 sources, MTFs, OPH, VET
Future casualty/patient estimates	G1
Outbreak status and control measures at ports, borders, or other locations of particular interest or impact on operations	Table 8 sources, local authorities, G2
MEDINTEL reports and information requirements for MEDINTEL collection	G2, NCMI and other MEDINTEL
Assess the likelihood that the outbreak was caused by a BW attack • See Section 4.C for discussion of clues to consider when performing this assessment • Consider recent environmental detection and reconnaissance results in relation to assessed adversary BW capabilities, recent weather, recent unit locations and associated key terrain features, and observed patterns of illness • Ensure clinical samples drawn or used for this purpose have appropriate chain of custody (packaging, labeling, transport, tracking, protection—see ATP 4-02.84 Appendix A for guidance)	 CHEM, G2, SWO CHEM, MP, JAG
Establish or revise mechanisms for health surveillance data fusion and analysis, plus sharing of results	OPH, VET, COSC, LAB, MTFs
Update health surveillance requirements, including animal and plant surveillance as appropriate (see Section 4.E.4 for discussion)	OPH, VET, COSC, LAB
Revise or establish plans and procedures for receiving, tracking inventory of, distributing, and storing medications, PPE, vaccines, consumables, equipment, and any other appropriate items	MEDLOG, SIMLM, TLAMM
Coordinate to establish plans for movement of potential biological agent samples for laboratory analysis	CHEM, G2, MP, JAG, LAB
Ensure outbreak-specific information is captured in the medical COP and presented to the commander as appropriate • Consider including: numbers of suspected and confirmed cases by location; patient tracking of suspected and confirmed cases; locations, actions, and results of investigations by any specialized assets; locations and availability of biocontainment evacuation assets • For presentation to the commander, consider a graphic showing patient locations on a unit/area map, indicating recent changes and expected near-term changes. If a BW was used, consider initial casualties, wind direction at the time of the attack, any key terrain like valleys or mountains, and estimated affected areas	 MTFs, PAD, MRO, OPH, VET, LAB CHEM, SWO

Tasks or Information to Consider	Sources or Coordination
Maintain awareness of how the HN, allies, partners, and other nations are affected by and reacting to the outbreak	
Verify routine health surveillance data/results sharing with HN, allies, and partners (as appropriate), using pre-established lines of communication	
Will foreign supply chain disruptions affect availability of medical supplies?	MEDINTEL
How transparent and accurate is foreign reporting on the outbreak?	MEDINTEL
Is the outbreak in a foreign country impacting local or regional stability in a way that poses a threat to friendly operations?	G2, MEDINTEL
Are foreign actions likely to impact friendly operations? Consider: • Foreign-imposed requirements affecting freedom of movement, access, basing, overflight, disinfection, vector control, controlled monitoring, isolation, quarantine, ROM • Misinformation or disinformation that can affect friendly operations • Foreign actions that indicate an attempt to exploit perceived U.S., partner, or ally vulnerabilities	G2, MEDINTEL
Are there likely to be requests for assistance? Consider: • Counts of cases, quarantine, and isolation in relevant civilian and military populations • Foreign nation ability to provide services to their force or population (capability, capacity) • Effectiveness of foreign public health campaigns, MCM, and other responses • Adversary attempts to gain influence or degrade U.S./partner/ally relationships by assisting other nations	MEDINTEL

C. Force Health Protection (FHP)

3-14. The AHS medical functions included in FHP are operational public health (OPH), veterinary services, COSC, dental services, and laboratory services. For primary tasks and purposes of each FHP function, see FM 4-02, Tables 5-1, 6-1, 6-2, 7-1, 7-2, 8-1, 8-2, 9-1, and 9-2.

3-15. FHP capabilities must be applied rapidly and effectively to minimize outbreak impacts on readiness and operations. Use of FHP capabilities must be informed by the foundational information and situational awareness discussed in Sections 3.A and 3.B. However, speed of action is important. It is likely better to initiate FHP actions with partial information than wait for complete information. FHP actions can also be used to gather additional information and awareness, enabling refinement over time.

3-16. The majority of the FHP actions in Table 10 relate primarily to OPH functions, but there are also roles for veterinary, COSC, dental, and laboratory capability. Table 10 recommends medical staff coordination with specific medical or other functions as a *starting point*, not to limit staff coordination to the entities listed.

3-17. Several items in Table 10 must be considered before an outbreak begins, and others cannot be done until an outbreak begins. Many items that must be considered before an outbreak will also require refinement during an outbreak, such as adapting NIOSH's Hierarchy of Controls for military use (Figure 2). Medical staffs must judge whether elements of Table 10 are not applicable to their situation or echelon, and whether other elements must be added.

Table 10. Biological Defense FHP Considerations for Medical Staff

Action to Consider	Sources or Coordination
Routinely verify and test surveillance, reporting, and laboratory networks and procedures; confirm and update points of contact and awareness of capabilities and capacities	OPH, VET, COSC, LAB
Maintain an up-to-date Health Risk Assessment—routinely, before any outbreak begins and as key information is gained or updated during an outbreak • See DA PAM 40-11 Chapter 4 and Appendix D • Coordinate with HN, allies, and partners as appropriate	OPH, VET, higher, lower, adjacent For biological defense information, consider the Intelligence and CBRN Threat sections of the OPLAN, and Table 8 sources
Establish or review prioritization of prophylactic medical countermeasures Recommend use of chemo- and immunoprophylaxis, as appropriate • Consider level of FDA approval and approvals from foreign regulatory agencies; different countermeasures might be needed in different locations	OPH, Table 6 sources, reachback organizations
Establish or review prioritization of PPE; recommend use of IPE[37] and/or PPE under conditions favorable for BW attack, if warranted by threat	OPH, CHEM
Maintain an updated database of personnel immunization status (whether from exposure or prophylaxis)	
Provide input to an overall command or unit mission assurance strategy to ensure critical personnel remain mission capable	OPH
Evaluate and recommend or initiate outbreak control measures as appropriate	
In evaluating, consider the potential impacts of control measures on readiness and operations, and whether/how control measures should differ in different situations (e.g., routine non-combat operations, combat operations, NEO)	OPH, VET, COSC
Coordinate to publish communications (potentially addressing all subsequent items) to the force, the public, and foreign audiences, as appropriate (see DA PAM 40-11, Appendix E)	PAO (lead), COSC, Chaplain
Update health surveillance requirements, including animal and plant surveillance as appropriate (see Section 4.E.4 for discussion)	OPH, VET, COSC, LAB
Coordinate to enhance behavioral health support at echelon, particularly for the case of adversary BW use because of the stress it can evoke due to lack of experience with adversary BW use	COSC (lead), Chaplain
Establish or enhance requirements, methods, and measures for several inter-related efforts to prevent infections (consider the concept depicted in the NIOSH Hierarchy of Controls, reproduced in Figure 2)	
• Coordinate to establish contamination avoidance requirements and methods	CHEM (lead)
• Coordinate to establish decontamination requirements and methods	CHEM (lead), VET
• Establish disinfection and vector control requirements and methods	OPH, VET
• Enhance hygiene and sanitation measures including vector/pest control	OPH, VET
• Enhance food and water inspection and safety measures	OPH, VET
• Infection control during preventive and treatment protocols and procedures	OPH, HSS, VET, DEN
Initiate dispersed operations, reduced in-person interaction, quarantine and other ROM, controlled monitoring	OPH, ENG, LOG

[37] Military protective ensembles (i.e., MOPP gear) protect against the full spectrum of biological threats, but are quite degrading. They may be "overkill" against biological threats, which may require only a mask or N-95 respirator or other standard medical PPE.

Action to Consider	Sources or Coordination
• Consider impacts on effectiveness resulting from HN or international agreement limitations to commander's authority (see DODI 6200.03, Section 3.5) • Consider implementation requirements like quarters, sustainment, and IT support, based on estimated number of personnel over time • Develop pre- and post-travel SOPs for screening, reporting, communication, and reception • Consider impacts on readiness and operations	
Declare of a public health emergency (for installations); see DODI 6200.03	Installation PHEO, MEM
Conduct epidemiological investigations	OPH, VET, LAB
Establish criteria for ceasing control measures	All above
Update and publish FHP guidance, adapting higher guidance as appropriate	
Consider including: outline of the situation; the FHP mission; case definitions; list of effective diagnostics or other screening tools; actions to take upon identifying cases; health surveillance and reporting requirements; the area affected (especially for a BW attack, if allowable in relation to OPSEC/EEFI); field hygiene and sanitation guidance; PPE guidance; prophylaxis guidance; behavioral health guidance	OPH, LAB, COSC, CHEM (if BW-related)
For a contagious disease, also consider including guidance on: contact tracing; isolation; quarantine; ROM or stop movement; dispersed operations; cessation of control measures; and implementation or implications for functions requiring medical advice, like mortuary affairs and medical waste management (see two subsections below for supporting information)	S3/G3, OPH, Mortuary Affairs, MEDLOG

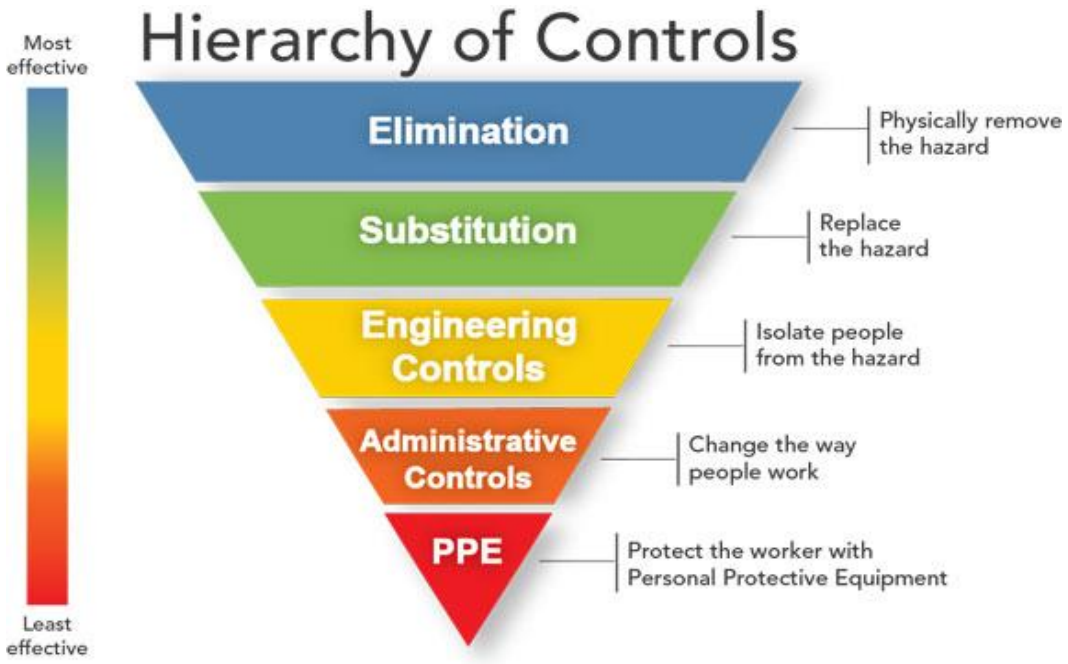

Figure 2. NIOSH's Hierarchy of Controls[38]

[38] https://www.cdc.gov/niosh/topics/hierarchy/default.html. The hierarchy is designed for civilians, but is adaptable to military forces.

1. Infectious Medical Waste Management[39]

3-18. Most medical planners recognize four categories of medical waste: infectious waste, radiological materials, hazardous materials, and general waste. Infectious waste is considered here.

3-19. Medical staffs must plan to facilitate enhanced FHP requirements as appropriate. This section primarily addresses the ideal, regulatory-approved answers. However, there may be situations when regulatory requirements cannot be met, and field expedient options are necessary. Unfortunately, no such measures have been developed, tested, and validated or approved. The best course of action for field units dealing with infectious waste under operational conditions is to coordinate with available public health assets regarding field expedient storage and disposal.

3-20. Most infectious agents potentially employed as weapons are highly hazardous. Some (though not all) are readily transmissible from person-to-person via respiratory droplets or aerosolized droplet nuclei. Transmission can also occur secondary to exposure to blood and body fluids of infected individuals, as well as to fomites (inanimate objects) contaminated with infectious substances. The same considerations apply when dealing with endemic and epidemic diseases of operational significance.

3-21. To prevent the secondary spread of infectious agents via contaminated blood, body fluids, and fomites, medical planners must possess an understanding of the basic principles of medical waste management.

3-22. Medical waste consists of the following:

1. Blood, or objects grossly contaminated with blood
2. Pathology specimens (e.g., amputated limbs, biopsy specimens, tissue)
3. Sharps (e.g., needles, scalpels)
4. Laboratory specimens (e.g., cultures)
5. Body fluids (e.g., cerebrospinal fluid, pleural fluid)
6. Animals (e.g., from research laboratories)
7. Teeth and dental specimens
8. Solids used in patient care and thus potentially contaminated (e.g., linens, gloves, PPE)
9. Chemotherapy waste
10. Anything else potentially contaminated with contagious agents

3-23. For purposes of infectious waste management, potentially infectious substances can be divided into two categories:

- Category A infectious substances are those that can cause permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to the substance occurs.
- Category B infectious substances are those that cannot cause permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to the substance occurs.

3-24. Category A infectious waste is medical waste potentially contaminated with a Category A infectious substance. Category A infectious waste must be inactivated (typically through autoclaving or incineration) onsite or properly packaged and shipped to an approved medical waste management entity. All other medical waste should be disposed of through the routine clinical waste disposal stream.

3-25. Packaging of Category A infectious waste must be done in accordance with established CDC and United Nations (UN) guidance. Detailed waste management and packaging instructions, as well as a list of pathogens that would lead to the generation of Category A infectious waste, can be found in:

- Centers for Disease Control and Prevention (CDC), *Managing Solid Waste Contaminated with a Category A Infectious Substance*, (Atlanta, GA: CDC, April 2019).

[39] For additional details on regulated medical waste, see DHA Procedural Instruction 6050.01 and MEDCOM Regulation 40-35.

https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/transporting-infectious-substances/6821/cat-waste-planning-guidance-final-2019-08.pdf

3-26. Category B infectious waste includes potentially infectious waste that does not meet the criteria for inclusion in Category A. In other words, it is being transported in a form that will not subject exposed individuals to the possibility of severe disease or death. Category B waste can enter the normal waste stream in clinical facilities. When shipped, packaging also must be done in accordance with U.S. Department of Transportation regulations.[40]

2. Infectious Disease and Mortuary Affairs (MA)

3-27. During conflict, medical personnel may be asked to provide advice to numerous command elements. Among these are MA personnel tasked with handling the remains of casualties who might have been the victims of an infectious agent. The following is a quick reference. ATP 4-02.84 (p. 1-18–1-19) contains additional information.

3-28. It is useful to consider three groups of handlers:

- Non-MA-trained Soldiers who could be pressed into service assisting with the clearance of remains from the battlefield
- Professional MA (quartermaster) Soldiers with training in the handling of remains
- Prosectors

3-29. Guidance for prosectors is beyond the scope of this document, but medical personnel should be prepared to provide advice to the first two groups.

3-30. It is useful to note that infectious diseases are transmitted in a limited number of ways: via respiratory droplets or aerosolized droplet nuclei, via blood and body fluids, via direct contact (with smallpox scabs, for example), or via fomites.

3-31. Human remains do not respire, so diseases transmitted via respiratory droplets or aerosolized droplet nuclei pose little risk to handlers. This fact serves to limit risk to a small number of diseases involving the release of large amounts of bodily fluids near the time of death or post-mortem. Among these are a few of the viral hemorrhagic fevers (VHFs), namely Ebola, Marburg, and Lassa. Similarly, while smallpox is transmitted principally via respiratory droplets, the scabs of victims pose a contact threat.

3-32. Whenever possible, the remains of victims succumbing to these four diseases should be handled only by trained MA personnel wearing protective ensembles (an encapsulating suit with hood and PAPR) or MOPP gear. In the case of casualties caused by other biological agents (including anthrax, botulism, plague, tularemia, brucellosis, Q-fever, VEE, SEB, ricin, and many others), standard precautions should suffice to protect handlers and non-MA-trained Soldiers can safely assist in the movement of remains.

3-33. Other mortuary affairs considerations include host nation and TRANSCOM policy, and religious preferences.

D. Health Service Support (HSS)

3-34. The AHS medical functions included in HSS are medical treatment, hospitalization, medical evacuation, and medical logistics. For primary tasks and purposes of each HSS function, see FM 4-02, Tables 10-1, 10-2, 11-1, and 12-1.

3-35. The HSS functions focus on treating patients. Table 11 focuses on assessments and adjustments that would be part of the medical staff's running estimate and could inform adjustments to optimize patient treatment. Some

[40] U.S. Department of Transportation, "Transporting Infectious Substances Safely," (Washington, DC: 2020), https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2020-04/Transporting%20Infectious%20Substances%20Safely.pdf.

items in Table 11 can also produce foundational knowledge and situational awareness that informs the broader outbreak response, medically and operationally.

3-36. Some items in Table 11 can be planned and prepared before an outbreak begins, and others cannot be done until an outbreak begins. Many items that can be planned and prepared before an outbreak will also require refinement during an outbreak, such as the potential situational standards of care in Table 12. Medical staffs must judge whether elements of Table 11 are not applicable to their situation or echelon, and whether other elements must be added.

Table 11. Biological Defense HSS Considerations for Medical Staff

Action to Consider	Sources or Coordination
Before any outbreak, establish baseline disease rates based on health surveillance	OPH, VET, COSC, MTFs
In light of the outbreak, review/revise medical rules of eligibility, humanitarian assistance commitments, medical elements of NEO plans, and any mutual support agreements	Legal
In light of the outbreak, review blood program for any changes needed to maintain safety	Blood units, OPH
Establish plans for individuals presenting directly at MTFs instead of through the normal evacuation chain (to prevent disease spread and preserve operational integrity)	MTFs, MP
Issue guidance for MTFs and for units on triaging "worried well" from infected personnel using personal exposure history and objective clinical signs, and on providing behavioral health support to the "worried well"	MTFs, OPH, COSC
Disseminate diagnosis and treatment recommendations (e.g., from reachback, organic personnel with experience, WHO, CDC, or other medical authorities) • Consider promulgating syndromic diagnosis guidance as discussed in Section 4.D.2	Higher, lower, adjacent
Establish or review prioritization of therapeutic countermeasures	MTFs
Establish or review prioritization of treatment (in cases of MTFs being full)	MTFs
Revise medical training requirements or prioritization	MTFs
Update medical logistics requirements, such as hygiene and sanitation supplies, disinfection supplies, prophylaxis, PPE, diagnostics and treatment equipment and consumables, and infectious waste management • Medical/infection control advice on outbreak-specific waste management practices may be required (see Section 3.C.1) • Consider establishing either general, or outbreak-specific push packages for specified types of outbreak (e.g., based on mode of disease spread)	MEDLOG, MTFs, MEDEVAC units, OPH, VET, LAB Estimating Supplies Program (ESP), in MPTk DLA's MCRW Table 6
Assess HSS capability and capacity relative to outbreak requirements (current, anticipated future)	
Prophylaxis: how does prophylaxis affect casualty estimates? If prophylaxis does not fully prevent disease, does it reduce severity? Consider PPE availability, by type.	OPH, reachback, MEDLOG
Diagnostics: what diagnostics can detect and/or identify the agent or disease? How does their performance vary during the course of disease? Consider capacity in terms of personnel, consumables, equipment, and throughput rates; break down by type, for example X-ray, CBC, rapid antigen, PCR.	MTFs, LAB, MEDLOG
Treatment: what therapy drugs or other treatments are effective and how do they impact mortality, severity, and return to duty? Consider capacity in terms of beds (by type); personnel (by function); key equipment like ventilators, oxygen	MTFs, MEDLOG

Action to Consider	Sources or Coordination
generators, and infusion pumps; consumables including MCMs, blood products, and medical gases.	
Evacuation: what biocontainment or isolation capability do evacuation platforms have? Consider capacity in terms of seat and litter capacity by type of platform (CASEVAC vs. MEDEVAC, ground, air, strategic); personnel; consumables; equipment; turnaround time.	PAD, MRO, TPMRC, JPMRC
Recommend or initiate responses to shortfalls detected in the above assessment	
Update MEDLOG requirements and item prioritization (reflecting total patient numbers and as warranted, shift in patient type away from trauma and toward infectious disease)	MEDLOG, MTFs, LAB, MEDEVAC
Redistribute organic/subordinate medical assets, including local stockpiling of Class VIIIA to minimize stressors on just-in-time logistics.	MEDLOG, MTFs, LAB, MEDEVAC
Identify potential alternative sources (non-CONUS, for example HN) of Class VIIIA to recommend for consideration.	MEDLOG, Policy
Designate some MEDEVAC and/or CASEVAC platforms for contagious patient transport (with field-expedient infection control measures, if needed).	OPH, PAD, MRO, TPMRC, JPMRC
Recommend changing theater patient movement policy • Consider whether sub-policies or policy exceptions make sense, for example in the case of a widespread but self-limiting disease (e.g., VEE) that will allow RTD within a few days of the current policy.	PAD, MRO, higher Surgeon
Employ Alternate Care Strategies	
• Move patients to decompress MTFs and/or to prevent the outbreak from reaching previously unexposed patients with other conditions. • Alter patient flow (e.g., route all contagious patients through dedicated contagious disease MTFs or wards).	OPH, PAD, MRO, TPMRC, JPMRC
• Establish alternate care facilities/sites (buildings or structures of opportunity converted for healthcare use).	MTFs, ENG, G4
• Employ situational standards of care (see Table 12).	MTFs, Legal, OPH

Table 12. Potential Situational Standards of Care for Outbreaks of Operational Significance

Situational Standard	Discussion	Infectious Disease Considerations
Use of alternative care facilities	Military uses tentage at Roles 1-3; often utilizes back of vehicle for Role 1. Can use "commandeered" facilities.	Casualties who might be hospitalized simply to keep them from spreading disease can be housed in tentage or commandeered facilities far removed from the location of the MTF.
Cohorting of patients	This is routinely done in military deployed settings where private rooms are not feasible.	Cohorting is especially important when dealing with contagious diseases. (Note: not all infectious diseases are contagious, that is, not all are transmissible from person-to-person). Patients with the same contagious disease can be hosted together, but they should not be housed with those who do not have the disease.[41]
Discharge low acuity patients	Free up bed space by sending low acuity patients either to their unit or to a medical holding area to complete recovery and then return to duty.	This should generally be done only for patients with non-contagious diseases or for patients whom treatment has rendered non-contagious.
Prioritize by operational factors	Critical mission requirements might require allocation of resources based on operational factors rather than medical risk (DOD 6200.03, page 45).	
Re-use of equipment	Military facilities might recycle splints, PPE, and other materials in a crisis.	PPE shortfalls might require cleaning and re-use of certain items (consult CDC guidance and local public health assets).
Use of staff extenders	Military makes ample use of Physician Assistants and Nurse Practitioners.	
Tiered staffing	Military makes ample use of tiered staffing, wherein one RN supervises several LVNs, who oversee multiple 68Ws providing bedside care.	
Altered staff to patient ratios	During combat operations, personnel typically care for more patients than most peacetime staffing models would call for.	
Augment with non-medical personnel	Use personnel without formal medical training to perform basic tasks under medical supervision; MINIMAL patients might be able to perform this function.	Patients with infectious diseases, once out of the acute phase of their disease, might simply require observed enforcement of antibiotic compliance. This observation might be accomplished by personnel with minimal training.
Use of telehealth	Expand the employment of telehealth technologies.	Compliance with prophylaxis and therapy might be monitored via teletechnology.
Operating outside peacetime	The military routinely uses pediatricians to provide primary care to adult Soldiers; gynecologists to perform certain surgeries;	

[41] For example, during an Ebola outbreak in West Africa, some malaria patients were placed in Ebola wards due to similarity of symptoms, and ultimately acquired Ebola and died.

Situational Standard	Discussion	Infectious Disease Considerations
or garrison scope of practice	psychiatrists, pathologists, radiologists to handle sick call in deployed environments. Of note, 18Ds routinely operate outside of what would be considered their civilian scope of practice.	
Use of triage	Triage applies during crisis situations; the battlefield is, by definition, a crisis situation.	Triage presents unique considerations when applied to biological casualties. Many infectious diseases of operational significance (e.g., VEE, SEB, Q-fever, botulism, influenza, COVID-19) can be successfully managed using only supportive care measures (fluids, oxygen, antipyretics). Others (e.g., anthrax, plague, tularemia, brucellosis, glanders, melioidosis), if diagnosed promptly, will respond favorably to widely available antibiotics. With rapid awareness and appropriate treatment, few infectious casualties would require an *Expectant* designation. Rare exceptions might include rabies as well as smallpox and VHF (Ebola, Marburg, Lassa) patients in the late stages of disease. MASCAL or delayed awareness can result in more *Expectant* casualties.
Altered clinical testing	Allow specified (pre-planned) deviation from SOPs or other clinical guidelines, where deemed appropriate by providers.	Alternative rapid testing might be appropriate in certain situations that might otherwise call for more sensitive or specific testing. For example, substitute rapid antigen testing for PCR-based tests.
PO versus parenteral (IV, IM, SQ) therapy	In cases where an IV Rx may be recommended under normal circumstances, an oral option may be employed in a crisis. This would be especially relevant to BW events involving mass casualties.	Many (but not all) antibiotics have good oral bioavailability. When an orally bioavailable antibiotic is effective, patients who might otherwise require IV treatment might be discharged on oral therapy, or oral therapy might be used in MASCAL.
Altered documentation requirements	Allow specified (pre-planned) deviation from standard procedures for documenting health care options, discussions, and decisions.	
Shelf-life extension programs	We would expect to use outdated materials and drugs on the battlefield if alternatives did not exist.	These extensions might specifically be applicable to antibiotics.

Note: Several, but not all, of the options listed here are included in DODI 6200.03, 43–46, and/or in the FCP-P&ID in Tab D to Appendix 1 to Annex C, and in the subordinate section Exhibit 2.

E. Strategic Communication

3-37. Outbreaks of operational significance will require a dedicated strategic communications effort at the highest levels of command, implemented by public affairs personnel at echelon. Medical staffs must be ready to support by providing medical subject matter expertise and by assisting in propagating the message, consistent with commander's intent, down the chain of command and into communities of practice. Medical staff may be asked to make statements to the media or the public, and should always coordinate such statements with the public affairs officer (PAO) and ideally have the PAO present when making statements. Table 13 lists communications tasks and considerations for medical staffs.

3-38. Medical support to strategic communications will be of better quality if medical staffs are familiar with some basic strategic communications principles. This section briefly summarizes some principles and refers to additional resources as a starting point (Table 14).

3-39. There are two types of audience and multiple purposes of strategic communications.

- **Internal audience**. Purposes include (1) informing the community about what to do; (2) building trust; (3) engaging the community to take ownership and support the response; and (4) countering fear and mis- or disinformation.
  - The "internal audience" includes Service members, their families, dependents, and contractor personnel interacting with the force, whether U.S. or foreign citizens.
- **External audience**: Purposes include (1) exchanging information about progress and challenges (as appropriate); (2) injecting truth into the churn of mis- and disinformation; and (3) assuring the external audience that operations will continue.
  - The "external audience" includes the HN, partners, allies, adversaries, and the general public.

3-40. Insufficient strategic communication will allow misinformation to fester, whether it began without malicious intent (e.g., rumors) or is the result of a disinformation campaign intentionally designed to sow doubt and fear. Misinformation and disinformation is often obviously flawed or unrealistic to experts (such as medical personnel), but the rest of the community could be left confused. Medical staffs must contribute medical scientific truth, as far as it is known, in a transparent, nontechnical, and digestible way, for inclusion in the broader strategic communications effort.

3-41. If the adversary uses a BW, it is likely to affect nearby civilians. In this case, strategic communication takes on another level of importance, as the military can likely provide the earliest warning to the HN or other surrounding civilians.

Table 13. Biological Defense Strategic Communication Considerations for Medical Staffs

Tasks or Information to Consider	Sources or Coordination
Before an outbreak, prepare and standardize releasable information on known threats and their effects, whether BW or natural endemic diseases	PAO (lead), higher command, CHEM; sources in Table 6
If a BW was used, coordinate to estimate medical impacts on local civilians and contribute to communications to the public (Army families, contractors, HN)	PAO (lead) G2, MEDINTEL, CHEM
Provide medical input on strategic communications; communications best practices medical staff should apply include: • Align with the commander's intent and stick to the core message • Begin early • Educate to empower the community to act for its own good and to accomplish the mission • Engage the community as a partner in the response, not a target of the response • Be empathetic while preparing the community for change • Be transparent on unknowns, resource limitations, and other challenges (balanced appropriately with OPSEC/EEFI concerns) • Use nontechnical language and digestible messages; balance against messaging that is too shallow or superficial to be meaningful • Communicate coherently via multiple channels and ensure the community has means to receive • Balance control of the message with mission command as lower echelons and communities of practice inherit and subsume the message • To address mis- and disinformation, expose the liar without worrying about every particular lie	PAO (lead), higher command

Table 14. Additional Sources on Strategic Communication

Source	Description	Link
CDC Field Epidemiology Manual	Contains guidance on communication during an outbreak	https://www.cdc.gov/eis/field-epi-manual/chapters/Communicating-Investigation.html
Communication Campaigning: Primer for Senior Leaders	Defines, describes, and teaches the art and science of strategic communication	https://apps.dtic.mil/sti/citations/AD1124811
DODI 6200.03	DOD Instruction on Public Health Emergency Management, contains guidance on communication	https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/620003p.pdf
COVID-19 lessons learned or best practices articles that address communications		https://www.brookings.edu/techstream/lessons-learned-from-taiwan-and-south-koreas-tech-enabled-covid-19-communications/ https://academic.oup.com/milmed/article/187/1-2/e138/6126418 https://www.tandfonline.com/doi/full/10.1080/20479700.2020.1862997

4. Supporting Technical Information

4-1. This chapter addresses the technical and medical characteristics of (1) biological agents, biological weapons, and BW outbreaks and (2) contagious diseases/outbreaks. BW attacks can produce non-contagious or contagious disease outbreaks. When this chapter discusses BW, it focuses on the primary technical aspects of BW agents and effects; that is, the outbreak directly caused by the dispersed agent. For any contagious BW agent, traditional contagious disease science applies after the initial exposure, and is addressed in the broader discussion of contagious disease.

4-2. The discussion of the technical and medical characteristics will provide the medical staff with specific knowledge to apply when recommending and/or answering IRs, when developing and assessing courses of action, and during the execution of other medical staff responsibilities. The characteristics influence the nature and magnitude of outbreaks and the capabilities and capacities required to respond.

4-3. The organization of this chapter is as follows.

- Section 4.A – characteristics of pathogens/agents and diseases that apply to any outbreak of operational significance.
- Section 4.B– implications particular to BWs, a few additional characteristics that factor into adversary decisions to produce or use a certain BW, and other BW-specific issues including casualty estimation.
- Section 4.C – clues one might use to determine whether an outbreak is the result of a BW attack or a natural occurrence.
- Section 4.D – using medical diagnostics to generate outbreak SA.
- Section 4.E – contagious disease discussion, including transmission dynamics and forecasting basics, discussion of outbreak response measures, challenges, and requirements for outbreak control, and disease surveillance support to situational awareness.

A. Characteristics of Pathogens, Biological Agents, and Diseases

4-4. Some characteristics below relate to pathogens or disease in general, and others relate specifically to the use of pathogens as biological agents to cause disease. The references in Table 6 discuss many of these factors for known biological agents and diseases. In particular, ATP 4-02.84, Table A-1 contains a succinct summary for several biological warfare agents. Each of the characteristics in the following list is discussed further, below the list.

- Infectivity
- Infection-to-disease ratio
- Incubation period
- Virulence
- Environmental stability
- Contagiousness
- Prophylactic countermeasure availability
- Therapeutic countermeasure availability
- Ease of detection and/or diagnosis

- Ease of production
- Stability in storage
- Ease of dispersal

4-5. **Infectivity**. Infectivity refers to the ease with which a pathogen infects exposed individuals.[42] It is often measured using an ID_{50} (pathogens) or ED_{50} (toxins), which indicate the number of viral particles or bacterial colony-forming, or mass of a toxin required to infect (pathogens) or affect (toxins) 50 percent of an exposed population. The terms "infectious dose-50 percent" or "effective dose-50 percent" may also be used. Infectivity is different from contagiousness, but does influence the ease with which an individual exposed to a contagious disease will become infected. Several agents with notably low ID_{50} values (*Francisella tularensis*, *Brucellae*, *Coxiella burnetii*) factored prominently in Cold-War-era arsenals. Infectivity also plays a role in determining the risk of acquiring disease from the re-aerosolization of organisms in the environment. For example, while *Bacillus anthracis* and *Coxiella burnetii* both form spores and thus persist in the environment, Q-fever (ID_{50} = 1) occurs frequently from exposure to dust,[43] and anthrax (ID_{50} = 8,000-40,000) does not. Note that for pathogens it is possible for an infection to not manifest in symptoms (see I/D ratio below).

4-6. **Infection-to-Disease (I/D) Ratio**. With many infectious diseases, individuals may become infected but may not manifest disease. The Cold War superpowers developed VEE virus as a weapon, despite the fact that related viruses such as EEE and WEE viruses are far more lethal. The presumed reason for this decision involves VEE's I/D ratio of nearly 1:1, in contrast to EEE, with a I/D ratio of 1:23 and WEE, with a I/D ratio of 1:1,150.[44] VEE's better I/D ratio makes its effects more predictable and therefore more attractive as a military weapon.

4-7. **Incubation period**. Certain infectious diseases have consistent incubation periods. Smallpox, for example, predictably develops 12 ± 5 days following exposure, and SEB produces symptoms in hours. On the other hand, certain diseases (such as brucellosis) may develop weeks to months after exposure, limiting their immediate tactical utility. Even if a disease has a *consistent* time to onset (like smallpox), its tactical utility may also be limited if the time to onset is too long relative to the military objective motivating a BW attack. Attacks with operational and strategic objectives may be more amenable to diseases with variable and/or longer incubation periods. See Section 4.B.6 for approximate timelines for BW-induced diseases.

4-8. **Virulence**. Virulence is typically measured in terms of morbidity and mortality (or case fatality) rates. Given the development of a specific disease within a unit, the medical staff will need to know and explain the nature of symptoms that personnel might exhibit, their severity (and thus their impact on mission success), and the expected mortality rate. Symptom severity, disease duration, and potential for return to duty also impact how far personnel must be evacuated.

4-9. **Environmental stability**. This umbrella term includes stability of both BW and naturally contagious pathogens in the environment, whether as an aerosol (from an attack or a person) or after deposition onto/into a surface, soil, or water. High environmental stability enables a pathogen to affect larger areas and numbers of people, to continue posing a hazard for a longer time, and potentially to pose a re-aerosolization threat (though this is uncommon even for BW; see Section 4.B.3). Environmental stability is one determinant of a disease's contagiousness. Environmental persistence of BW agents is discussed in Section 4.B.

4-10. **Contagiousness**. Contagiousness (also called communicability) refers to the ease with which infected individuals might transmit disease to others, and is typically expressed as the R_0, the number of secondary cases developing from each primary case. Among putative biological weapons and common infectious diseases of operational significance, plague, smallpox, influenza, coronaviruses, and certain viral hemorrhagic fevers (VHFs) are contagious. Some contagious animal or agricultural diseases can also be operationally significant, such as African swine fever. The mode of transmission (e.g., fomite, vector, fecal-oral, contact, blood, droplet,

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42 For toxin BWs, infectivity is not an appropriate term, and "effectivity" or toxicity is used instead.

43 Alicia D. Anderson et al., "Q Fever and the US Military," *Emerging Infectious Diseases* 11, No. 8 (2005): 1320–1322. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3320491/

44 The cited I/D ratios are derived from natural disease transmitted by mosquitos; it is not known whether they would change for aerosol-delivered encephalitis viruses.

airborne) is also critical for informing outbreak response measures. Anthrax, brucellosis, tularemia, Q-fever, glanders, melioidosis, the equine encephalitis viruses, and all toxin-mediated diseases are not contagious.

4-11. **Prophylactic Countermeasure Availability**. Licensed vaccines (immunoprophylaxis) exist to prevent Anthrax, Smallpox, Influenza, and COVID. Investigational vaccines, in many cases developed by the U.S. military, are available for other potential weapon threats. In most cases, vaccines must be administered well before exposure occurs, limiting their use in situations where an attack was unforeseen (one exception is Smallpox, for which vaccination remains effective during the first 96 hours after exposure). Antibiotics (chemoprophylaxis) may be effective at preventing overt disease from developing after an exposure to anthrax, plague, tularemia, brucellosis, Q-Fever, and other bacterial pathogens. Antivirals (e.g., oseltamivir for influenza) may also be effective at preventing some viral infections following exposure. Commanders and medical personnel will need to understand the range of prophylactic countermeasures available to them. Medical planners and clinicians should be cognizant of the possibility that adversaries, particularly those with robust state-sponsored programs, may attempt to engineer pathogens so as to make them more infectious, more contagious, or more hazardous. Nature may also produce strains that circumvent prophylactic countermeasures. Medical staff (with help from clinicians) should collect antibiotic sensitivity and vaccine effectiveness data.

4-12. **Therapeutic Countermeasure Availability.** Once infection occurs, commanders and medical personnel will need to know whether effective treatment is available. In certain cases (Botulism), such treatment may not improve a patient's symptoms, but may prevent them from progressing further. In other cases (Anthrax, Plague), treatment is life-saving only if instituted very promptly. While many therapeutic agents may be administered orally, others require intravenous administration. In some cases, a drug may not be approved by the FDA, and it will be important to understand associated limitations. In other cases, a drug may exist only in very limited quantities (e.g., Botulinum antitoxin) or may have cold chain requirements that cannot be satisfied on the battlefield. Commanders and medical personnel will need to understand the range of therapeutic countermeasures available to them, considering stockpile locations and logistics factors. As with prophylactic countermeasures, medical staff (with help from clinicians) should collect data on therapeutic effectiveness, given the possibility of either naturally or intentionally produced strains that defeat existing therapeutics.

4-13. **Ease of Detection and/or Diagnosis**. Commanders, as well as medical and public health personnel, will need to know whether environmental detection systems can detect the agent(s) in question, and the associated timelines for results that can inform situational awareness. Similarly, they will need to understand the capabilities, limitations, and timelines of clinical diagnosis.

4-14. **Ease of Production**. While some biological agents are readily grown in quantity, others are more difficult to produce, sometimes requiring living systems (such as chick embryos). Sufficient technology is available worldwide to produce biological agents in bulk. The production process itself merely requires the application of science and engineering to the pathogen of interest—production is generally not a barrier. Commanders and staff will need to understand this and an adversary's capabilities in this regard (if intelligence is available) to determine whether an outbreak of disease might plausibly be attributed to a specific adversary.

4-15. **Stability in Storage**. Given production, the agent must be able to withstand storage for some period of time. Agents lose viability over time in storage. Storage stability can be increased by the method of production, the use of additives, and environment conditioning (refrigeration).

4-16. **Ease of Dispersal**. The dispersal of biological agents, many of which are living organisms, has historically avoided the use of explosive dissemination. Biological agents may not survive the blast and heat produced by explosive dissemination. However, adversaries may choose to use explosive dissemination despite its general inefficiency, so this means of dispersal should not always be ruled out. Historically, most BW agents have been weaponized for dispersal as sprays. Most sprayers were specially designed spray tanks. Commanders will want to know whether a belligerent possesses systems such as sprayers. Other munitions, such as bomblets, were also designed to spray-deliver agent. Sprayers may be employed either covertly and overtly. The availability of off-the-shelf agricultural and other sprayers makes spray dissemination easily achievable.

B. Biological Warfare

4-17. The purpose of this section is to provide general technical information on biological weapons and biological warfare, to clarify that BW attacks are not "too hard" for adversaries to execute, and to provide information to help recognize and plan against BW attacks. This section addresses the following topics.

- The impact of aerosol characteristics and meteorology on the effectiveness of an attack. These topics are relevant to medical staffs for explaining BW attack impacts to the commander.
- The re-aerosolization hazard, which is relevant for medical staffs is in explaining post-BW attack hazards to the commander.
- BW employment considerations, which are relevant for recognizing indicators of an attack and for advising and planning against the range of effects of BW attacks.
- An overview of tactical biological agent detection. This is a CBRN corps responsibility, but it is important that medical staffs be aware so they can effectively coordinate with chemical staffs and chemical units and present consistent advice to the commander.
- The approximate timing of the course of disease for several BW-associated diseases. These are intended as a planning aide.
- An overview of BW casualty/patient estimation and the associated challenges, to inform planning.

4-18. For a brief history of biological warfare, see the Blue Book (p. 2–8). For an overview of current unclassified threat information, see the Blue Book (p. 2–8) and ATP 4-02.84 (p. 1-1–1-8). There are also generic classified threat sources,[45] and medical staffs should coordinate with MEDINTEL and S-2/G-2 for sources more specific to the situation.

4-19. There is significant uncertainty about modern BW programs, so it is impossible to confidently predict what a modern BW agent or attack might look like. Agents could be those explored in the past, modified strains of those pathogens, or completely new pathogens. Therefore, the medical staffs must be broadly aware of what has been done or is possible in biological warfare, be prepared to explain these characteristics, be prepared to recognize a biological attack in the absence of intelligence, and advise commanders accordingly. This section will attempt to provide sufficient perspective to medical staffs.

4-20. The former U.S. program, which was discontinued in 1969, had agents and delivery systems capable of covering large areas (tens to hundreds of km^2), as well as targeting smaller areas, units or facilities by specially designed munitions. Table 15 lists agents that were investigated or weaponized in the past. Some agents would affect humans directly and others would affect animals or agriculture. Today, advances in bio-technology since the 1960s (1) enable easier production and weaponization; (2) potentially enable other or more effective pathogens to be weaponized; and (3) potentially enable non-state actors to develop and employ biological weapons. One should assume that adversary state BW programs are at least as or more capable than the U.S. program of the 1950s and 1960s.

4-21. Note that this section focuses on aerosol-delivered BW. Delivery mechanisms from the former U.S. BW arsenal included a variety of ground and air sprayer devices, remotely operated sea mine sprayers, and munitions that released vectors (e.g., mosquitoes). In the past, direct contamination of water sources and food with biological agents has not been considered effective, except for very small specialty designed and delivered attacks. Enforcing standard public health, filed sanitation, force health protection, and force protection measures should prevent attacks or identify the agent presence before any personnel are affected by food or water contamination.

[45] For example, consult the sources cited in Table 6.

Table 15. Biological Agents Included in Previous BW Programs

Agent	Disease
Bacteria	
Bacillus anthracis	Anthrax
Brucella spp.	Brucellosis
Burkholderia mallei	Glanders
Burkholderia pseudomallei	Melioidosis
Chlamydia psittaci (formerly "psittacosis virus")	Psittacosis
Coxiella burnetii	Q fever
Francisella tularensis	Tularemia
Legionella pneumophilia	Legionnaire's disease
Rickettsia prowazekii	Epidemic typhus
Yersinia pestis	Plague
Viruses	
African swine fever virus	African swine fever (ASF)
Capripoxviruses	Goatpox, sheeppox
Chikungunya virus	Chikungunya
Eastern equine encephalitis virus	EEEV disease and encephalitis
Foot-and-mouth disease virus	Foot-and-mouth disease
Hantavirus	Hemorrhagic fever with renal syndrome and hantavirus pulmonary syndrome
Lassa virus	Lassa (hemorrhagic) fever
Junín virus	Argentinian hemorrhagic fever (O'Higgins disease)
Machupo mammarenarivus	Bolivian hemorrhagic fever (black typhus)
Marburg virus	Marburg virus disease
Newcastle disease virus	Virulent Newcastle disease
Rift valley fever virus	Rift valley fever
Rinderpest virus	Rinderpest
Variola major	Smallpox
Venezuelan equine encephalitis virus	VEEV disease and occasionally encephalitis
Western equine encephalitis virus	WEEV disease and encephalitis
Yellow fever virus	Yellow fever
Toxins and Fungi	
Botulinum toxin	Botulism
Coccidioides	Valley Fever
Phytophthora infestans	Potato blight or late blight
Ricin	Ricin intoxication
Staphylococcal enterotoxin B (SEB)	SEB intoxication

Sources: (1) https://www.health.mil/Military-Health-Topics/Health-Readiness/Environmental-Exposures/Dugway-Proving-Ground; (2) Milton Leitenberg and Raymond A. Zilinskas, *The Soviet Biological Weapons Program: A History* (Cambridge, MA: Harvard University Press, 2012), 46 and 79–250; (3) Simon M. Whitby, *Biological Warfare Against Crops* (Palgrave Macmillan, 2002); (4) Mark Wheelis, *Deadly Cultures: Biological Weapons Since 1945*, (Harvard University Press, 2006), Table 11.1; (5) Eric Croddy, C. Perez-Armendariz, and J. Hart, *Chemical and Biological Warfare: A Comprehensive Survey for the Concerned Citizen* (Springer Science & Business Media, 2002); (6) Stockholm International Peace Research Institute, *The Problem of Chemical and Biological Warfare* (New York, Humanities Press, 1971), 122–123.

1. Impact of Aerosol Characteristics

4-22. The aerosol characteristics of the agent influence the infectivity, survival in the atmosphere, and the deposition of agent. These factors interact with meteorology to determine the effective area of an attack. Biological agent is generally not dispersed as single organisms. The organisms are grown in media, then processed for storage and weaponization. When released by a delivery device, agent is normally dispersed as particles containing the agent, growth media, and additives to enhance dispersion and survivability. In the U.S. program, biological agents were delivered both in wet and dry form. Wet agent was pathogen or toxin suspended in liquid media that, once sprayed, rapidly evaporated leaving aerosol particles. Dry agent was dried, for example by freeze drying, and sometimes concentrated agent material. Dry agent was dispersed as particles by the delivery system.

4-23. This section addresses two factors that influence the impact of a BW attack: **aerosol stability** and **particle size**.

4-24. **Aerosol stability** refers to the viability of the pathogen or toxin over time from release. Once disseminated, pathogens are subject to environmental conditions that affect their viability, or, their ability to cause illness. Ultraviolet radiation from sunlight will destroy pathogens in the environment over time. Each pathogen has a generally unique aerosol stability. Agent stability in the atmosphere may be enhanced by additives. Relative humidity and temperature may also affect the viability of some pathogens, causing desiccation. Larger particle sizes may provide some protection to pathogens within the volume of the particle, but generally speaking, larger particles are less effective as weapons (see discussion of particle size below). Aerosol stability is typically expressed using an overall decay rate (percentage/min). Table 16 presents example aerosol stability data. Classified data also exist for agent decay rates but there is no DOD or Service standard planning data or assumptions for decay rates.[46]

4-25. **Aerosol particle size** also strongly influences the effect of a BW attack for two primary reasons: (1) particle size influences deposition into the target's respiratory system, and (2) particle size influences the downwind travel of the disseminated agent (and re-aerosolization, which is discussed separately in Section 4.B.3).

- Note that particle size is influenced by other factors, even after initial production and storage of agent. For example, high relative humidity and the presence of electrostatic charge in the agent can cause agent particles to agglomerate into larger particles. The exact impact of relative humidity and electrostatic charge depends on multiple factors, including the production process and whether the agent is wet or dry.

[46] The DOD software program Hazard Prediction and Assessment Capability (HPAC) also contains unclassified decay rate data.

Table 16. Example Aerosol Stability Data (Compared to Decay in Other Environments)

BW Agent	In the Air	In Soil	In Water	
			Native	Chlorine Sensitive
Anthrax (vegetative)	Wet: 0.1-2 %/minute Dry: 0.1-2 %/minute	<0.5 %/minute	Stable 2 years 25-minute boiling	Stable in 0.5 parts per million (ppm) Free Available Chlorine (FAC)
Plague	Wet: 0.5-5 %/minute	60 days, if moist	Stable 16 days Deactivated in < 15 minutes at 55 °C	Stable in 0.5 ppm
Tularemia	Wet: 4-12 %/minute 2.5 %/minute (stabilized) Dry: 5-8%/minute	Months, if moist	Stable 90 days Deactivated by heat	Deactivated by 1 ppm FAC
VEE	Wet: 2-3 %/minute Dry: 1.5-4 %/minute	<15 minutes in strong sunlight		
Smallpox	2 %/minute	5% hypochlorite destroys in 4 hours	Stable	
Botulinum toxin A	Wet: 0.1-8 %/minute Dry: 0.1-8 %/minute	Stable	Stable 7 days 15 minute boiling	Deactivated by 6 ppm FAC for 20 minutes
Ricin	0.1 %/minute	Stable	Stable 24 hours Detoxified in 10 minutes at 80 °C	Stable in 10 ppm FAC Deactivated by 100 ppm FAC for 20 minutes
Staphylococcal enterotoxin B (SEB)	0.1 %/minute	Not stable	Stable Deactivated by boiling for a few minutes	

Source: Adapted from Navy Warfare Development Command (NAVWARDEVCOM), *Guide to Biological Warfare Defense and Bioterrorism — Afloat and Ashore*, Tactical Memorandum 3-11.1-02 (Newport, RI: NAVWARDEVCOM, October 2002), Figure 1-6, accessible at https://search.dtic.mil/ under "CB-035496."

4-26. Because biological agent is delivered as particles,[47] achieving maximum effect as a weapon requires the particles be delivered in a specific particle size range. For pathogens and toxins, desired particle size is typically said to be between 1 and 10 microns (µm), and more particularly in the 2–5 micron range because:

1. it provides efficient deposition in the lungs (pulmonary)—see Figure 3 and Table 17, and
2. it keeps the settling rate of the agent in the atmosphere low, improving area coverage—see Figure 4, Table 18, and Table 19.

4-27. However, the submicron range is also relevant for viruses and toxins (individual bacteria are too large to be delivered as submicron particles). Figure 3 shows airway deposition by particle size and airway region (TB = tracheobronchial). Note particularly the line labeled "pulmonary airways," as biological agents generally have the greatest effect when deposited in the lungs. Observe that efficient pulmonary deposition occurs in the 1–10 (or 2–5) micron range *and* in the 0.01 and 0.1 micron range.[48] Biological detection technologies that use any form of light scattering will have difficulty detecting submicron particles.

4-28. If particles are too small (e.g., < 0.01 micron), many will be inhaled and exhaled without depositing. If they are too large they will not stay airborne to reach the target, they can be stopped by normal inhalation protection (nose hairs, mucus), and they require a larger number of particles to cause an infection.

47 In older publications, this was often characterized using agent containing particles per liter of air (ACPLA).

48 Note also that certain viruses are adapted to bind to lower respiratory epithelial cells, which facilitates their retention and entry into the body to a degree beyond what is indicated in Figure 3.

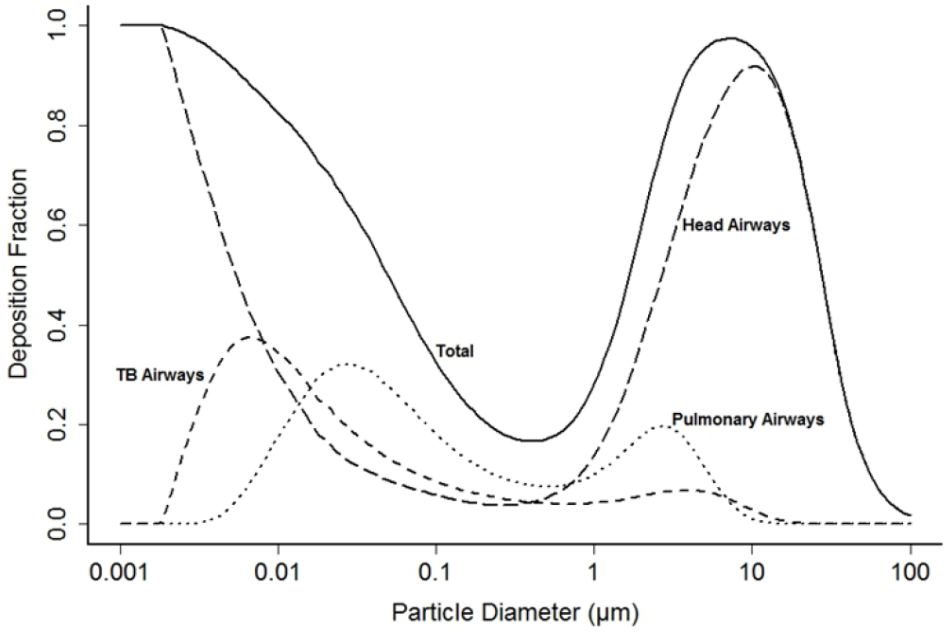

Figure 3. Influence of Particle Size on Deposition in the Human Respiratory System[49]

4-29. Table 17 shows example laboratory data demonstrating the impact of particle size; it displays the relationship between particle size and number of anthrax spores per particle, plus the change in effect on guinea pigs. A similar relationship exists for all pathogens, based on the size of the particular pathogen. A couple notes will help to clarify that changing particle size was the dominant reason for the changing effect on guinea pigs.

- The dose of agent changed insignificantly for the different tests.
- Even when the experimenters artificially created particles with fewer spores per particle (denoted by "a"), the effect on the guinea pigs hardly changed.

Table 17. Influence of Particle Size on Anthrax Spores per Particle and Infectivity in Guinea Pigs

Particle Size (µm)	# Spores per Particle	# Particles per Liter of Aerosol	Concentration-Time (~Dose) (organism-minute per liter of aerosol)	% Dead Guinea Pigs
3.6	18	9.20×10^4	1.70×10^6	100
8.4[a]	19	7.30×10^4	1.40×10^6	27.5
8.4	235	5.90×10^4	1.40×10^6	22
11.6[a]	18	6.10×10^4	1.10×10^6	22
12	680	1.60×10^4	1.10×10^6	18

a Particles artificially made to size by addition of dextrin.

Note: # of spores per particle, # of particles per liter of cloud, and breathing rate are used to calculate concentration-time.

Source: Adapted from M. Louise. M. Pitt, "Medical Implications of BW Agent Exposure" (Fort Detrick, MD: USAMRIID, undated).

4-30. As noted above, particle size also affects the downwind travel of disseminated biological agent, as do other factors like wind speed, temperature, and humidity. This is sometimes characterized using terms like "settling rate" or "velocity of fall," both referring to the rate at which particles deposit on the ground. Figure 4

[49] Defense Threat Reduction Agency (DTRA), *Chemical and Biological Effects Manual Number 1 (CB-1)*, Chapter 3 – Human Effects. Revision 1.11. (Fort Belvoir, VA: DTRA, November 2020), accessible at https://search.dtic.mil/ under "AD1150600."

shows settling time data for generic aerosol particles. Table 18 shows experimental data on velocity of fall data for aerosol particles. The impact of particle size on downwind travel in an open environment can also be characterized by measuring the fraction of disseminated particles that deposit at certain distances downwind. Table 19 shows field data on the impact of particle size on deposition at various downwind distances, and the impact of wind speed on particle deposition.

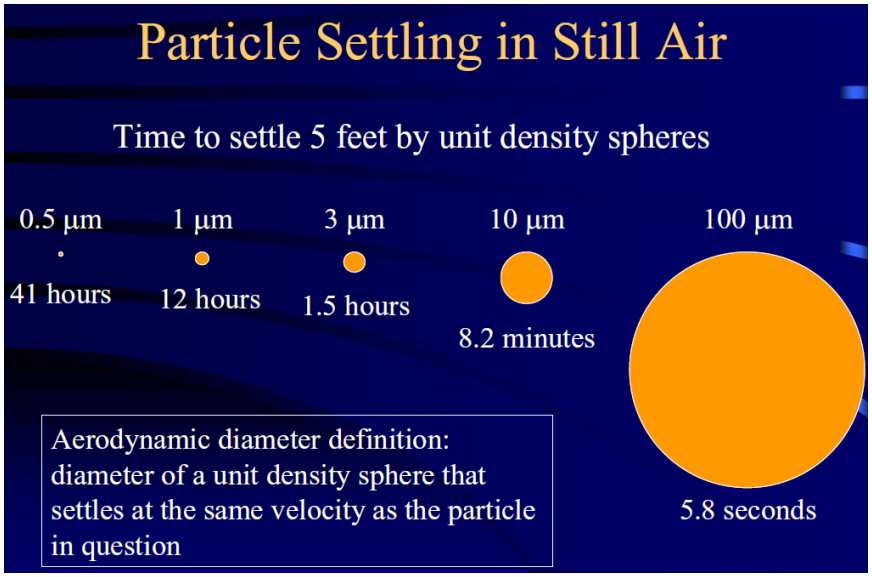

Figure 4. Impact of Particle Size on Settling Time (in still air)[50]

Table 18. Velocity of Fall for Aerosol Particles (in an enclosed space)

Particle Diameter (µm)	Velocity of Fall (cm/sec)	Number of Times Faster Than 1 µm
1	0.0035	N/A
2	0.0125	3.6
3	0.0275	7.9
5	0.078	22
10	0.30	86
15	0.68	194
20	12	3,428

Source: Parker et al., *Counter Proliferation-Biological Decontamination*, DPG Document DPG/JCP-098-002 (Salt Lake City, UT: Andrulis Research Corporation, June 1998), 95, accessible at https://search.dtic.mil/ under "ADB237977."

50 Paul Baron, "Generation and Behavior of Airborne Particles (Aerosols)," (Division of Applied Technology, National Institute for Occupational Safety and Health, CDC, undated), slide 12, https://www.cdc.gov/niosh/docket/archive/pdfs/NIOSH-219/0219-092310-baron.pdf.

Table 19. Deposition of Aerosol Particles from a Continuous Line Source, at Various Distances

Downwind Distance (yards)	Percent of Particles Deposited by the Stated Distance (Cumulative) (Separate Data for Different Particle Sizes)									
	Wind Speed = 2 mph					Wind Speed = 5 mph				
	1 µm	5 µm	10 µm	20 µm	50 µm	1 µm	5 µm	10 µm	20 µm	50 µm
10	0.5 %	12.4 %	37 %	70 %	90 %	0.0 %	6 %	18 %	49 %	85 %
50	0.7 %	15.4 %	42 %	74 %	93 %	0.2 %	7 %	22 %	54 %	88 %
100	0.9 %	16.3 %	44 %	76 %	95 %	0.2 %	7 %	24 %	57 %	88 %
500	1.0 %	19.5 %	49 %	79 %	96 %	0.4 %	9 %	28 %	61 %	90 %
1,000	1.2 %	20.8 %	51 %	81 %	96 %	0.4 %	10 %	30 %	63 %	91 %
5,000	1.4 %	24.5 %	56 %	84 %	97 %	0.5 %	11 %	34 %	68 %	93 %
10,000	1.5 %	26.4 %	58 %	85 %	97 %	0.5 %	12 %	36 %	70 %	93 %

Source: Parker et al., *Counter Proliferation-Biological Decontamination*, DPG Document DPG/JCP-098-002 (Salt Lake City, UT: Andrulis Research Corporation, June 1998), 95, accessible at https://search.dtic.mil/ under "ADB237977."

4-31. As alluded to in Table 16, **wet agent is generally less efficient than dry agent**, largely because wet agent tends to have larger particle sizes (though there are other factors). The following information about wet and dry agents is taken from a test of wet and dry biological agent simulant[51] using an off-the-shelf agricultural sprayer that was not specifically modified to disseminate biological agent (Figure 5 is a picture of the sprayer in operation—note small size and relative simplicity).[52] Individual BG spores are 1–2 microns in length, however:

- When stored as a dry agent, BG would form clusters of two or three spores, leading to a mean diameter of about 1.3 microns. When sprayed, the spores tend to become only slightly larger—typically 2–3 microns (see Figure 6, left, note the zoom factor is 6,600).
- When stored as a wet agent (suspended in liquid), the spores would separate from clusters. When sprayed, the number of particles per droplet depends on multiple parameters. But once the droplet is formed, the liquid rapidly evaporates, causing the particles to agglomerate into larger dry spherical particles, for example 12 microns (see Figure 6, right, note the zoom factor is 4,800).

51 *Bacillus globigii*, or BG, which is a simulant for *Bacillus anthracis* (anthrax).

52 Carlon R. Hugh et al., *Field Evaluation of an Agricultural Sprayer as a Potential Biological Disperser During Operation Desert Storm (ODS)*, ERDEC-TR-039 (Aberdeen Proving Ground, MD: Edgewood Research Development and Engineering Center (ERDEC), March 1993), 18–21, 27, accessible at https://search.dtic.mil/ under "CBRNIAC-CB-022789."

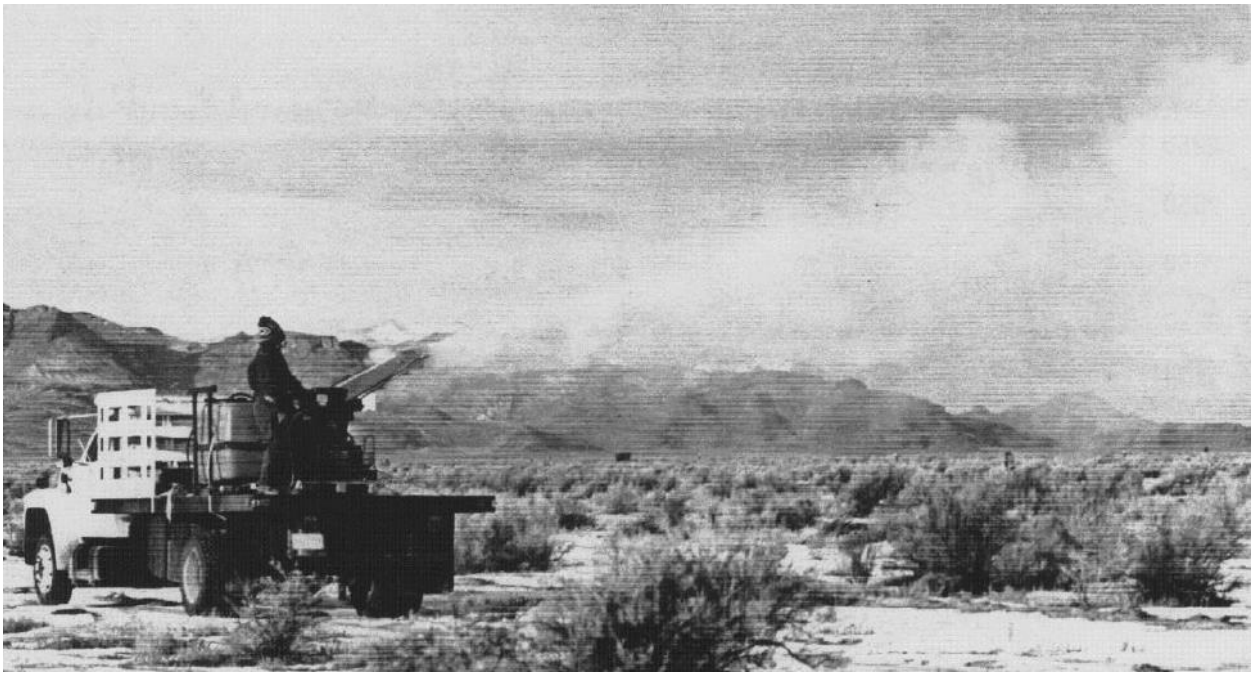

Figure 5. Agricultural Sprayer Disseminating Dry Simulant

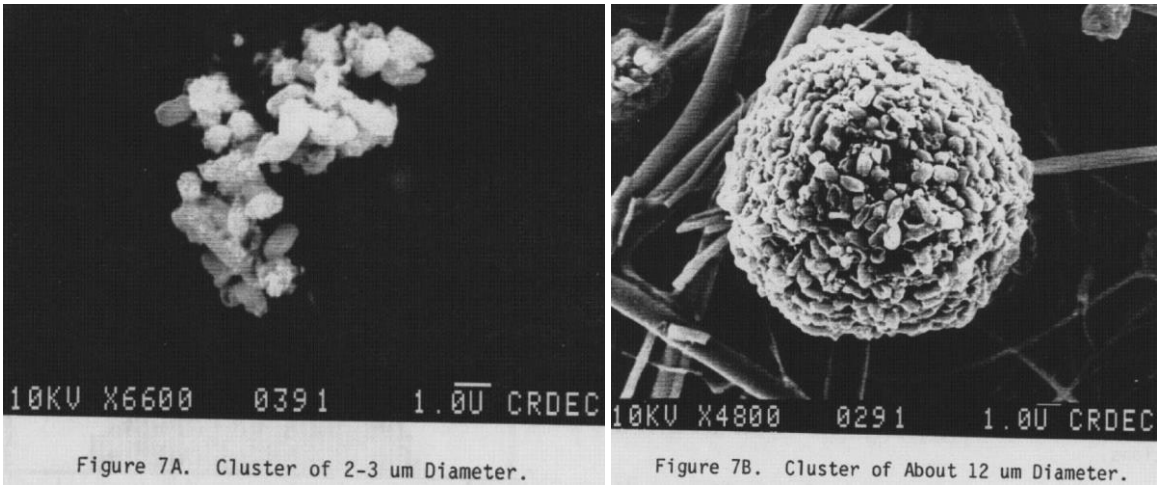

Figure 6. Examples of Small (2–3 µm) Particles from Spraying Dry Simulant and Large (12 µm) Particles from Spraying Wet Simulant (*Bacillus globigii*)[53]

2. Impact of Meteorology

4-32. Meteorology is the primary factor in BW attacks. Meteorology includes time of day, temperature, relative humidity, cloud cover, wind speed and direction, precipitation and atmospheric stability category (e.g., Pasquille Stability Class). It is essential the medical staff understand, be aware of, and have access to meteorological data/records for their area of operations. The medical staff should coordinate daily with the operational, meteorological, and chemical staff and establish a system to record unit locations and meteorology. Having

[53] Images produced by a scanning electron microscope. See Carlon Hugh et al., *Field Evaluation of an Agricultural Sprayer*, 21.

these records will allow the staff to conduct analysis to determine likely area coverage of a recent BW attack and estimate what units might be affected.

4-33. Figure 7 shows a limited example of how meteorology affects BW attack effectiveness.[54] Generally speaking, BW attacks will be more effective with wind that is not too strong (e.g., 5—15 kph), and in conditions with reduced UV radiation and air turbulence (night is best, and cloudy days are better than sunny days).

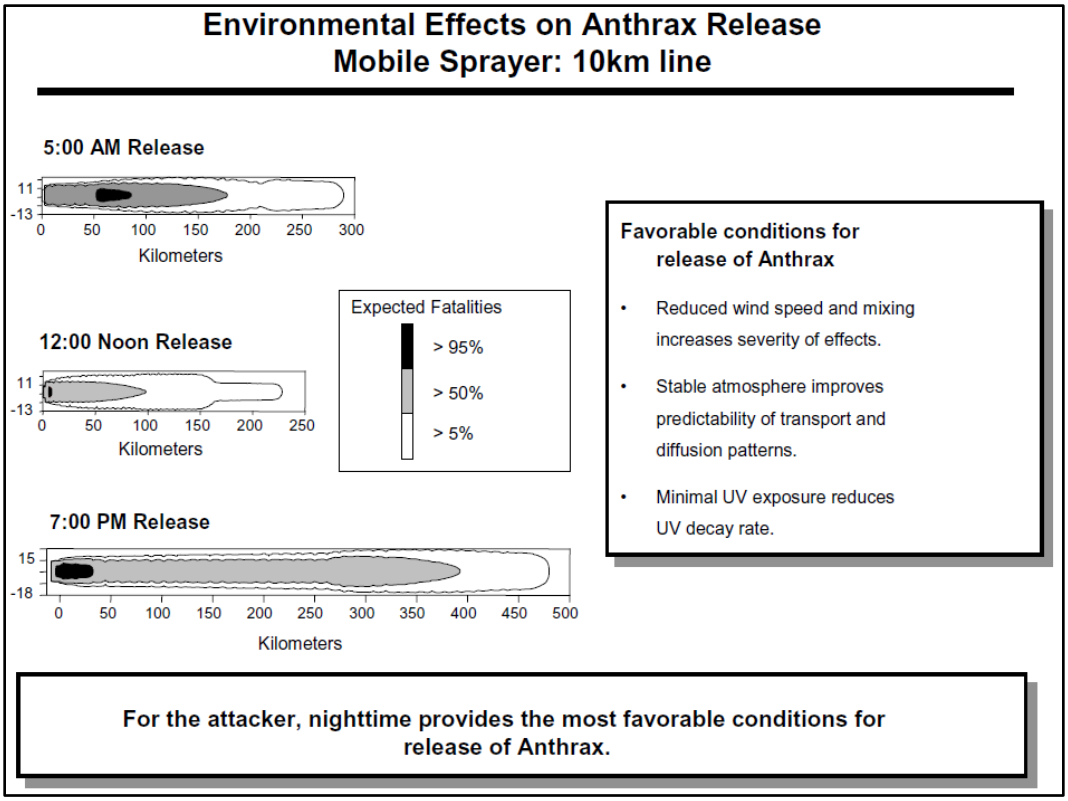

Figure 7. Example of Meteorology Impact on BW Attack Effectiveness

3. Deposition and Re-Aerosolization Hazard

4-34. Aerosol characteristics and meteorology also have an impact on the re-aerosolization hazard. Re-aerosolization hazard refers to the situation where biological agent has first deposited on a surface, and is then made airborne again, for example by foot traffic, vehicle traffic, or helicopter downwash.

4-35. Since the anthrax attacks through the U.S. mail, there has been considerable concern and research on biological re-aerosolization hazards, particularly for indoor releases. However, even before that, DOD had been researching deposition and re-aerosolization from biological attacks. Re-aerosolization is a complex subject due to many physical, chemical, and biological factors. U.S. forces cannot quantify the hazards presented by deposition and re-aerosolization in the field. Sampling can detect and presumptively identify agent on surfaces using hand held assays. Confirmatory identification and assessment of viability require laboratory support.

4-36. The text in the following indented paragraphs is quoted from a Dugway Proving Ground report summarizing an in-depth assessment of deposition and re-aerosolization of biological agents in a field environment. In the quotation, the first paragraph refers to the data in Table 19. Note the relationship to particle size.

[54] NAVWARDEVCOM, *Guide to Biological Warfare Defense and Bioterrorism — Afloat and Ashore*, Tactical Memorandum 3-11.1-02 (Newport, RI: NAVWARDEVCOM, October 2002), Figure 1-5, accessible at https://search.dtic.mil/ under "CB-035496."

> The employment of BW probably will involve the dissemination of biological aerosols and contamination in a target area probably will result from deposition of particles from an aerosol cloud. An aerosol cloud will contain particles having a range of sizes. The larger particles will be deposited nearest the dissemination point or line and the small particles, particularly those smaller than 10 µm diameter will remain airborne and travel long distances from dissemination. Most of the deposition in open areas will occur within a few meters of dissemination, 49 percent of 20 pm particles in the first 9 meters, 6 percent of the 5 um particles. However, in the next 9,000 meters only another 6 percent of the 5 um particles and another 21 percent of the 20 um particles will be deposited. **With downwind travel the aerosol cloud will diffuse and the deposition density will rapidly diminish**. (emphasis added)
>
> The hazard associated with biological contamination deposited on surfaces from an aerosol cloud is reaerosolization of those particles to produce a secondary aerosol. The potential hazard is related to the density of the contamination, the physical nature of the contamination, the meteorological conditions, the physical energy applied to produce the secondary aerosol, the hazard inherently associated with that particular agent and other factors associated with the aerosol. Field tests have shown that a significant hazard can be associated with secondary aerosols generated by troops operating in contaminated vegetation, by vehicles traveling over dusty contaminated roads and various other means of secondary aerosol production.[55]

4-37. For tactical rules of thumb, one can reasonably focus on the impact of biological agent delivery means and gloss over other factors that have lesser impact.[56] Because of weaponization characteristics, "delivery means" includes the effects of particle size, settling rate, and the number/mass of pathogens or toxins. The two delivery means and associated hazards are:

1. Airborne release where agent is sprayed, released explosively, or otherwise released above the ground. The overall consensus is that airborne aerosol releases present no residual hazards, largely because of dilution before agent deposits onto the ground.
2. Ground release, where agent is released by munition contact with the ground or a few meters above ground, including submunitions and spray devices at ground level (could be stationary, or a moving vehicle). Ground releases might present local or short downwind (less than 1,000 meters) re-aerosolization hazards. The degree of hazard depends mainly on the amount of agent deposited. Bursting munitions will deposit/force enough agent into the ground that it can be re-aerosolized in the area immediately surrounding the point of detonation. Ground-based sprayers will also deposit some agent close to the sprayer, especially the larger particles.[57]
   - See Table 20 for predictions derived from 31 field trials with biological agent simulant. The concentration of deposited agent used, 1 mg/m^2, was based on simulations of a tactical ballistic missile depositing agent on an air base.
   - Note that *Bacillus anthracis* is the most persistent biological agent. Although other agents have higher infectivity, they will degrade much more rapidly after deposition, decreasing the re-aerosolization hazard.

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55 Parker et al., *Counter Proliferation-Biological Decontamination*, DPG Document DPG/JCP-098-002 (Salt Lake City, UT: Andrulis Research Corporation, June 1998), 95, accessible at https://search.dtic.mil/ under "ADB237977."

56 Various other factors do affect re-aerosolization hazards, but the scientific detail required to assess their impact is generally beyond the need for tactical rules of thumb.

57 One caveat is that many of the field experiments conducted applied heavy amount of agent to ground—more than would be deposited except in rare cases by detonating munitions. Also, many of the tests took measurements within minutes or hours of the deposition, thereby not considering environment effects before and after deposition. So the estimated hazards may be overstated.

Table 20. Downwind Lethality of 1 mg/m^2 *Bacillus anthracis* Spores, Re-Aerosolized by a Military Vehicle with Trailer

Downwind Distance (meters)	% Lethality for Asphalt-Paved Surface	% Lethality for Gravel-Paved Surface
1	2.5	4.8
5	2.5	4.8
10	2.5	4.8
25	2.5	4.7
50	2.4	4.6
100	2.2	4.4
200	2.0	3.9
300	1.6	3.3
400	1.4	2.7
500	0.9	2.0
600	0.4	1.0

Source: Kenneth S. Chinn, *Technical Assessment of Reaerosolization Hazard from Dugway Biological Agent Field Trials*, (Dugway, UT: Battelle Dugway Operations, September 2000), 25, accessible at https://search.dtic.mil/ under "CB-124216."

4-38. Medical staffs should also know that in a ground release situation, where one can expect some degree of deposition or re-aerosolization hazard, currently fielded systems cannot quantify biological agent concentration in the air or deposition on surfaces. BW agent cannot be quantified without the deployment of specialized assets. This presents practical problems for response measures. **Decisions will have to be made without quantification of the re-aerosolization hazard**.

4. BW Employment Considerations

4-39. The BW employment considerations and examples in this section will help medical staff recognize potential indicators of a BW attack, advise the commander on the feasibility and potential range of effects of BW attacks, and develop medical plans to address the effects of an attack. If an adversary has a BW program, then they can execute a BW attack and with no more complication than procedures developed for the former U.S. BW program in the 1960s.

4-40. There is a defined sequence of events to take a biological agent from the stockpile and deliver it to a target. Once the agent is produced in quantity and stored, the steps to employ it include:

- Filling the munitions,
- Moving the munitions to the delivery system or unit,
- Target analysis to set parameters for the attack, and
- Delivery or employment of the munition.

4-41. **Munition filling** may be done at a specialized filling facility, or at the unit. Depending on the agent, technological factors, and adversary TTPs, the filling and movement sequence could provide indications of a pending BW attack. Indicators could include refrigerated storage and transportation, personnel in protective gear, the presence of decontamination equipment, extra security measures, unusually high presence of medical personnel, or use of unusual vaccines or other pre-exposure prophylactic measures.

4-42. **Target analysis** considerations include: the concept of employment; desired military effect; knowledge of the target location, size, scheme of maneuver, and defensive characteristics; available means of delivery and dispersal, and predicted meteorology. Two examples of attacks with different desired military effects follow

(desired effects can range from strategic to tactical, from simple revenge to damaging or complicating an operation):

- An aerial line sprayer disseminating 10s of kilograms of agent across 10s of kilometers, for a large area effect. Depending on the agent used, examples of the desired military effect could be to incapacitate the unit within hours (toxin) or to incapacitate the unit within the next few days (pathogen).
- A point sprayer releasing 10s to 100s of grams of agent, intended to "seed" a few initial infections that lead to a growing outbreak of contagious disease. The desired military effect might be to distract the target with outbreak response and bog down the medical system, while avoiding attribution.

4-43. Target analysis in the U.S. BW program was guided by instructional manuals and guides that made target analysis no more complicated than other target analysis procedures of the time.[58] A modern state-sponsored program would be at least as sophisticated as the U.S. program from 50+ years ago. An "ad-hoc" weapon delivered by terrorists might be less effective, but could still cause mass casualty situations. Factors considered in target analysis in former U.S. BW instructional guides included:

- Selecting an agent, munition, and delivery system based on desired military effect
- Source strength, or number of median doses at the point of dissemination
- Agent decay rates
- Wind speed
- Casualty contours as the agent traveled downwind
- Correction factors for terrain, precipitation, immunization, individual protection, collective protection, and physical protection, and
- Determination of hazard to friendly forces

4-44. Two figures from the referenced instructional guide will help staffs understand that BW target analysis is similar to modern target analysis. Figure 8 shows an example of the downwind hazard results that could be computed easily using former U.S. BW instructional guides. Figure 9 shows a visual guide for troop safety computations.

[58] For example, see *Biological Target Analysis and Effects Assessment*, Instructional Guide File No. 3200.2 (Fort McClellan, AL: US Army Chemical Corps School, March 1962), accessible at https://search.dtic.mil/ under "CB-125764."

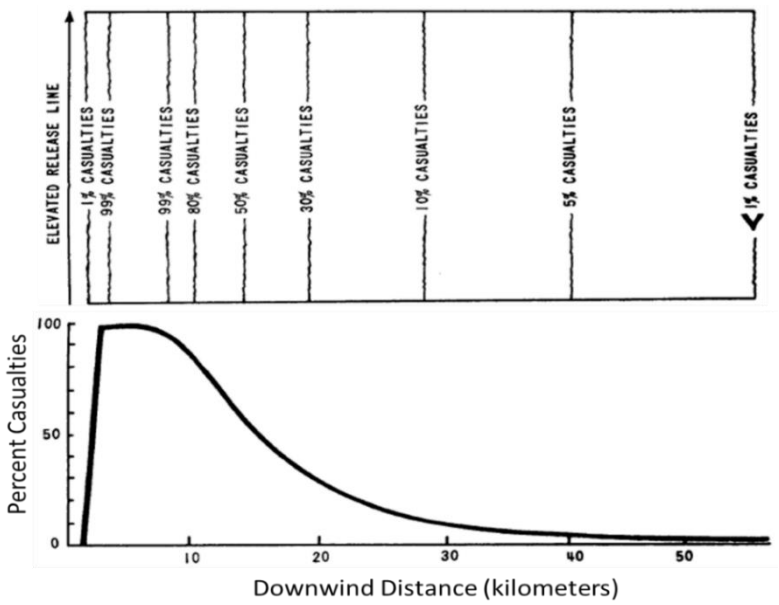

Figure 8. Example of Casualties vs. Downwind Distance From a 1960s Instructional Guide[59]

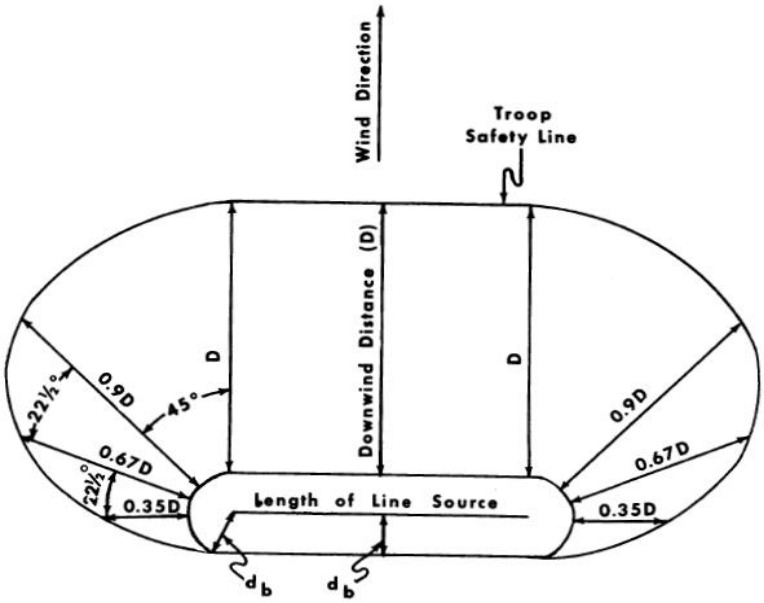

Figure 9. Guide for Calculating Troop Safety Line for a Line Source From a 1960s Instructional Guide[60]

4-45. The following are two examples from simulations showing the potential impact of large BW attacks. Note that these are specific examples intended only to show how large an impact BW attacks can have. Many other potential attacks could be conducted, including much smaller areas of effect.

59 Adapted from *Biological Target Analysis and Effects Assessment*, 32.

60 *Biological Target Analysis and Effects Assessment*, 44.

- Figure 10 shows an example heavy brigade combat team (HBCT) moving to contact.[61] Figure 11 shows the result of a 10 km line sprayer used to disseminate 50 kg of dry VEE virus against three HBCTs moving to contact. The individual circles in Figure 11 represent groups of personnel or vehicles. Note that the brigades are spread across an area of about 20 by 45 kilometers. In the example, there are 5,821 VEE casualties out of a population of 11,229.
- Figure 12 shows an example Stryker brigade combat team (SBCT) in the offense. Figure 13 shows the result of a 40 km line sprayer used to disseminate 620 kg of dry SEB against an SBCT in the offense. The individual circles in Figure 13 represent groups of personnel or vehicles. The SBCT occupies an area of about 10 by 15 kilometers, and the entire brigade (3,772 personnel) receives an effective dose.

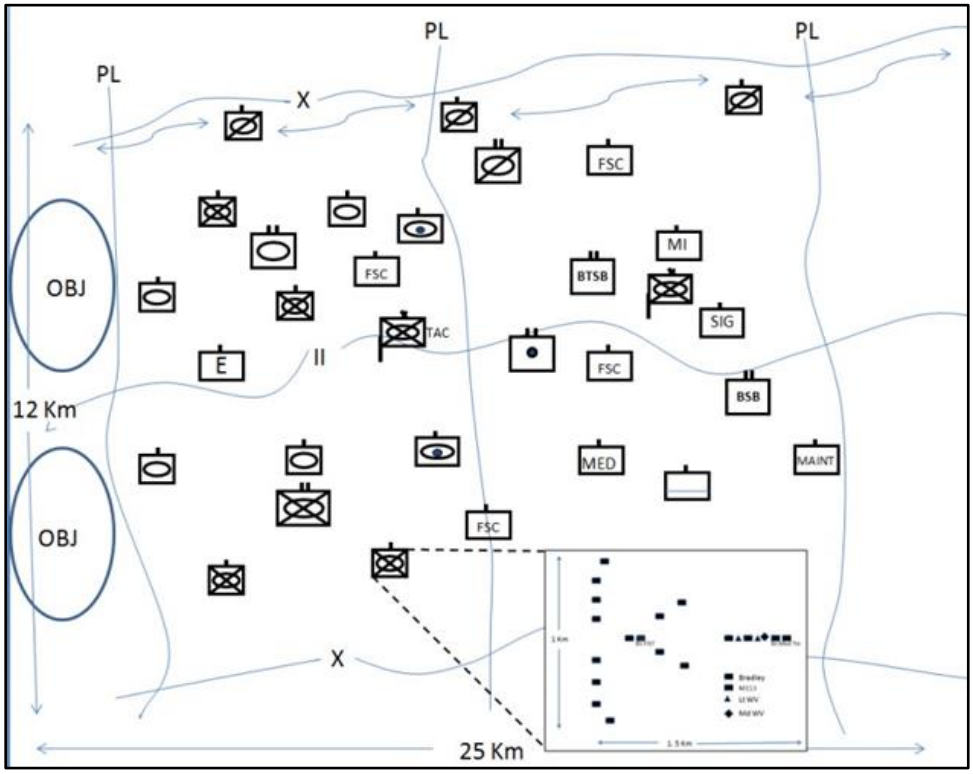

Figure 10. Example HBCT Moving to Contact

[61] HBCTs are no longer active, but still reasonably represent a modern Armored Brigade Combat Team (ABCT), for the purpose of an example.

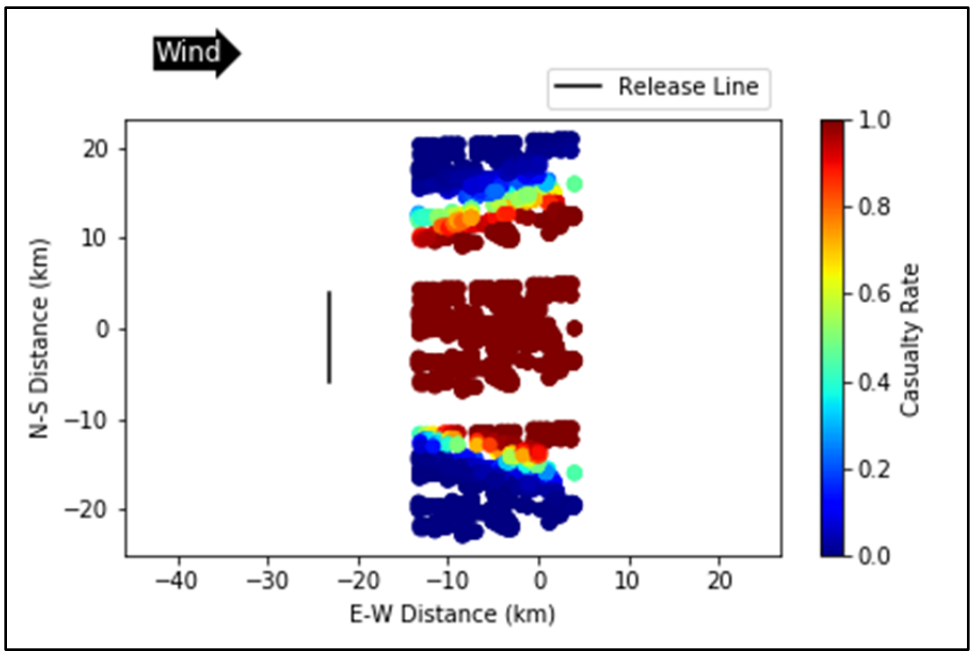

Figure 11. Example VEE Attack Against Three HBCTs Moving to Contact, Producing 47 Percent (5,821) Casualties

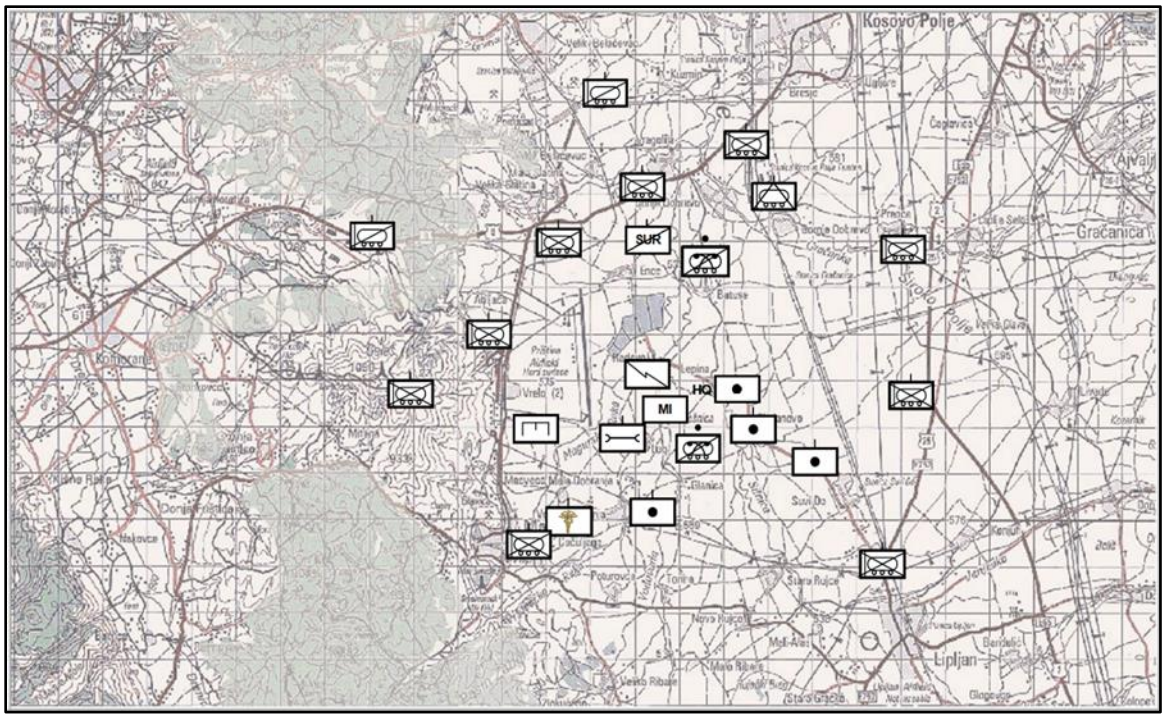

Figure 12. Example SBCT in the Offense

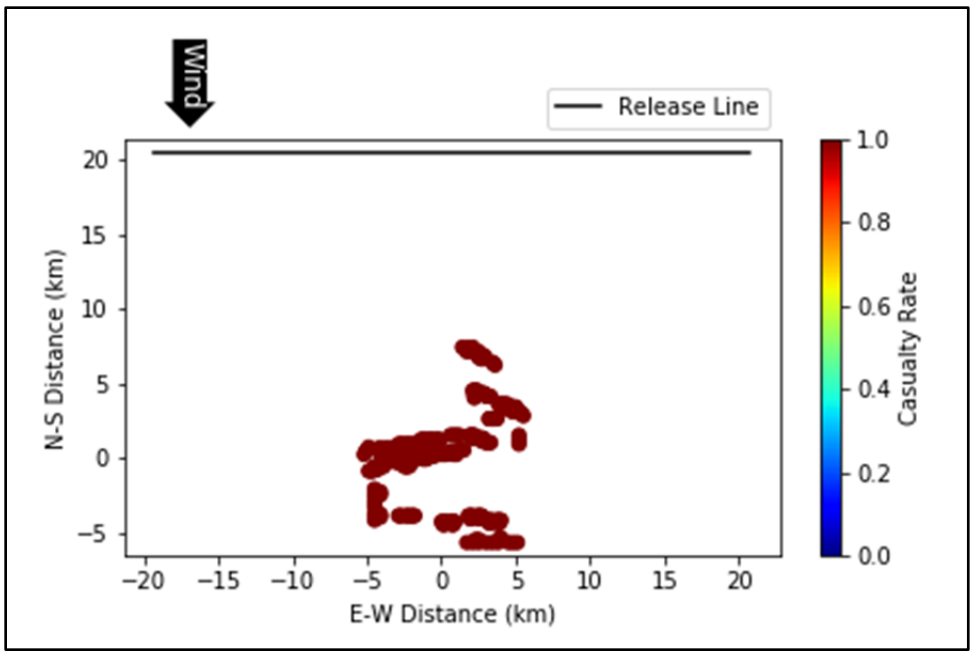

Figure 13. Example SEB Attack Against an SBCT in the Offense, Producing 100 Percent (3,772) Casualties

4-46. These attacks can cause catastrophic effects on an unwarned, unprotected force. A force that anticipates BW employment can be alert for attack indicators (such as aircraft with spray tanks) and can employ biological detection equipment. Indicators and detector alarms can trigger protective measures. However, current detection systems do not provide "real-time" results that could trigger a timely decision like donning masks or activating collective protection.

5. Detection of Biological Agents

4-47. Although tactical BW agent detection systems are operated by the chemical corps, medical staffs must know the capability of the systems.[62] This knowledge will allow medical staffs to integrate samples and information across tactical detection, medical surveillance, and clinical diagnosis. Medical staffs should coordinate with the chemical staff and chemical units on the capability and employment of the systems. Further, both staff elements must be able to explain to the commander the capability and advantages/disadvantages of the systems.

4-48. Depending on the technology, environmental detection capabilities can also identify agents. However, this identification does not provide quantification of agent concentration nor can it report the proportion of viable (live, infectious) vice non-viable (dead, non-infectious) agent in the atmosphere/sample. Samples must be collected for analyses at theater or other designated laboratories.

4-49. A few challenges associated with tactical detection and identification of biological agents, for any system including those listed on the next few pages, include the following:

- Fielding a sufficient density of biological detection assets to improve the chances of detecting an attack.
- Knowing where to put biological detection assets or where to take samples from.
- Knowing when to employ detectors or take samples (for any capability that is not operated continuously).

[62] See also Frequently Asked Questions Regarding Biological Detection (https://apps.dtic.mil/sti/pdfs/ADA406047.pdf).

- Acquiring timely results from a high enough CBRN Identification Level to support the decisions that need to be made. See Figure 14 and Table 21 for information on CBRN identification levels.

4-50. Part of understanding the capability of tactical BW agent detection systems is knowing the levels of CBRN identification, and how available detection and identification capabilities align; Figure 14 and Table 21 summarize. Consult ATP 3-11.37 for more detail.

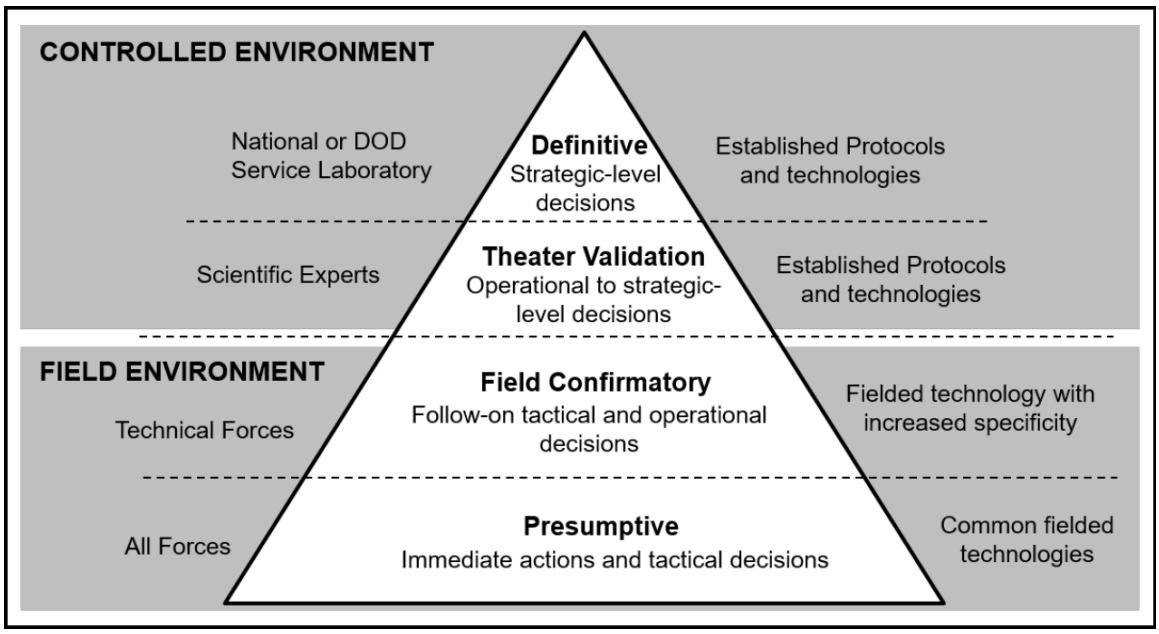

Figure 14. Overview of CBRN Identification Levels[63]

4-51. Select medical capabilities are relevant for the detection and identification of biological warfare agents. Aside from general laboratory capabilities at Role 3 and 4 MTFs (for clinical identification), consider the following environmental detection capabilities.

- The Next Generation Diagnostic System (NGDS) can independently provide presumptive identification and can contribute to field confirmatory identification. The Sentinel Panel is specifically designed for use with environmental samples.[64]
- The GFML (formerly the 1st AML) can provide up to theater validation-level laboratory evaluation, detection, identification, and quantification. It can analyze many types of sample relevant to biological defense, including environmental (air, water, soil), food, veterinary, and entomological. The GMFL can do certain BSL-3 cultures using a "BSL-2+" capability.[65] It does not normally analyze human clinical samples, but can support sample collection from humans in MASCAL situations with suspected BW or highly infectious disease. Depending on the level of analysis required, the GMFL can produce results anywhere from near real-time through 72 hours after receipt of samples. The GMFL can also document and transport samples.[66]

63 Source: ATP 3-11.37, Figure 2-1.

64 For additional information on the Sentinel Panel, see https://www.hsdl.org/?view=&did=814627, particularly Table 3.

65 BSL-2+ refers to using a class 2 biosafety cabinet with enhanced PPE. True BSL-3 capability is not possible in deployable assets.

66 Sources with additional details: (1) *AHS Doctrine Smart Book*, 157–160, 181 and (2) GMFL TOE on FMSWeb (https://fmsweb.fms.army.mil, TOE 08660K000).

Table 21. CBRN Identification Levels & Field Locations for Army Biological Identification

Level	Definition	Description	Possible Medical Tasks	Army Bio ID "Field Location"
Presumptive Identification	The employment of technologies with limited specificity and sensitivity by all forces in a field environment to detect the presence of chemical, biological, radiological, and/or nuclear hazards with a low, but sufficient level of confidence to support immediate tactical decisions.	Presumptive identification is obtained by using a single, commonly fielded device, material, or technology available to all U.S. forces to provide initial indications of a CBRN threat or hazard presence within minutes to one hour of detection.	Sampling and reporting	All forces, using any fielded identification capability
Field Confirmatory Identification	The employment of technologies with increased specificity and sensitivity by technical forces in a field environment to identify chemical, biological, radiological, and/or nuclear hazards with a moderate level of confidence and the degree of certainty necessary to support follow-on tactical and operational decisions.	Field confirmatory identification is obtained by using two or more technologies that use different analysis processes and are available to specially trained personnel and units in a field environment. It may include the collection and analysis of samples, with the intent to find results within 1–48 hours of detection.	Prophylaxis, treatment, reporting, sample evacuation to theater or definitive laboratory	Civil support teams, GMFL, Role 3 MTFs, VET units
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 chemical, biological, radiological, and/or nuclear hazard with a high level of confidence and the degree of certainty necessary to support operational to strategic-level decisions.	Using accepted quality assurance measures, theater validation quantifies the CBRN sample. It provides additional, critical information to support timely and effective decisions regarding assessment, protection, and mitigation measures and medical prophylaxis and treatment for affected units and personnel within 48–72 hours of detection. It can support preliminary attribution to implicate or support trace analytics for the source of the identified CBRN material.	Prophylaxis, treatment, reporting, sample evacuation to definitive laboratory	CBRNE Command, GMFL, Role 3 MTFs
Definitive Identification	The employment of multiple state-of-the-art, independent, established protocols and technologies by scientific experts in a nationally recognized laboratory to determine the unambiguous identity of a chemical, biological, radiological, and/or nuclear hazard with the highest level of confidence and degree of certainty necessary to support strategic-level decisions.	Definitive identification supports attribution to help implicate or point to the source of the identified material. It uses the highest level of quality assurance measures to achieve identification within 72 hours to 30 days of detection. The time-to-result may be the least-critical element.	Targeted treatment	National, DOD Service, or NATO Laboratory (e.g., USAMRIID, USAMRICD)

Sources: ATP 3-11.37, 2-2 to 2-8; ATP 4-02.84, 6-4 to 6-6. The referenced pages in ATP 3-11.37 also state Air Force and Navy units that can conduct CBRN Identification.

4-52. The next few paragraphs discuss fielded tactical detection systems.

4-53. Currently, the Army fields one tactical biological detection and identification system, the truck-mounted Joint Biological Point Detection System (JBPDS). Commonly called the Biological Integrated Detection System (BIDS), these devices are operated by companies with 35 systems per company. All BIDS companies are in the reserve or national guard. The JBPDS uses a particle detector to trigger collection of samples, and an antigen test to provide presumptive identification.

4-54. The NBC Reconnaissance Vehicle (NBCRV) is based on the Stryker vehicle system. For biological detection, it uses the JBPDS. It must be stationary while using the JBPDS. There are two NBCRVs in each armored BCT.

4-55. The Dry Filter Unit (DFU) is an aerosol collector that requires the use of laboratory, portable PCR, or Hand Held Assay (HHA) to identify an agent collected by the DFU. For basic information on PCR and rapid antigen tests like the HHA, see Table 23 in Section 4.D.1. The turnaround time from collection to identification depends on subsequent procedures. The DFU is not a Table of Organization and Equipment (TOE) item.

4-56. The HHA is a rapid antigen test that can be used to presumptively identify select pathogens or toxins. Each individual HHA ticket is designed to identify one specific agent.[67] The Army fields HHAs as part of other kits to CBRN companies and other specialty teams. See Table 23 in Section 4.D.1 for more on rapid antigen tests.

4-57. The Instantaneous Bio-Analyzer and Collector (IBAC) provides generic detection of biological material in the air, followed by sampling to enable subsequent analysis with identification capabilities. The 405 nm laser it uses will cause fluorescence in many biological materials in the natural environment. Two implications are: (1) results must be compared to appropriate background readings, and (2) the IBAC can trigger awareness of "extra biological matter" in the air but it cannot specify if that extra biological matter is a threat. In a high-threat environment, it might be used to trigger actions such as masking, but otherwise its primary use might be to trigger additional investigation.

4-58. Figure 15 shows the organization of CBRN companies. All CBRN companies can collect samples manually and use the HHA for identification. The biological company (BIDS) is equipped with the JBPDS. In all cases where samples are collected, Army doctrine and federal regulations have requirements and procedures for sample collection and transport. Even clinical samples, when moved outside the medical facility, are generally required to follow certain procedures. Medical staffs should coordinate with CBRN staffs and units to establish sampling plans and SOPs for collection, transportation and analyses.

[67] AFTTP 3-10.26, 20–21, 131.

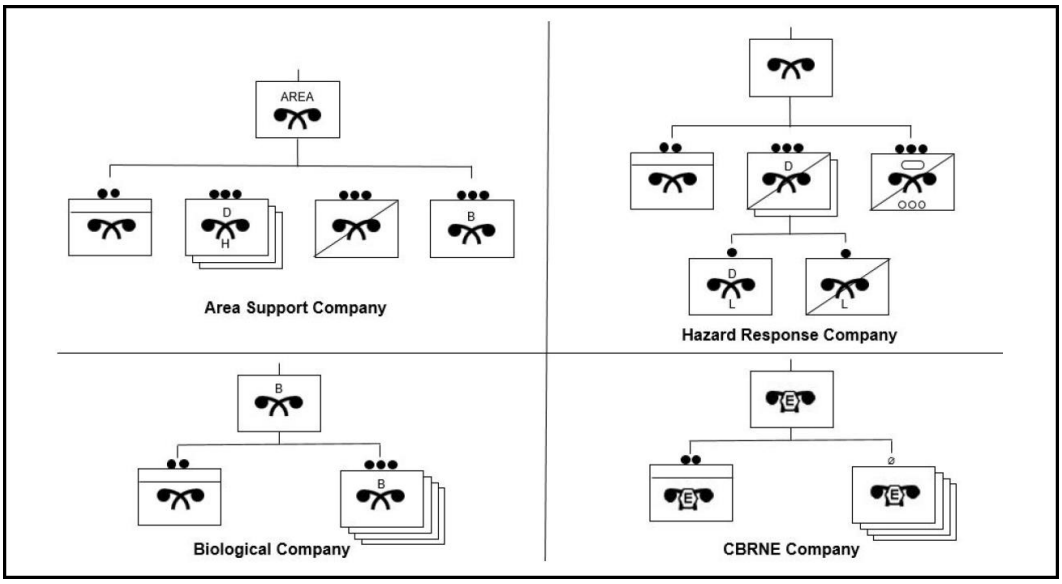

Figure 15. CBRN Companies[68]

4-59. CBRN reconnaissance & surveillance (R&S) platoon organization differs between light and heavy formations (Figure 16). The light version is organic to IBCTs and conducts dismounted R&S using DR SKO and up-armored vehicles. CBRN R&S Platoon (Light) does not have a JBPDS capability, but can conduct dismounted missions in urban environments where maneuver is confined. The CBRN R&S Platoon (heavy) conducts mounted R&S using the NBCRV.

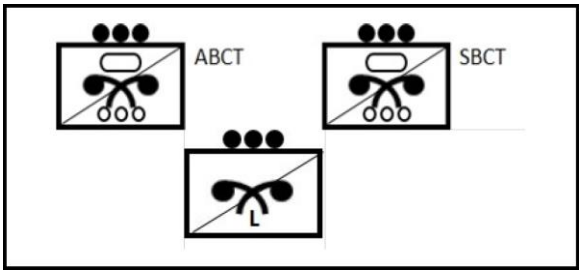

Figure 16. CBRN R&S Platoons[69]

68 Source: FM 3-11, Figure 2-5. For more details on Army CBRN capabilities and employment, see ATP 3-11.36, Appendix C.

69 Source: FM 3-11, Figure 2-7. For more details on Army CBRN capabilities and employment, see ATP 3-11.36, Appendix C.

6. Approximate Timing of BW Disease Course

4-60. Figure 17 through Figure 27 depict the approximate population-level timing of the disease course for several BW-associated diseases.[70] Note that "population-level" timing means that the figures do not apply to individuals, but rather to the overall force, over time. Implications of the population-level focus include:

- Day 0 is the day that exposure occurred. For contagious diseases (plague, smallpox), the figures do not reflect secondary cases that would have a later exposure date.
- The "windows" indicate when symptoms might begin for individuals in an exposed population; when individuals in the exposed population might require Role 3 care;[71] when individuals in the exposed population might die; or when initiation of prophylaxis might benefit at least some of the population. The portion of the population that will benefit from initiating prophylaxis will decrease over time.
- The figures do not indicate the fraction of the population that is in the different "windows" on different days. However, that fraction does change over time. For details, see the cited sources.
- The "windows" do not indicate what will happen for any particular patient.

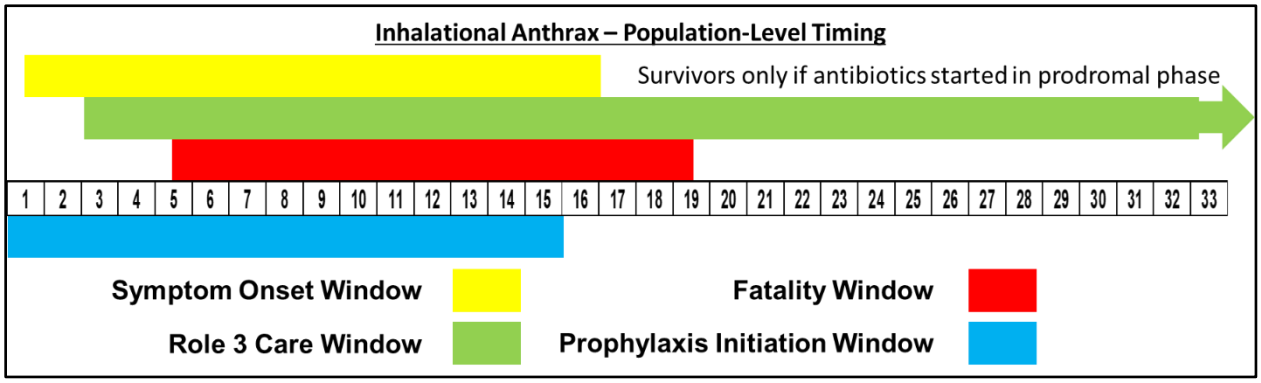

Figure 17. Approximate Population-Level Timing (Days) for Inhalational Anthrax

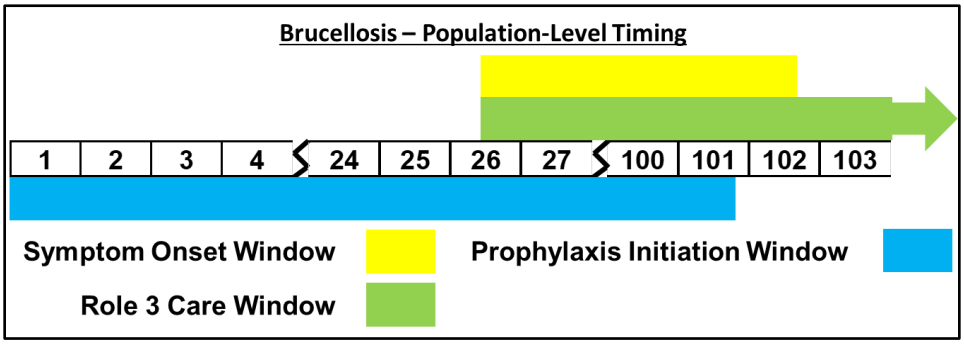

Figure 18. Approximate Population-Level Timing (Days) for Brucellosis

[70] The figures are based on NATO publication AMedP-7.5, Chapter 5, which contains additional quantitative details. AMedP-7.5 was derived from many sources, including CDC web pages, Blue Book, *Medical Aspects of Biological Warfare*, and ATP 4-02.84.

[71] Role 3 care will depend on many factors, including whether diagnostic uncertainty exists or whether optempo and evacuation policies preclude holding and lower roles of care.

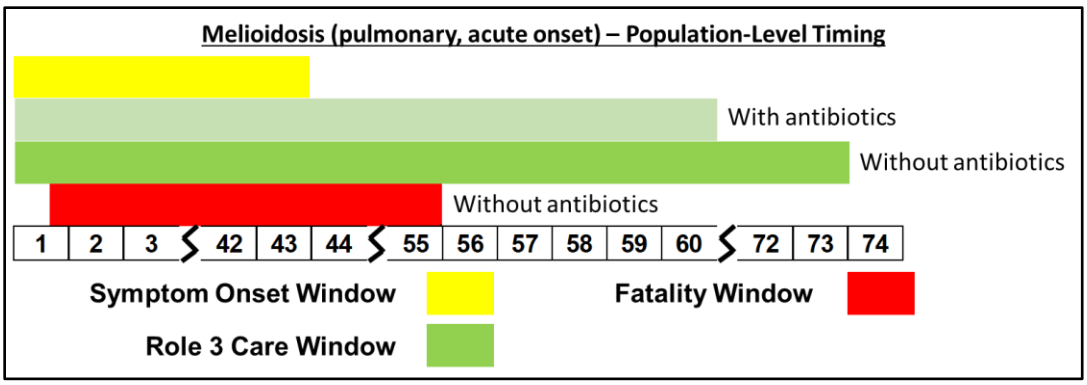

Figure 19. Approximate Population-Level Timing (Days) for Melioidosis (Pulmonary, Acute Onset)

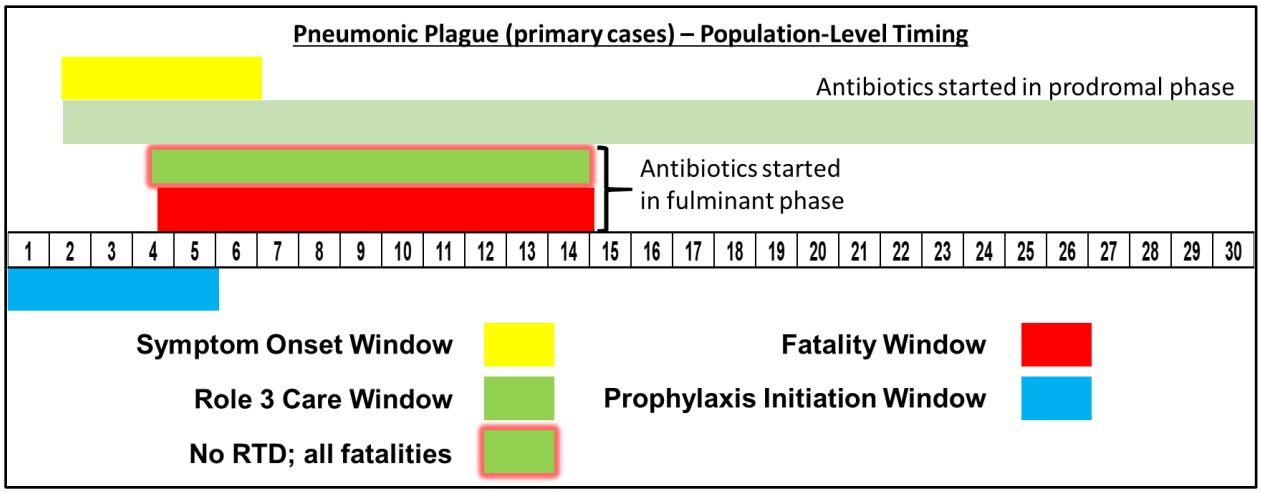

Figure 20. Approximate Population-Level Timing (Days) for Pneumonic Plague (Primary Cases)

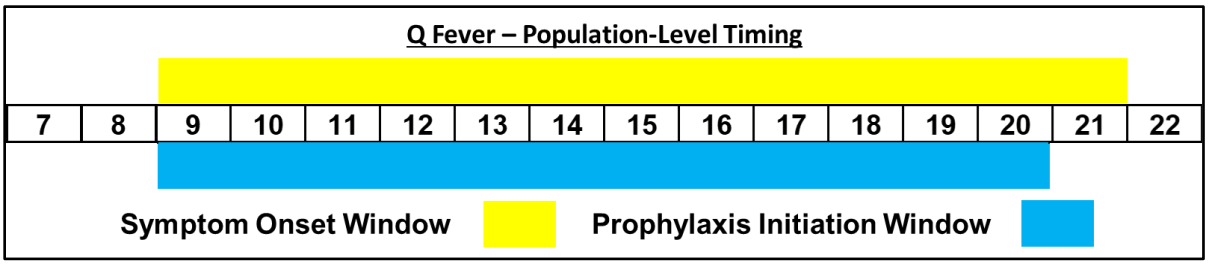

Figure 21. Approximate Population-Level Timing (Days) for Q Fever[72]

[72] Note that hospitalization is rare for young healthy adults with Q fever (<5%).

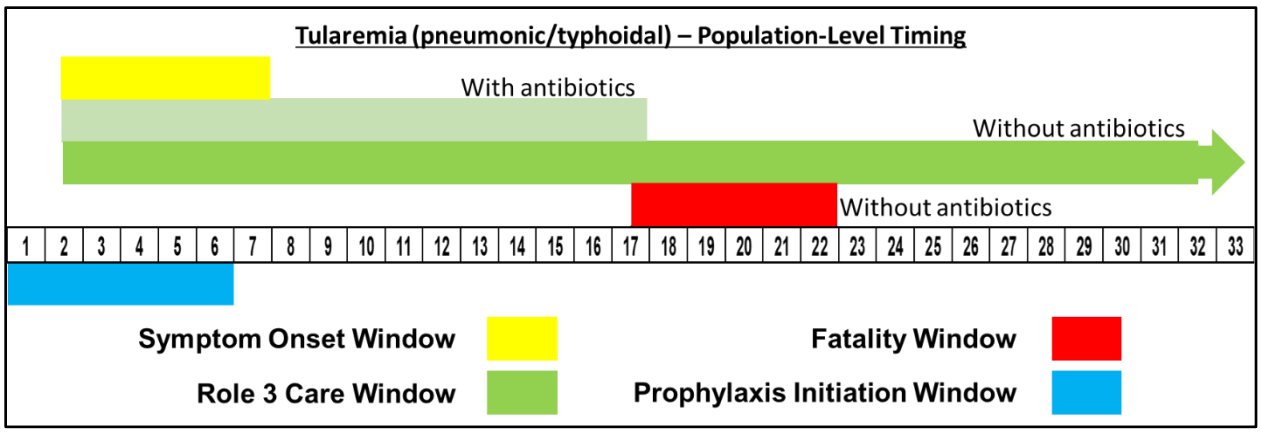

Figure 22. Approximate Population-Level Timing (Days) for Tularemia

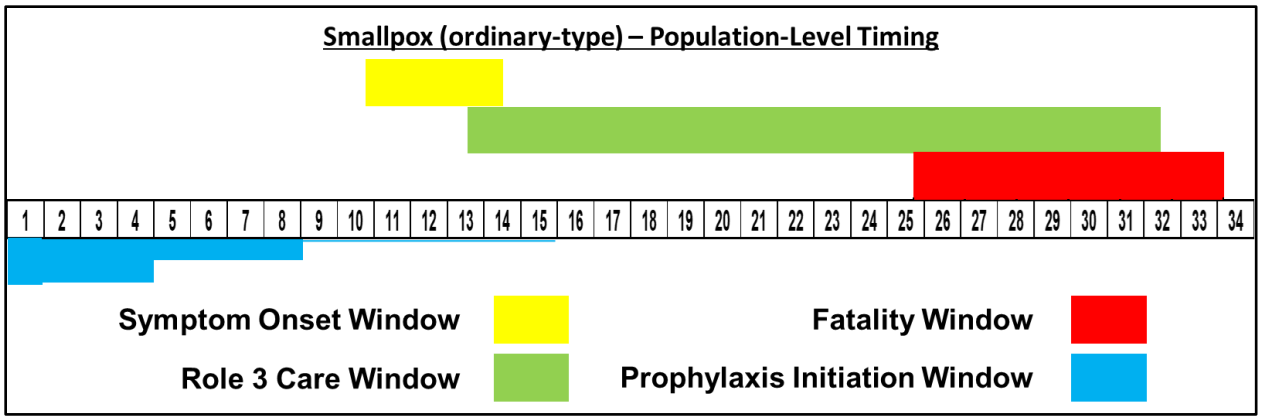

Figure 23. Approximate Population-Level Timing (Days) for Smallpox (Ordinary-Type)

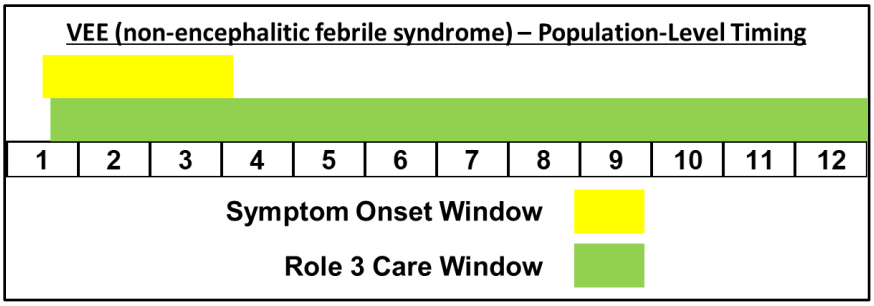

Figure 24. Approximate Population-Level Timing (Days) for VEE (Non-Encephalitic Febrile Syndrome)

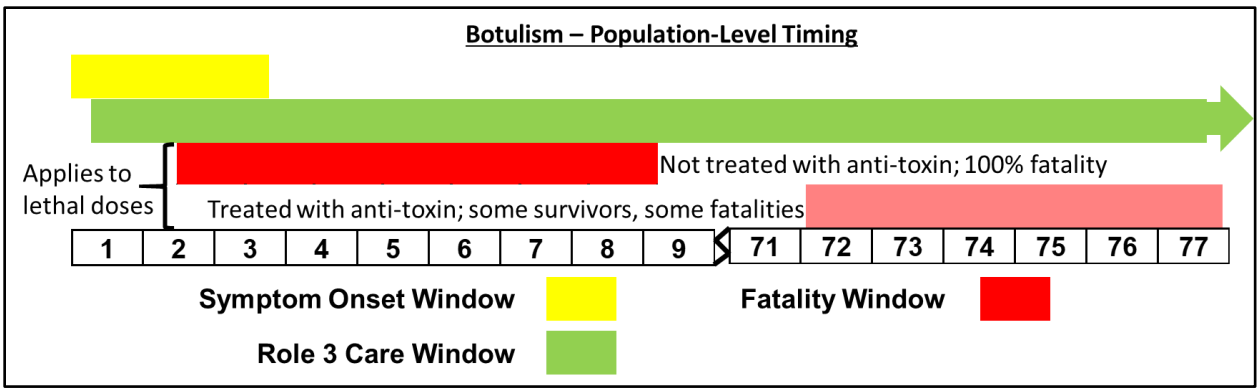

Figure 25. Approximate Population-Level Timing (Days) for Botulism[73]

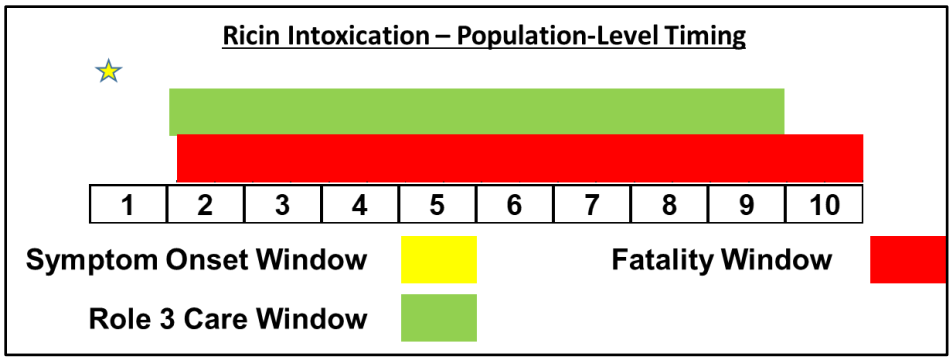

Figure 26. Approximate Population-Level Timing (Days) for Ricin Intoxication

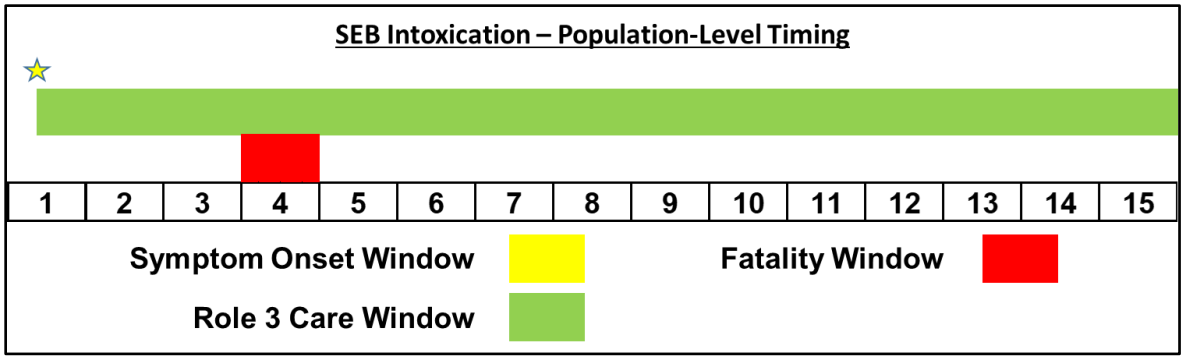

Figure 27. Approximate Population-Level Timing (Days) for SEB Intoxication

7. BW Casualty and Patient Estimation

4-61. The G-1 is responsible for casualty estimation, but focuses on estimating casualties who require replacements, which differs from the number of patients. The G-1 may require support from other staff elements including medical, particularly for estimates of casualties from biological weapons or a contagious disease outbreak. The medical planner derives patient estimates from casualty estimates.

[73] Note that although botulism antitoxin can theoretically be used prophylactically, it is unlikely to be available for use in a timely manner in a theater of operations, given the rapid onset time. However, it is also useful as treatment, prior to complete respiratory paralysis.

4-62. There is no established formal methodology for estimating biological casualties/patients that a staff could execute as part of crisis action planning during LSCO after receiving indicators of a (potential) outbreak of operational significance.

4-63. As observed during the COVID-19 pandemic, in the case of a large natural outbreak, many new tools may be rapidly developed and published to forecast the progress of the outbreak. Consider using several such methodologies to understand the range of possible outcomes. See Section 4.E.2 for more on contagious disease forecasting.

4-64. Subsection a (below) summarizes the tools and process for biological casualty estimation during deliberate planning. It may be possible to quickly *update* simulations and results previously completed during deliberate planning, if a good relationship and communications channels with reachback organizations are established.

a. Biological Casualty Estimation During Deliberate Planning

4-65. The Army's only authorized casualty estimation tool for echelons above brigade is the Medical Planners' Toolkit (MPTk).[74] MPTk can estimate both casualty streams and patient streams. MPTk is designed to export its patient streams to the Joint Medical Planning Tool (JMPT), which simulates patient flow from point of injury through the roles of care, and can be used to inform medical planning. This section provides basic information about MPTk; training is available.[75]

- MPTk has Patient Codes for several BW diseases,[76] and Patient Codes for several other diseases not associated with BWs.
  - BW-associated diseases included in JMPT are: anthrax, botulism, brucellosis, viral encephalitis,[77] plague, Q fever, ricin intoxication, SEB intoxication, smallpox, tularemia, and viral hemorrhagic fever (representing Ebola or Marburg).
  - Other JMPT patient codes that may be useful for representing outbreaks of operational significance include: 008.5 Bacterial enteritis; 047.9 Unspecified viral meningitis; 066.9 Arthropod-borne viral disease, unspecified; 079.99 Unspecified viral infection; 465.9 Acute upper respiratory infections of unspecified site; 466.0 Acute bronchitis; 486 Pneumonia, organism unspecified; 487.1 Influenze with other respiratory manifestations; 780.60 Fever, unspecified; and more well-known diseases like Dengue (061) or Malaria (084.6).
- BW casualty estimates are imported into MPTk from a ".CBRN" file that must be generated separately; these files can be acquired by coordinating through by DTRA's Operations Center.
  - To acquire a ".CBRN file" the staff must submit a Request for Information (RFI) to DTRA's Operations Center that contains a significant amount of information required as input to simulations. The MPTk-JMPT CBRN Smart Book[78] provides guidance on the RFI process.

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74 FM 1-0, 3-2. Two other tools are described in ATP 4-02.55. Medical and Casualty Estimator (MACE) tool estimates daily casualties admitted to Role 3, for division size forces and smaller. It can estimate disease casualties as part of DNBI, but does not address BW casualties. Statistical Analysis Cell (SAC) DNBI methodology estimates Role 3 admission rates for U.S. military personnel and nontraditional planning populations such as coalition or NATO. The SAC DNBI methodology addresses natural disease as part of DNBI, but not BW casualties. The medical planner must contact SAC to request DNBI estimates.

75 "Joint Medical Planning Tool (JMPT) Course," Military Health System, https://health.mil/Military-Health-Topics/Education-and-Training/DMRTI/Course-Information/Joint-Medical-Planning-Tool-Course. This is the same training provided by NHRC during staff assist visits to CCMDs.

76 Specifically, anthrax, botulism, brucellosis, Venezuelan equine encephalitis disease, plague, Q fever, ricin intoxication, SEB intoxication, smallpox, tularemia, and hemorrhagic fevers.

77 Note that "ENCEPH VRL" refers to a patient with encephalitis. However, the most BW-associated encephalitis virus, VEE, actually causes encephalitis very rarely (e.g., less than 0.5%) in healthy adults. See *Medical Aspects of Biological Warfare*, Chapter 20.

78 To request a copy of the MPTk-JMPT CBRN SmartBook, send an email to support@jmptonline.com.

- MPTk models natural disease using DNBI. The user can edit the distribution of Patient Conditions (e.g., increase the incidence of a specific disease to represent an outbreak) and can also change the fraction of DNBI that are NBI, vice disease.
- MPTk does not address the spread of contagious disease, whether caused by BW or a natural outbreak, other than cases that are included in the DNBI rate. The DNBI rate is applied as a rate relative to the population at risk (that may change over time); MPTk does not explicitly model disease transmission.

C. Clues That an Infectious Disease Outbreak May Be Intentional

4-66. Table 22 describes 12 clues that may be useful when assessing the likelihood that an outbreak was caused intentionally. The clues and related definitions, comments, and examples were derived from multiple sources.[79] One source (Grunow and Finke) provides a means of quantitatively scoring each clue, but may be overly complicated and formal.

4-67. Many of the clues are interrelated. Other than "direct evidence," it would generally be unwise to decide based on a single clue or even a few clues that an outbreak is, or is not, intentional. Best practice is to assess as many of the potential clues as possible, recognizing that time may be limited.

4-68. The actions and other considerations in Chapter 3 can provide much of the information required to assess the clues in Table 22. In particular, consider:

- The sources listed in Table 6 for information on what is "normal" for known diseases.
- The sources listed in Table 8 for information on new or ongoing outbreaks.

[79] (1) R. Grunow and E.-J. Finke, "A Procedure for Differentiating between the Intentional Release of Biological Warfare Agents and Natural Outbreaks of Disease: Its Use in Analyzing the Tularemia Outbreak in Kosovo in 1999 and 2000," *Clinical Microbiology and Infection 8, no. 8* (August 2002): 510–521. http://dx.doi.org/10.1046/j.1469-0691.2002.00524.x; (2) John H. Garr ed., chap. 2 in *Medical Aspects of Biological Warfare*, Textbooks of Military Medicine, (Washington, DC: Department of Defense, Office of the Surgeon General, U.S. Army, Borden Institute, 2018), https://medcoe.army.mil/borden-tb-medical-aspects-bio-war.; (3) ATP 4-02.84, Chapter 2; (4) the Blue Book; (5) TM 4-02.33, chapter "Outbreak Response in Case of Deliberate Use of Biological Agents to Cause Harm."

Table 22. Clues That an Infectious Disease Outbreak May Be Intentional

Clue	Definition, Examples, and Other Comments
Direct evidence	Discovery of the delivery device or munition (with evidence of biological agent) Direct evidence that the agent is a biological warfare agent (such as genetic evidence that it matches an agent known to be in an adversary stockpile) A public claim by a state or non-state actor that a BW attack was conducted
Existence of a biological risk	The presence of a political or terrorist environment from which a biological attack could originate; examples include • States, groups, or individuals have access to biological warfare agents, the means to disseminate them, and willingness to use them • Armed conflicts in connection with a suspected or program biological warfare program (R&D, production, storage) Known natural disease hazards in the AO complicate this factor; the natural disease could explain cases, or could be used to conceal BW use
Existence of a biological threat	A state, group, or individual has openly threatened to use BWs or a specific interest in such use can be reasonable assumed
Special aspects of the biological agent	Examples include: • Plausible evidence of intentional genetic manipulation or weaponization of a pathogen or toxin • Re-appearance of eradicated diseases like smallpox or rinderpest
Peculiarities of the geographic distribution of the biological agent	(1) The disease or pathogen species or strain appears outside its normal geographic range, for example • A disease or agent strain appears in a region for the first time • A disease reappears in a region after a long absence • A vector-borne disease appears outside the vector's current range (2) Evidence of a downwind casualty pattern, when factoring in the recorded weather, terrain, and personnel locations; this may appear as a tightly defined geographical zone of risk for illness in humans and/or animals (3) Evidence of a point source or multiple point sources, such as illnesses being clustered in a particular location or appearing in multiple separate locations (whether simultaneous or not) Also consider: • Whether the disease is endemic in neighboring regions • Recent changes in the population or range of potential vectors • The normal geographic area of the particular strain • The prevalence of anti-vaccine movements; for example, measles has resurged in pockets of CONUS and Europe due to anti-vaccine groups
High concentration of the biological agent in the environment	An artificially released biological agent will produce unusually high concentrations in the air, soil, and surface water • Vectors may also contaminate soil and surface water • Both medical and chemical corps assets may provide evidence • Opportunity to detect biological agent will typically be short lived because biological agent will typically degrade (hours to days, though *B. anthracis* may survive longer in soil) Consider that some biological agents do have non-zero background in the environment; depending on risk, it may be worthwhile to characterize the background levels of specific biological agents during routine operations

Clue	Definition, Examples, and Other Comments

Peculiarities of the intensity and dynamics of the epidemic	The number of cases of a disease per unit time or the total number of cases is high, compared to baseline; example peculiarities include
	• An explosive epidemic of a disease that typically evolves slowly
	  • Could indicate high dose yielding short incubation period
	  • Could indicate many people infected at one time (cluster of onset dates)
	  • Could indicate an unusually short incubation period
	• Major differences from predictions by established models of endemic diseases
	Also consider that the initial indicator might be a spike in illness of animals rather than illness in humans, or that both humans and animals could experience a spike in illness rates at the same time

Peculiarities of the transmission mode of the biological agent	A mode of transmission other than the known or expected mode(s), such as • Pneumonic plague not preceded by bubonic plague • Transmission by a new vector • Reverse zoonotic spread (i.e., from humans to animals) or spread among animals and humans at the same time, instead of spread among animals occurring first Note: observations on the mode of transmission must be tied to clinical observations; they should correspond
Peculiarities of the timing of the epidemic	(1) The outbreak does not conform to expected temporal patterns, such as occurring: • In an unusual month or season • In the absence of weather that normally drives an outbreak (e.g., via effects on vectors, or recent flooding) • At a time that is not aligned with typical intervals between outbreaks (2) Serial epidemics; multiple epidemics strike the same general area or population in succession Note: consider recent changes that may drive a chance in a disease's timing, such as recently degraded hygiene (e.g., due to war), climate change, or habitat encroachment
Unusually rapid spread of the epidemic	The speed of geographic spread from point(s) of origin to other areas is unusually fast • Intentional dissemination of a BW can create the appearance of very rapid spread of disease (both geographically and in case counts) • Rapid spread of a zoonotic disease without evidence of increased activity and/or infection in the host
Limitation of the epidemic to a specific population	(1) The locus of disease is in a particular population, which could be defined by military unit or base affiliation, ethnicity, religious affiliation, industrial sector, or other factors (2) The presence of dead animals (3) People who were indoors or otherwise protected at a certain time are less affected Also consider the general health and hygiene practices of any population that appears to be unduly affected
Peculiarities of the clinical manifestation	(1) Unexpectedly high morbidity or mortality for the disease (in all, or in a specific age group), or an uncommon form of the disease; examples include • Pulmonary or typhoidal form of a disease that usually presents differently • Neurological syndrome: meningitis, encephalitis, encephalopathy, or neurological disturbance • Respiratory syndrome: pneumonia, infiltrates, pneumonitis, ARDS • Acute fulminating septicemia or shock • Fulminant hepatitis or hepatic failure (2) Disease is unusually resistant to therapy (3) Unusual uniformity in disease presentation across many individuals

D. Using Medical Diagnosis to Generate Outbreak SA

4-69. This section focuses on use of medical diagnosis to generate SA for purposes such as early recognition of an outbreak, assessing whether an outbreak is or will become operationally significant, and informing the overall response to an outbreak. Patient treatment is part of the overall outbreak response, but not the focus here.

4-70. The early portion of an outbreak can be thought of as a race between the disease and the response measures implemented to control the disease. The role of medical diagnosis in the race is to produce SA that helps commanders and staffs implement effective response measures in a timely manner. Medical diagnosis is but one component of the total SA picture, which is also informed by disease screening and surveillance.

4-71. A medical staff that understands medical diagnosis, the role of diagnostics in diagnosis, and how diagnostic results should be used to generate SA will be better able to guide health surveillance collection and interpret health surveillance data to advise the commander and devise medical courses of action.

4-72. Medical diagnosis typically depends on a combination of factors, starting from individual patient histories, epidemiologic clues, and physical examination. This initial information is filtered through the lens of clinical judgment and ideally informed by a health risk assessment and medical intelligence reports that make clinicians aware of the particular hazards of the area of operations (AO) and capabilities of the adversary. If medical staffs gather information on recent environmental detection and share the results, then clinician awareness will be further heightened. Initial information collection, clinical judgment, and clinician awareness apply to every situation and are the starting point in generating SA from diagnosis. Clinicians may also request radiographic and laboratory studies, which may include infectious disease diagnostics. The more information is shared up, down, and across the medical chain of command, the more likely that clinicians can make rapid and correct diagnoses, improving patient outcomes and outbreak SA (see Section 4.E.4). The following focuses primarily on the role of diagnostic tests in diagnosis.

1. Infectious Disease Diagnostics

4-73. Numerous unique diagnostic techniques apply to infectious diseases. Figure 28 bins infectious disease diagnostic capabilities using broad categories, each representing multiple techniques with varying performance and requirements. Different situations will require different combinations of capability to generate a diagnostic answer. The use of multiple types of capability increases confidence in the accuracy of the diagnostic answer. In some cases, one capability alone may be sufficient basis for a diagnosis. Table 23 provides a general overview of each category of diagnostic laboratory test (culture, molecular diagnostic, antigen-based tests, and antibody-based tests). See ATP 4-02.84 Chapter 6 for additional information on identification technologies. Simple definitions of a few key terms are as follows. Table 24 contains more information on the latter four.

- True positive: the patient has the disease and the test is positive.
- False positive: the patient does not have the disease, but the test is positive.
- True negative: the patient does not have the disease and the test is negative.
- False negative: the patient has the disease, but the test is negative.
- Sensitivity: the probability that the test will be positive, assuming the person truly has the condition; probability of a true positive.
- Specificity: the probability that the test will be negative, assuming the person does not have the condition; probability of a true negative.
- Positive predictive value (PPV): the proportion of positive results that are true positives.
- Negative predictive value (NPV): the proportion of negative results that are true negatives.

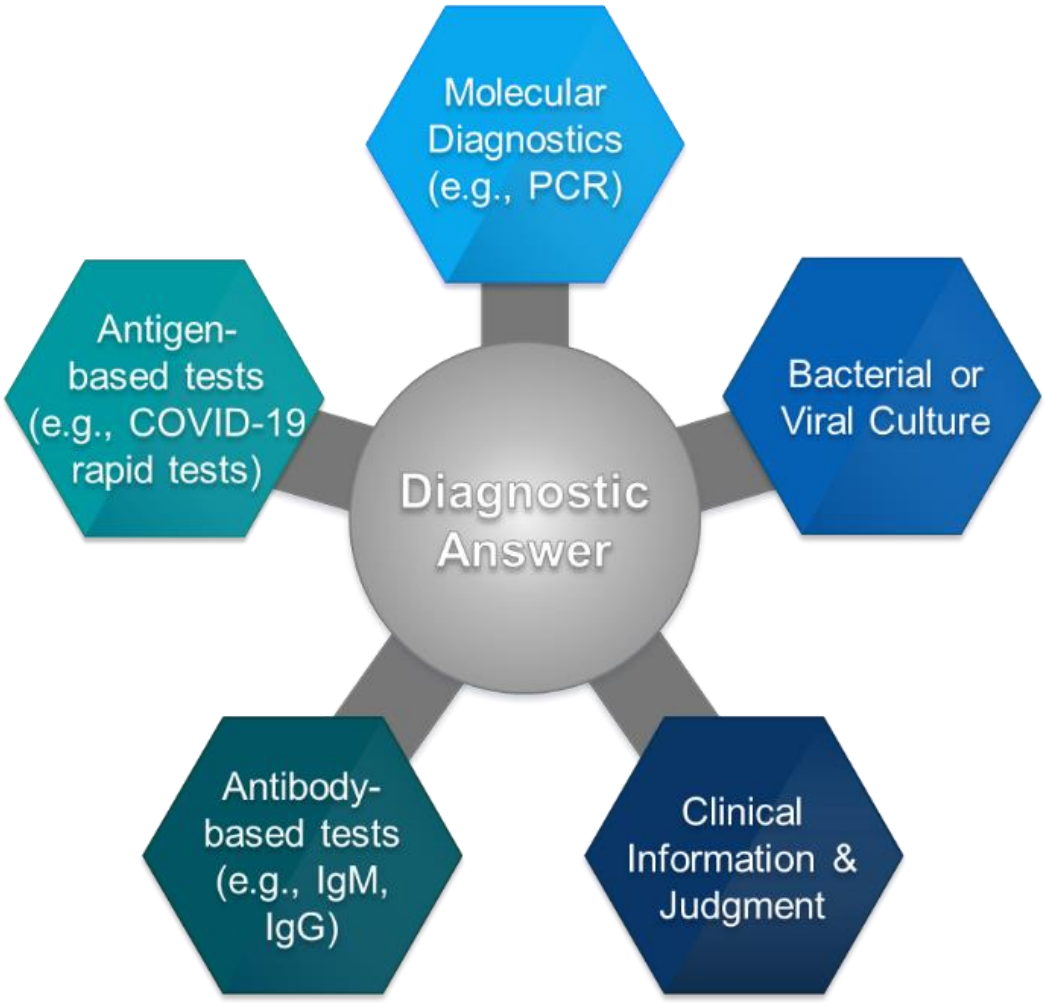

Figure 28. Bins of Infectious Disease Diagnostic Capabilities

4-74. Note that other capabilities sometimes serve as a supporting or enabling capability for infectious disease diagnostics. As an example, whole genome sequencing was used frequently during the COVID-19 pandemic to ensure that diagnostics (and other capabilities) were not made obsolete or less effective by virus mutation.

Table 23. Select Characteristics of Infectious Disease Diagnostics

Category	Description	Advantages	Disadvantages	Army Capability[a]
Culture	Growth of the bacteria or virus in question	• Inexpensive and generally easy to perform in the case of bacteria • Often considered the "gold standard" in diagnostics as it provides firm proof of the presence of the offending pathogen • Only detects viable pathogen	• Often difficult in the case of viruses • Requires time (48–72 hours for most bacteria; sometimes longer) • Requires equipment such as incubators • Requires trained personnel • May require BSL 2, 3, or 4[b]	• Field Hospital labs can perform bacterial culture up to "BSL-2+"[c] • USAMRIID can perform bacterial and viral culture up to BSL-4
Molecular Diagnostics (e.g., PCR)	Amplification and detection of small amounts of genetic material from the pathogen	• Very high sensitivity and specificity • Modern systems can yield results in a few hours • Required equipment has been "ruggedized" for use in austere environments	• Can be overly sensitive, detecting tiny quantities of residual genetic material even after a patient has recovered • Detects both viable and non-viable pathogen • Requires sophisticated equipment and trained operators	• Role 3 has PCR capability • There are plans to field PCR capability to Role 2
Antigen-Based Tests (e.g., COVID-19 rapid antigen tests)	Detect components of the pathogen in question (e.g., proteins on its surface)	• Inexpensive, portable (like pregnancy tests) • Easy-to-use (can often be collected and interpreted by untrained personnel) • High specificity; useful for rule-out screening • Results typically available within 30 minutes (rapid tests) or a few hours (laboratory tests)	• Often have high false negative rates • Cannot distinguish between viable and non-viable pathogen • Not available for many agents • Quantitative results require reference laboratories and trained personnel	• Rapid (point of care) antigen tests can be done at Role 1 and up • Laboratory/quantitative tests require reference laboratories
Antibody-Based Tests (e.g., IgM and IgG assays)	Detect antibodies (proteins produced by the immune system in response to infection)	• Available for virtually all pathogens • Can still be useful long after active infection has passed	• Antibodies may not be present for weeks after infection begins • Quantitative results require reference laboratories and trained personnel • Usually cannot discern between antibody produced by infection vice immunization • Often cannot discern between active, recent, and distant past infection • Performance varies widely across pathogens	• Rapid antibody tests can be done at Role 1 and up • Laboratory/quantitative tests require Role 3 or reference laboratories

a Note that the GMFL has significant capability, but does not routinely address clinical samples. See paragraph 4-50 in Section 4.B.5 for more on the GMFL.

b BSL-3 for anthrax, plague, tularemia, brucellosis, glanders, and melioidosis; BSL-4 for smallpox and many VHFs.

c BSL-2+ refers to a class 2 bio-safety cabinet plus enhanced PPE, which can be used situationally as for BSL-3 agents as warranted by the situation.

4-75. Generating a useful diagnostic test result requires that medical personnel first have sufficient reason to use an available diagnostic. That is, they must have a certain "index of suspicion." The medical staff can play a significant role in creating an index of suspicion by ensuring that MEDINTEL, Health Risk Assessments, and results from environmental detection and from health surveillance data analysis and fusion are appropriately shared, including back *down* the (medical) chain of command.

4-76. Once a provider decides to use a diagnostic test, an appropriate clinical specimen must be collected during a stage of disease progression when sufficient indicator[80] is present in the specimen.[81] Figure 29 depicts the requirements for getting an accurate diagnostic test result.

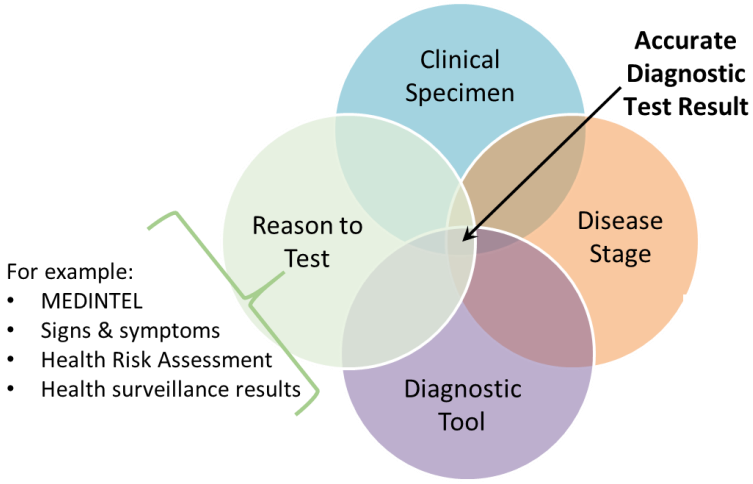

Figure 29. Requirements for an Accurate Diagnostic Test Result

4-77. When interpreting diagnostic results it is also important to know *exactly* what the diagnostic detects, including whether it can distinguish between those pathogens capable of causing disease and those that have been killed or inactivated. Table 23 provides some information that is worth explaining further.

- A positive **culture** result definitively indicates live bacteria or competent virus. If the sample contained only dead or inactivated pathogen, the culture would not be positive. This is one reason culture is typically the "gold standard."
- **Molecular diagnostics** and **antigen-based tests** detect the *presence of some amount of the pathogen or components of it*, but do not distinguish between live and dead pathogen. For a positive result, the sample must contain a certain amount of indicator; that threshold amount varies. Two particular types of problem arise from results based on a simple threshold of indicator.
  - Problem type 1: a person who has recovered and is no longer contagious could still test positive (false positive) because remnants of the indicator remain in their body.
    - The risk of false positives increases particular with too many PCR amplification cycles (high cycle threshold, or CT). PCR exponentially amplifies any genetic material in the sample. Inconsequential amounts can be amplified enough to produce a (false) positive result. To be clear, the CT does not directly indicate whether a person is contagious, but is related to the amount of genetic material in the original sample. Thus, the CT used in tests is valuable information that should not be ignored in favor of simply reporting "positive" or "negative."

[80] For simplicity, the term "indicator" is used to refer to the organism, antigen, antibody, or other substance that provides evidence of the presence of a given pathogen or toxin.

[81] For reference information on specimen collection for biological warfare agents, see *Medical Aspects of Biological Warfare*, Table 26-3, and ATP 4-02.84, Table A-2.

    - Antibodies are formed as part of the body's immune response to infection. These antibodies begin to appear within days of the initial infection and may persist for months, years, or even for life. While positive antibody titers are seen in some active infections (HIV is a good example), more often high antibody titers are seen in patients who have recovered from a disease. Their usefulness in diagnosis is thus often retrospective.
  - Problem type 2: a sample with little indicator, for example because the disease is in the early stage, may produce a false negative because the test's limit of detection is not low enough.
    - The risk of this kind of false negative increases if tests are used "too early," but the challenge is knowing what is "too early." (See Figure 30 and surrounding discussion).

- **Antibody-based tests** detect all circulating antibodies (of a certain type, e.g., IgG or IgM), so they cannot typically cannot distinguish between antibodies resulting from infection vice immunization or explain *when* the antibodies were generated. When antibody tests are coupled with other information, these distinctions may become possible.

4-78. When collating and interpreting diagnostic test results from subordinate MTFs to provide SA on the outbreak, it is important to understand and be able to explain the terms *sensitivity*, *specificity*, *positive predictive value (PPV)*, and *negative predictive value (NPV)*. Table 24 defines the terms and provides comments to aid in understanding how tests and the terms can be applied. Sensitivity and specificity evaluate the diagnostic test, whereas PPV and NPV evaluate the utility of the test results.[82] There are websites that can calculate and display PPV and NPV based on user input sensitivity, specificity, and prevalence.[83]

Table 24. Sensitivity, Specificity, and Positive and Negative Predictive Values

Term	Definition	Comments
Sensitivity	The probability that the test will be positive, assuming the person truly has the condition	• High sensitivity is most useful for ruling out disease • Does not address false positive rate • Varies over the course of disease • Independent of the prevalence of the disease in the population
Specificity	The probability that the test will be negative, assuming the person does not have the condition	• High specificity is most useful for ruling in disease • Does not address false negative rate • Varies over the course of disease • Independent of the prevalence of the disease in the population
Positive predictive value (PPV)	The proportion of positive results that are true positives	• Varies with prevalence, sensitivity, and specificity • If the condition is rare (low prevalence), such as BW-associated diseases in the absence of a BW attack, false positives are more likely (PPV is low)
Negative predictive value (NPV)	The proportion of negative results that are true negatives	• Varies with prevalence, sensitivity, and specificity • If the condition is common (high prevalence), as may occur in a pandemic or after a BW-attack has affected a unit, false negatives are more likely (NPV is low)

2. Forward Diagnosis

4-79. It is often assumed that pushing diagnostics farther forward will necessarily lead to earlier awareness. While it may, there is no guarantee. The idea that "forward necessarily means earlier awareness" is based on

[82] For more information, see (1) https://microbenotes.com/sensitivity-specificity-false-positive-false-negative/; (2) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2636062/; (3) https://academic.oup.com/bjaed/article/8/6/221/406440.

[83] For example, see https://kennis-research.shinyapps.io/Bayes-App/.

the flawed assumption that the performance (e.g., sensitivity, specificity) of a diagnostic will not be affected by pushing it forward. Figure 30 demonstrates why diagnostic performance may suffer if diagnostics are pushed farther forward.

4-80. Fielded diagnostics were tested, during development, in a way that represents a single point along the notional curves shown in Figure 30. The stated test performance, such as sensitivity and specificity, will not apply to a particular patient if that patient is at a *different* point in disease progression. Worse, as of early 2022, real versions of the curves shown in Figure 30 remain generally unknown.

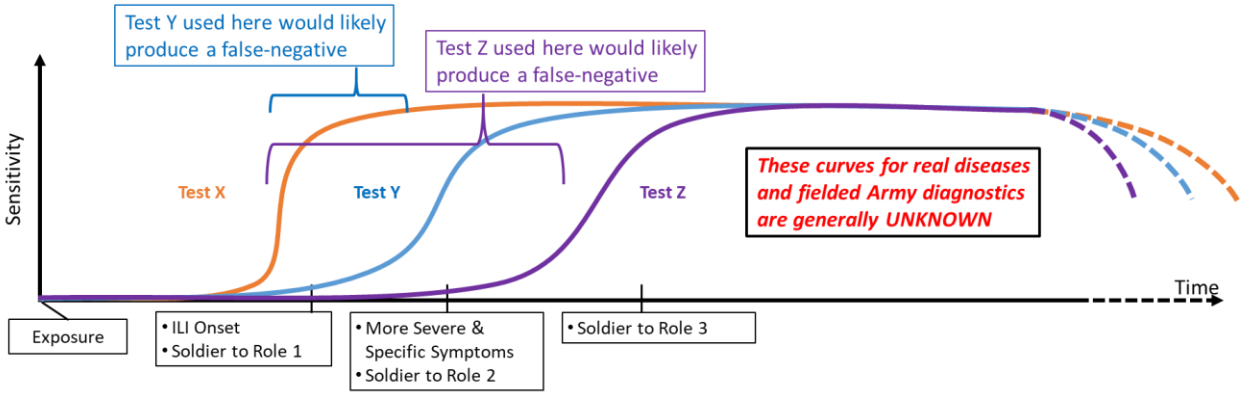

Figure 30. Notional Probability of Detection Over Time and Roles of Care[84]

4-81. For medical staffs trying to generate SA from diagnostic results, caution is needed, especially when interpreting a small number of tests. Consider two example situations:

- Example 1: the earlier stages of disease (at which point patients are likely at Role 1 or 2) may present a *small* amount of indicator in clinical samples. This would make it harder for diagnostics to detect the indicator, and more likely to produce a false negative from samples early in the course of disease. If the test has a high sensitivity based on development tests that used samples from a later stage of disease, then a false negative may be treated as a true negative, confounding both treatment and SA.
- Example 2: the indicator may peak early and then decline. This would mean samples drawn earlier (farther forward) present a bigger "signal" for detection, and samples drawn later (farther to the rear) present a smaller signal. In this case, samples drawn later would be more likely to produce a false negative than samples drawn earlier.

4-82. Despite the challenges with availability and use of diagnostic tests, and limited access to subject matter experts such as infectious disease clinicians and microbiologists at forward locations, medical personnel will be expected to diagnose and treat infectious disease patients. If diagnostics are not available, medical personnel in forward locations may need to make tentative clinical diagnoses and initiate empiric therapy, based on syndromic diagnosis. In addition to benefiting patients, tentative clinical diagnoses and the outcomes of empiric therapy can still produce SA if medical staffs have the information and analyze it. They can also inform the subsequent use of diagnostics, once diagnostics are available.

4-83. Medical staffs, therefore, might consider promulgating guidance on syndromic diagnosis.[85] The following bullets and tables may be helpful.

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84 Adapted from Kristen A. Bishop et al., *Evaluation of Biological Agent Clinical Sampling and Analysis*, IDA Paper P-21576 (Alexandria, VA: Institute for Defense Analyses, May 2021), available at https://search.dtic.mil under "AD1163136."

85 Note that syndromic diagnosis and empiric therapy are not substitutes for definitive diagnosis when such is possible. Every attempt should be made to confirm suspected diagnoses. Furthermore, casualties should be continually re-assessed, and treatment regimens refined based on clinical response, laboratory investigations, environmental detections, expert consultation, and intelligence assessments.

- Syndromic diagnosis is aided by the fact that diseases produced by exposure to credible biological threat agents (as well as by endemic/epidemic infectious diseases and by chemical exposures) produce a limited number of clinical syndromes. Moreover, a small number of treatment options are indicated.
- An approach to syndromic diagnosis begins with determining whether casualties are presenting tightly clustered in time and space. With rare exceptions, such clustering is characteristic of conventional and chemical weapons. Conversely, biological agents (whether natural or intentional), owing to their inherent incubation periods, will produce casualties days after exposure and spread out over time and location. Thus, one can divide casualties into sudden- (or intermediate-) onset and delayed-onset categories.
- Many infectious diseases, including those that constitute viable weapons, produce a number of non-specific symptoms, such as malaise, fatigue, fever, myalgia, nausea, and vomiting, among others. Nonetheless, they can also be readily divided into those that produce a respiratory syndrome and those where neuromuscular or dermatologic findings predominate.
- Taking these factors into consideration, one can "pigeonhole" chemical and biological agent-induced diseases into a few discrete syndromes (e.g., delayed-onset neuromuscular syndrome, sudden-onset respiratory syndrome) as shown in Table 25. A related algorithm is given in ATP 4-02.84 Appendix E.
- Syndromic diagnosis should not replace definitive diagnosis supported by appropriate diagnostic tests. However, when such definitive diagnosis is achievable (such as it often might be at higher echelons of care), it may allow clinicians to institute lifesaving empiric therapy promptly. Possible empiric therapies for various clinical syndromes are outlined in Table 26.

Table 25. Syndromic Diagnosis Guidance

	Neuromuscular Symptoms Prominent	Respiratory Symptoms Prominent	Dermatologic Symptoms Prominent	Syndrome Limited to Non-Specific Symptoms
Sudden-onset or intermediate-onset	Nerve agents	Chlorine Phosgene Cyanide	Mustard Lewisite	
Delayed-onset	Botulism VEE / EEE / WEE	Anthrax Plague Tularemia Ricin Influenza, COVID-19	Smallpox	Brucellosis Q-Fever

Table 26. Empiric Therapy Based on Syndromic Diagnosis

	Neuromuscular Symptoms Prominent	Respiratory Symptoms Prominent	Dermatologic Symptoms Prominent	Syndrome Limited to Non-Specific Symptoms
Sudden-onset or intermediate-onset	Consider ATNAA, CANA	Consider cyanide antidotes, oxygen	Consider topical anesthetics, monitor for subsequent pulmonary involvement	
Delayed-onset	Consider botulinum antitoxin	Isolate, consider ciprofloxacin or doxycycline	Isolate, consider tecovirimat	Consider doxycycline

3. Practical Suggestions for Using Diagnosis to Generate SA

4-84. Several challenges outlined above combine to make it difficult for medical diagnosis to produce early SA of an outbreak, particularly in the absence of a specific threat or identified health risk. The challenges stated in

bullets below are not easily resolved, but being aware of them will improve the medical staff's ability to understand health surveillance results and advise the commander on their meaning.

- For a brand new disease or variant, there may be no effective diagnostic test.
- Providers' motivation to test for a rare disease will generally be low, absent a particular threat.
- Diagnostics may perform poorly (e.g., produce false positives or negatives) during the early stages of disease, which are more likely to be encountered at more forward locations.
- In the early phase of an outbreak, the prevalence of disease will be low, which means the PPV of any diagnostic will be relatively low even if the test has high sensitivity and specificity. That is, even if a diagnostic produces a positive result, it may well be a false positive.

4-85. One strategy that medical staffs might consider is pushing out syndromic diagnosis guidance, as discussed above. Making providers aware that their individual patient diagnoses contribute to broader SA is important, as is instituting procedures to facilitate rapid reporting for analysis.

4-86. Another strategy to use diagnosis to gain early SA about a new outbreak or recent BW attack is to routinely use rapid antigen tests for common diseases like influenza and COVID-19 for rule-out screening, combined with rapid health surveillance data analysis. Absent threat information, the instinct of most providers observing a patient with ILI will be to think of common diseases, not exotic diseases. If rapid antigen tests consistently produce negative results for common diseases, then providers will have a basis for exploring uncommon diseases, even absent a specific threat. This strategy leverages the following factors:

- Even for common diseases, prevalence is typically low (e.g., less than 10 percent), which makes NPV high, meaning that ***rule-out testing is relatively reliable***. On the contrary, the low prevalence of uncommon diseases makes PPV low, which means low reliability for rule-in testing.
- ***Rapid antigen tests are typically good for rule-out testing*** because of high specificity (low false positive rate).
- ***Rapid antigen tests are cheap and simple to use*** and can therefore be used at point of care.
- ***There can be great value in simply knowing that "something is wrong"*** as a trigger for generic outbreak response activities such as enhanced PPE and distancing, followed by further investigation.

E. Contagious Disease

4-87. The purpose of this section is to provide general technical information on contagious disease outbreaks that will help medical staffs better understand, plan for, and explain contagious disease outbreaks and outbreak response options. It will help to put into context information that staffs may receive back from reachback sources, particularly reachback modeling. It addresses the following topics:

- Disease transmission dynamics, and how those dynamics affect outbreak response.
- Outbreak forecasting basics.
- Technical aspects of outbreak response measures and factors that challenge response effectiveness.
- Disease surveillance support to situational awareness.

1. Disease Transmission Dynamics and Implications for Outbreak Response

4-88. For purposes of forecasting casualties and the progression of disease outbreaks, assessing operational impact, and evaluating responses, the diseases caused by biological agents can be divided into two categories: contagious and non-contagious.

4-89. Non-contagious diseases can be transmitted to humans from various environmental sources, such as fomites, vector (insect and animal bites or handling of live or dead animals), direct contact, ingestion of food and water, or inhalation of droplets and aerosols. The mode of transmission will affect clinical presentation and

course of disease: for example, contact exposure can result in cutaneous anthrax or tularemia, while inhalation exposure can cause primary pneumonia and systemic effects.

4-90. Contagious diseases are transmitted from one human to another. While the first case or cases (typically termed "index cases") acquire disease from the same range of environmental sources as non-contagious diseases,[86] onward transmission of disease can continue occurring through environmental sources and through direct human-to-human transmission.[87] Note that during an outbreak of communicable disease, as long as environmental sources persist they can still generate infections among the human population. As above the clinical presentation and course of disease may be different for human-transmitted cases than for cases acquired from the environment, complicating diagnosis, hampering early detection of the outbreak, and inhibiting the establishment of situational awareness.

4-91. Table 27 lists possible modes of disease transmissions, with examples and notes on the types of precautions required to protect against them.

Table 27. Generic Modes of Disease Transmission

Mode of Transmission		Examples	Precautions
Respiratory	Droplets (cough, sneeze)	Influenza, common cold, pneumonic plague	Droplet
	Aerosolized droplet nuclei (smaller particles that can be exhaled)	Tuberculosis, measles, COVID-19, SARS, MERS, smallpox	Airborne
Blood & Body Fluids	Needle sticks, sexual exposures	HIV, hepatitis B & C, Ebola, smallpox (from exposure to scabs)	Contact
Fecal-Oral	Exposure to feces	Cholera, most diarrheal diseases	Contact, hand washing
Fomites	Inanimate objects contaminated with infectious droplets (usually respiratory) or particles	Many respiratory and diarrheal diseases, inhalational anthrax (from contaminated animal hides)	Hand washing
Vector-Borne	Arthropod bites	Malaria, Lyme disease, tularemia, VEE, EEE, WEE, CCHF	Insect precautions (repellents, bed netting, permethrin)
Food- & Water-Borne	Exposure to contaminated food and water	Cholera, most diarrheal diseases, SEB, brucellosis, gastrointestinal anthrax	Food & water discipline, proper food preparation practices, water treatment

Note: Many diseases are transmitted via multiple routes, such that a combination of precautions is sometimes warranted.

4-92. The number and timing of cases of disease within a population at risk will look very different for traditional aerosolized BW attacks and naturally occurring outbreaks of contagious disease. In a traditional aerosolized BW attack, with either contagious or non-contagious agents, exposure of personnel will occur near-simultaneously, and one would therefore expect to see a single, large spike of cases very early in the outbreak. Naturally occurring outbreaks of contagious disease will begin with a small number of initial cases and spread quite slowly at first, then accelerate as growth becomes exponential, and then fall off. As shown in Figure 31, there can also be intermediate cases where adversaries execute crude biological attacks that expose limited numbers of people, or attempt to exploit natural outbreaks through opportunistic means.

[86] The exception is smallpox, which has no non-human host.

[87] This transmission may be mediated by the environment; for example, a person may cough out droplets or exhale aerosolized droplet nuclei that another person inhales, leading to infection.

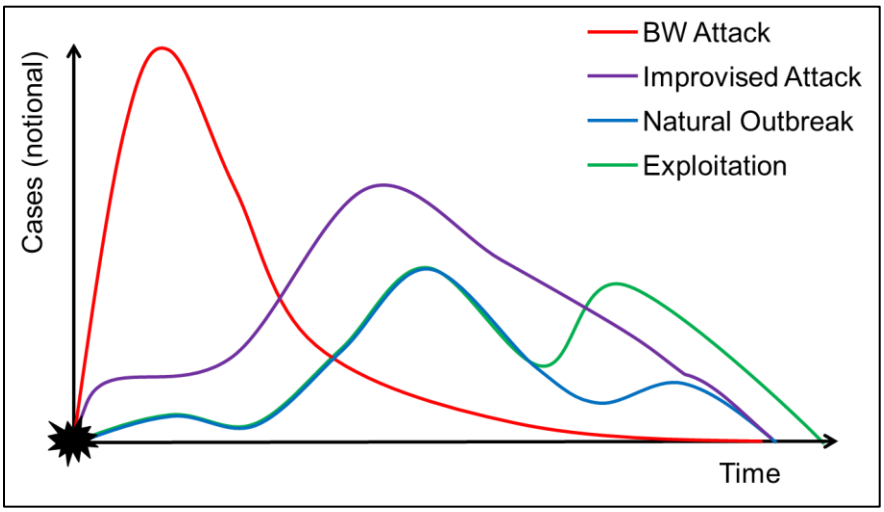

Figure 31. Notional Presentation of Casualties over Time in Different Biological Scenarios[88]

4-93. Each of the biological scenarios shown in Figure 31 presents its own challenges for response, due to differences in the number and timing of disease cases among the population at risk. Outbreaks of disease resulting from biological warfare agent attacks would be relatively easy to detect, but would allow very little time to implement an effective response. In improvised biological scenarios and natural outbreaks of contagious disease, by contrast, even determining that an outbreak is underway would be a challenge initially. This lack of situational awareness at the outset could allow exposed and infected personnel to disperse throughout the population at risk and make controlling the spread of disease much more challenging.

4-94. Once exposure/infection occurs, opportunities for intervention to mitigate the onset, severity, and duration of disease are determined by incubation period, progression of illness, and the effectiveness of medical countermeasures and therapy drugs in various stages of illness.

4-95. For contagious diseases, the spread of disease within a population is further driven by a number of additional factors: latent period, duration of contagious period, profile of contagiousness over time, R_0, the possibility and magnitude of asymptomatic spread, and the effectiveness of medical countermeasures in truncating transmission.

- **Latent period** is the time between exposure and onset of contagiousness. Outbreaks of disease with longer latent periods will generally grow more slowly than those with short incubation periods.
- **Incubation period** is the time between exposure and onset of symptoms. Symptom onset is a key time point in efforts to control outbreaks of contagious disease, as typically it is the most observable means to identify and isolate contagious individuals. Prior to the onset of symptoms, individuals who are incubating disease are difficult to distinguish from others who may have been exposed but are not incubating disease.
    - Incubation period and latent period are not synonymous. For many diseases, individuals become contagious at the onset of symptoms, or at some point thereafter, usually when more serious or distinctive symptoms emerge. In these cases, the latent period is equal to or longer than the incubation period, and the contagious period is equal to or shorter than the symptomatic period of illness. Some diseases, like COVID-19, can be contagious prior to symptom onset (latent period is shorter than incubation period and contagious period is longer than symptomatic period).

88 Julia K. Burr et al., *Emerging Infectious Diseases Study*, IDA Paper P-5302 (Alexandria, VA: IDA, August 2016), 15, accessible at https://search.dtic.mil/ under "AD1165599."

- **Contagious period** is the time in which an infected individual can transmit disease to others. Understanding the duration of the contagious period and the presentation of the disease during that time is key to identifying contagious individuals and establishing requirements for measures to prevent disease transmission. For example, contagious period is often used as the basis for determining the required duration of quarantine.
    - The contagiousness (or transmissibility) of disease during the contagious period is not typically uniform, but increases, peaks, and ebbs with time and the progression of disease. Contagiousness of COVID-19, for example, peaks at or slightly before onset of symptoms, while that for Ebola peaks in the most severe stages of illness.
- **Asymptomatic transmission** (or pre-symptomatic transmission) refers to the possibility that an individual without symptoms can be contagious.
    - Asymptomatic transmission can occur when the latent period of a disease is shorter than the incubation period, and individuals become contagious before onset of symptoms. Diseases in this category and the approximate number of days of asymptomatic transmission are influenza (1 day), yellow fever (1 day), varicella (2 days), measles (2 days prior to rash), and COVID-19 (2 days).
    - For some diseases, symptomatic transmission can also occur in cases where infected individuals never show symptoms but are nonetheless contagious (e.g., COVID-19).
    - Outbreaks where asymptomatic transmission contributes to the spread of disease are more complex and difficult to control; this is especially true when contagious individuals never develop symptoms and cannot be readily identified.
- $\boldsymbol{R_0}$ is the average number of infections a contagious individual would be expected to cause in a completely susceptible population. This value is determined by a combination of disease characteristics, such as mode of transmission and duration of the contagious period, and social factors, such as population density and contact patterns. $\boldsymbol{R_0}$ describes disease transmission unrestrained by outbreak control measures, adaptive changes in population behavior, growing herd immunity, or any other mitigations. It represents the upper bound of the rate of transmission of disease within a population.
- $\boldsymbol{R}$ is the average number of infections caused per contagious individual, given some level of population immunity or control measures. When the value of $\boldsymbol{R}$ exceeds one, outbreaks will grow; when the value of $\boldsymbol{R}$ falls below one, outbreaks will abate. **The primary objective of outbreak control measures is to cause the value of $\boldsymbol{R}$ to fall below one as quickly as possible**.
- **Medical countermeasures** are pharmaceutical interventions that reduce personnel susceptibility to infection or treat illnesses resulting from such exposure, thus limiting the overall number of disease cases or reducing the duration and severity of illness. In the context of containing disease spread, medical countermeasures can reduce the size of the susceptible population and shorten the length of time in which contagious individuals transmit disease.

4-96. Not all of these factors will be well-understood at the start of an outbreak, particularly for rare or novel pathogens. Yet unless the behavior of the disease and the dynamics of transmission are known, it will be difficult to control the spread of disease efficiently and effectively.

- One critical component of outbreak response is the establishment of clear, consistent, and comprehensive methods for collecting the information needed to improve understanding of the mode of transmission, latent period, transmissibility over time, and the potential for/magnitude of asymptomatic transmission.
- As understanding of disease behavior and transmission grows, control measures can be better targeted to be as minimally disruptive as possible. Initially, however, such measures may need to be broader based to ensure that they can be effective.

2. Contagious Disease Outbreak Forecasting

4-97. Predictions of the spread of contagious disease throughout a population at risk are important inputs to planning and execution of outbreak control measures, and in a military context, to decisions that balance health risks to the population with operational risks to mission execution. Epidemiological models that generate such

predictions broadly assess the intersection between the behavior of a disease—typically characterized by the factors described above—and the social behavior of humans. Characterization of human behavior in these models can range from the simple to complex, focusing at the individual or population level, with stochastic (random) or deterministic (non-random) processes and outputs, and can be adapted to explore unique features of specific diseases or particular outbreak responses. The simplest forecasting models can be implemented in spreadsheet form. The most complex require computational capability of the highest level.[89]

4-98. Established reachback capabilities dedicated to providing subject matter expertise to military forces, including USAMRIID, WRAIR, and DTRA's Operations Center,[90] can provide outbreak forecasting resources and references. There are numerous other organizations that conduct contagious disease modeling and generate predictions of contagious disease spread, including the CDC, the WHO, national laboratories, research institutes, and universities. The ongoing efforts and published body of work in this arena can be a valuable source of information about known and emerging disease behavior in a population.

4-99. The rest of this section provides an overview of the two most common approaches to outbreak forecasting. The purpose is to give the medical staff a basic familiarity and a context for understanding results they may receive from reachback or that other specialized analysis cells may produce.

4-100. One common epidemiological approach used in outbreak forecasting is the traditional Susceptible-Exposed-Infectious-Removed (SEIR) compartmental model. A basic SEIR model classifies individuals as members of one of four cohorts:

- S—susceptible to infection;
- E—exposed but non-contagious (not yet contagious);
- I—infectious/contagious; or
- R—removed as a source of infection, through recovery[91] or death.[92]

4-101. In the SEIR model, illustrated in Figure 32, individuals move in a linear path over time from one cohort to another in a manner determined by the characteristics of the disease. Specifically, these are the latent period (which describes the amount of time individuals spend in the E cohort), the contagious period (which describes the amount of time individuals spend in the I cohort), and the rate of disease transmission (which determines the number of people who move from the S cohort to the E cohort per unit time, given assumptions about the interaction between members of the S and I cohorts). Predictions of the progression of outbreaks within the population are generated by integrating these cohorts over time.

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89 For example, Argonne National Laboratory has developed CityCOVID, an agent-based model implemented on high-performance computing platforms that represents behavior, movement, and disease progression on an individual level, and incorporates large-scale machine learning algorithms to quantify the impact of outbreak control measures of various types. See https://www.anl.gov/dis/citycovid-about-the-model.

90 Or on SIPRNet, go to https://opscenter.dtra.smil.mil.

91 For patients who recover, removal as a source of infection could be permanent if immunity is long-lasting (relative to the duration of the outbreak), or could be temporary if immunity is short-lived. In the case of short-lived immunity, individuals could return to the S cohort (as observed with COVID-19). However, short-lived immunity is relatively rare compared to the duration of military operations.

92 The SEIR model and its variants are well-described in the literature, beginning with the foundational publication on the subject, D. T. Haydon, M. E. J. Woolhouse, and R. P. Kitching, "An Analysis of Foot-and-Mouth-Disease Epidemics in the UK," *IMA Journal of Mathematics Applied in Medicine & Biology* 14 No. 1 (1997): 1–9. https://pubmed.ncbi.nlm.nih.gov/9080685/.

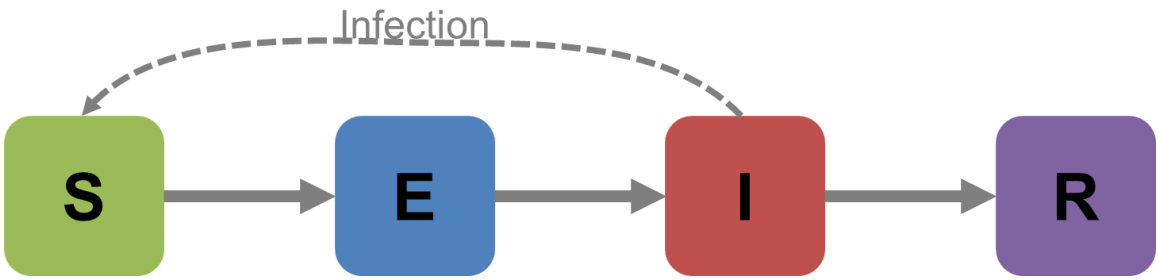

Figure 32. Basic SEIR Compartmental Model

4-102. This basic SEIR framework often serves as a starting point for more sophisticated models used to analyze additional features of disease or a range of outbreak responses. For example, Figure 33 depicts a model of pneumonic plague transmission that incorporates numerous adaptations of the basic SEIR model:

- Individuals can move directly from the S and E cohorts to the R cohort through the use of pre- or post-exposure prophylaxis;
- Individuals can move from the I cohort to the R cohort before the resolution of their illness through isolation, which effectively truncates transmission early;
- The I cohort is subdivided into two parts, corresponding to two stages of illness. Individuals in the first stage can be removed through treatment and eventually return to duty; all individuals who progress to the second stage of illness will be removed through death.

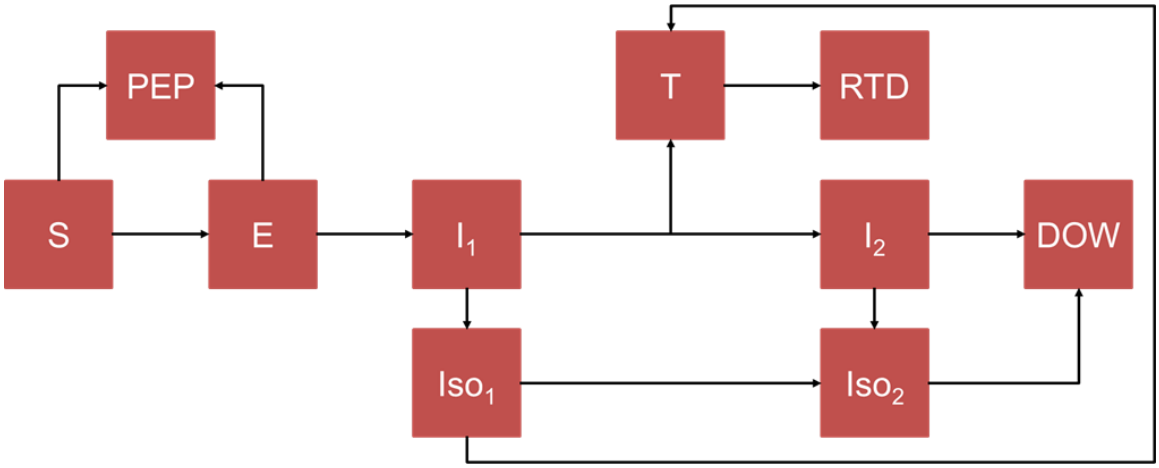

Figure 33. SEIR Model Adapted to Consider Prophylaxis, Treatment, and Isolation for Pneumonic Plague

4-103. Another common method of outbreak forecasting is the use of simple "generational" models. A generation of a disease is sometimes referred to as the serial interval, which is defined as the "time interval between successive infections in a chain of transmission."[93] Serial interval duration is typically calculated from empirical data collected during an outbreak, but can also be estimated from disease-specific latent and contagious periods and assumptions about the timing of interactions between the susceptible and contagious populations. Parameters of interest in a generational model are:

- The total size of the susceptible population (**S**) at the start of the outbreak;

[93] Emilia Vynnycky and Richard G. White, *An Introduction to Infectious Disease Modelling* (Oxford, UK: Oxford University Press, 2010), XXV. https://anintroductiontoinfectiousdiseasemodelling.com/.

- The initial number of contagious individuals; and
- The number of new infections caused per contagious individual (**I**).

4-104. Assuming that each contagious individual causes the same number of infections, the total number of new infections in a generation is simply ***R*** multiplied by the number of contagious individuals in the previous generation. The cumulative number of cases that have occurred up to a given generation is the sum of the number of cases in each previous generation, and the number of remaining susceptible individuals in any given generation is the total population, minus the cumulative number of cases to that point.

4-105. Figure 39 shows an example of the analytical use of a generational model, which notionally describes the cumulative number of disease cases, given the prophylactic use of medical countermeasures of varying effectiveness during the third generation of an outbreak.

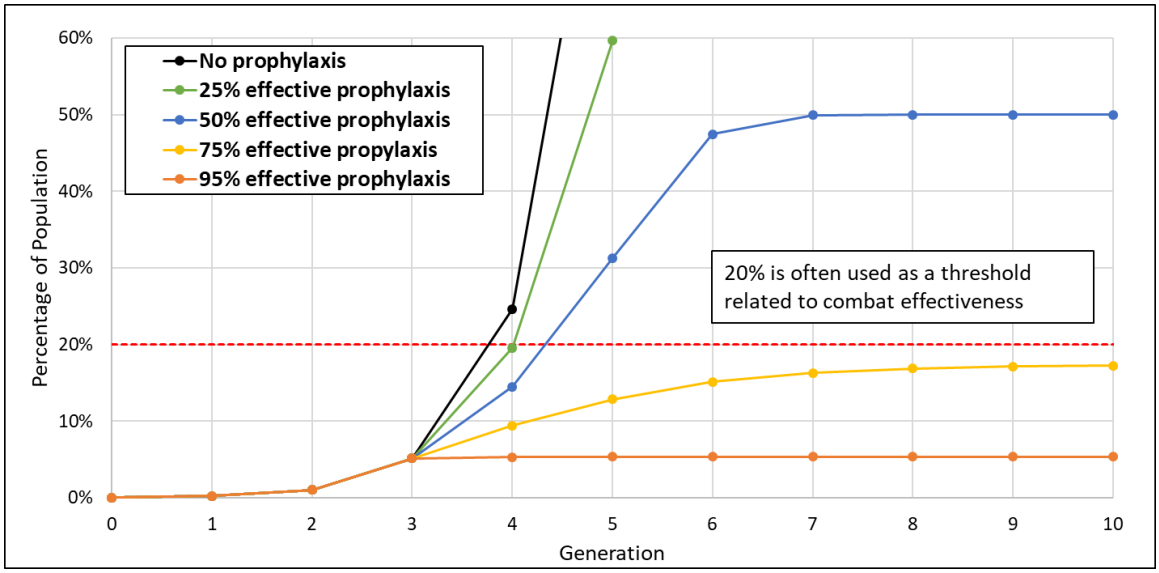

Figure 34. Notional Consideration of Prophylaxis in a Generational Model of Outbreak Progression[94]

4-106. In this notional example, prophylaxis that is 95 percent effective (orange line) and 70 percent effective (yellow line) causes the outbreak to begin to wane within one or two generations following administration and prevents the number of infected individuals from exceeding 20 percent of the population. At 50 percent effectiveness (blue line), prophylaxis of the remaining susceptible population also causes the outbreak to wane, but at much higher rates of infection. Finally, although the vertical axis is not shown in its entirety, the use of prophylaxis that is 25 percent effective (green line) will delay progression of the outbreak but will neither stop it nor prevent the infection of the entire population.

3. Outbreak Response Options

4-107. During normal operations, military medical units at all levels should be trained and equipped to manage small numbers of patients who are ill with common and relatively benign contagious diseases. Implementation of broader outbreak control measures may be advised when 1) this baseline capability is inadequate because of the severity of the disease, the number of casualties, or the insufficiency of standard precautions in preventing the spread of disease, and 2) when operationally significant outbreaks occur as a result. Standard disease control measures might break down for any number of reasons:

94 Julia K. Burr et al., *Controlling the Spread of Contagious Disease in an Operational Environment*, IDA Paper P-10877 (Alexandria, VA: IDA, February 2020), 19, accessible at https://search.dtic.mil/ under "AD1099456."

- Some diseases can be contagious before the onset of symptoms.[95]
- Mechanisms of disease transmission—and the requirements for controlling them—may not be fully understood for newly emerged diseases, as was the case early in the COVID-19 pandemic.
- Operational circumstances, including high operational tempo and large geographic distances between combat units and isolation facilities, can increase the time that it takes to isolate contagious personnel.
- Limitations in deployed laboratory capability may delay the diagnosis of the causative agent of disease and the associated awareness of the type of outbreak responses needed to contain it.
- Biological warfare attacks could generate large numbers of near-simultaneous primary infections, overwhelming available isolation capabilities from the outset.
- In any contagious disease outbreak, deployed military personnel are unlikely to be the only source of disease. Host nation military and civilians and animal or insect vectors may also contribute to the spread of disease.

4-108. Options for controlling outbreaks and limiting the spread of contagious disease fall into two general categories: medical countermeasures that limit the susceptibility of the population to infection, and physical control measures that prevent transmission by restricting contact between healthy personnel and personnel who are or could be contagious. Outbreak response options can be implemented alone or in combination, depending on need, and include medical countermeasures, isolation, quarantine, and restriction of movement (ROM). In addition, contact tracing, diagnostic testing, and public health measures, such as increased sanitation, social distancing, and masking, can be adopted to complement/enhance selected measures.

a. Candidate Outbreak Response Measures

4-109. **Medical countermeasures (MedCMs)**, as noted above, can reduce the size of the susceptible population and/or shorten the length of the contagious period. Vaccination is the archetypical medical countermeasure. However, antibiotics and antiviral drugs can in some cases be used prophylactically to prevent onset of disease, and as therapy they can reduce the duration and severity of illness.

4-110. Successful administration of medical countermeasures as an outbreak response depends on four factors: availability, efficacy, time window for administration, and compliance.

- *Availability* is a condition that must be met before other parameters can be evaluated. Medical countermeasures do not exist for all diseases.
- *Effectiveness* is the probability that a medical countermeasure will have its desired effect when administered to the real-world population of interest.[96] For example, COVID-19 vaccine clinical trials broadly focused on reducing severe disease and preventing death, but these vaccines have also demonstrated effectiveness in preventing COVID-19 infections. Preventing infection is of primary importance when assessing the ability of medical countermeasures to reduce *R*.
- *Time to administration* is the delay between a decision to use medical countermeasures and the successful delivery of them to a population.
- *Compliance* is the percentage of the susceptible population that has received a medical countermeasure.

4-111. When available, medical countermeasures can be among the most effective options for controlling an outbreak. For some diseases, they may be able to reduce $\boldsymbol{R}$ below one (abate the outbreak) even without other response measures. Assuming total compliance, the minimum required effectiveness for medical countermeasures to accomplish this objective is driven solely by the $\boldsymbol{R_0}$ value associated with the disease of interest, and can be calculated as:

[95] Known examples are influenza (1 day before), yellow fever (1 day before), varicella (2 days before), measles (4 days before the rash), and COVID-19 (2 days before).

[96] Effectiveness is different from "efficacy," which refers to the results of laboratory or clinical studies.

$$Effectiveness > 1 - \frac{1}{R_0}$$

- The higher the value of R_0, the higher the minimum effectiveness of a medical countermeasure must be in preventing infection. This relationship can be observed in Figure 35, which shows the minimum vaccine effectiveness requirements for four diseases of interest. Three of the diseases shown (plague, influenza, and SARS) have estimated R_0 values that are very similar, here assumed to range from 1.32 to 1.54. Smallpox, on the other hand, has a much higher estimated R_0 value, here assumed to be 5. As can be seen, to cause R to fall below 1, a smallpox vaccine would need to be 80 percent effective, while vaccines for the other diseases would need to be between 25 percent and 35 percent effective.[97]

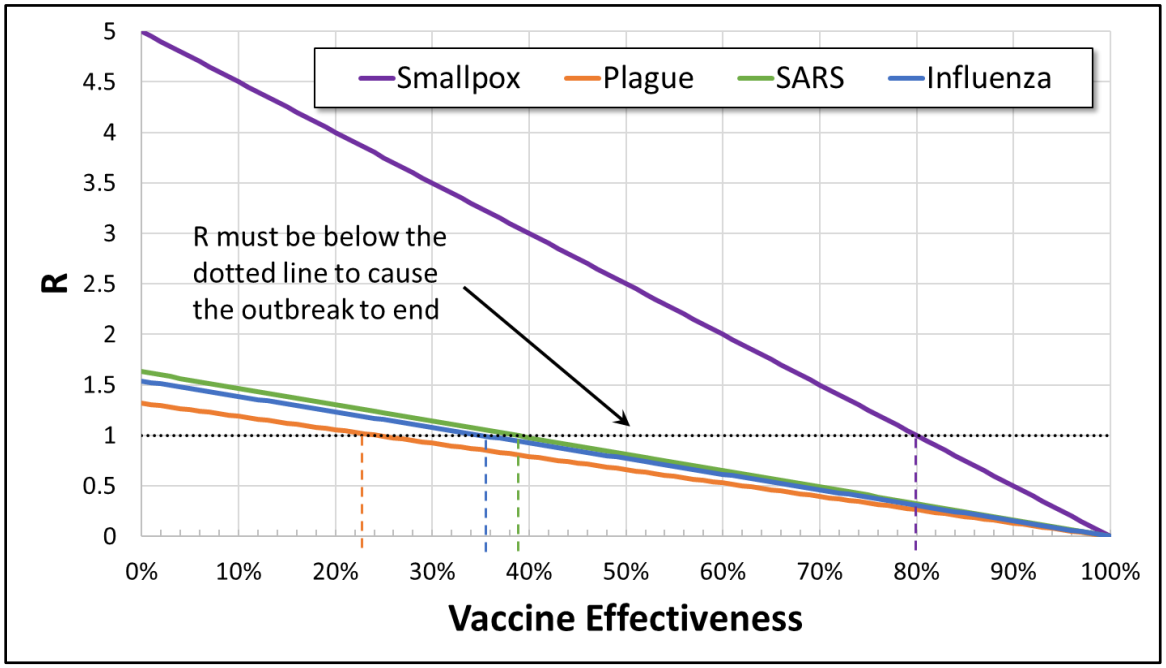

Figure 35. Calculated Minimum Vaccine Effectiveness (Without Other Response Measures)

4-112. If compliance with medical countermeasures is less than 100 percent, a fraction of the population will continue to be vulnerable to infection. The presence of vulnerable individuals in a population must be offset by increases in vaccine effectiveness. Depending on the value of R_0 and compliance rate, even countermeasures with 100 percent effectiveness can fail to control outbreaks.

- While vaccine compliance can be mandated within a military population in advance of an operation, there may be instances where personnel may not be vaccinated or administered antibiotics/anti-viral drugs until a disease threat has materialized. This is likely to be the case for rare or emerging diseases or covert BW attacks. In such cases, compliance is affected by the time to administration, which in turn depends on factors such as strategies for procurement, stockpiling, and distribution; the number of doses required; and the time needed to generate the desired physiological response after administration. These factors, in turn, determine the speed with which medical countermeasures will impact an outbreak, and the number of cases that will occur in the meantime.

4-113. **Isolation** is the separation of contagious individuals from a healthy population. Depending on the ease of transmission and the severity of disease, procedures for isolation in a military setting can range from

[97] Julia K. Burr et al., Controlling the Spread of Contagious Disease in an Operational Environment, IDA Paper P-10877 (Alexandria, VA: IDA, February 2020), 15-16, accessible at https://search.dtic.mil/ under "AD1099456."

confinement to quarters, to retention in a hospital isolation ward, to treatment within a high-level containment care facility.

- Isolation of contagious patients is a routine medical practice, in combination with infection control practices—collectively referred to as standard precautions—that include: "hand hygiene; use of gloves, gown, mask, eye protection, or face shield, depending on the anticipated exposure; and safe injection practices."[98]
- For most contagious diseases, standard precautions and isolation are sufficient to limit the spread of disease and avoid outbreaks. However, there are diseases and operational circumstances that create numerous challenges to effective isolation of contagious individuals. In such circumstances, although isolation will continue to contribute to outbreak response efforts, other enhancements should be added. Enhancement should include ensuring that medical treatment facilities have equipment and personnel capable of implementing transmission-based precautions.[99]

4-114. The effectiveness of isolation as an outbreak response measure is a function of two parameters: 1) the fraction of the contagious population that will be isolated, and 2) the delay from the appearance of symptoms in an individual to the isolation of that individual.

- Assuming that all contagious individuals will be isolated, the effectiveness of isolation is solely dependent on how quickly contagious individuals are isolated following the onset of their symptoms. Figure 36 illustrates the maximum time that isolation can be delayed and still be an effective response measure for four diseases: smallpox, plague, SARS, and influenza.[100] In Figure 36, *Days Following Exposure* on the horizontal axis refers to the time since an individual has been infected. On the vertical axis, *Number of People Infected* shows the average cumulative number of infections caused by each infected individual, assuming that contagiousness is constant through the duration of the contagious period. For each disease, the shape of the corresponding curve is determined by the mean values of the durations of each stage of illness as well as $\boldsymbol{R_0}$. For example, the smallpox curve shows that individuals are not contagious for a lengthy period following exposure. Smallpox has a mean incubation period of 11.6 days and is not contagious until an average of 3 days after the onset of symptoms. Once smallpox cases do become contagious, they infect 5 additional individuals on average over the next 14 days, at which point they cease being contagious.
- A set of horizontal bars is shown in the lower half of the figure. The segments within the bars represent the mean duration of different stages of illness. The gray segment shows the mean duration of time before the onset of either symptoms or the period of contagion, whichever comes first. The yellow segment shows the mean duration of a symptomatic but noncontagious period, if such a period exists for that disease. The red segment shows the mean duration of the contagious period. Below each bar, the letters *S* and *C* show the mean time at which individuals become symptomatic and contagious. The time window in which isolation must be implemented is shown as the black arrow within each bar, with the duration provided above the arrow. In other words, the black arrows show the values that will result in an effective isolation response for each disease—assuming that all contagious individuals are isolated.

98 Jane D. Siegel et al., *2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings (Updated)* (Atlanta, GA: CDC, October 2017), 66. https://www.cdc.gov/infectioncontrol/pdf/guidelines/isolation-guidelines-H.pdf.

99 See Blue Book, Appendix H for details and guidance.

100 Julia K. Burr et al., Controlling the Spread of Contagious Disease in an Operational Environment, IDA Paper P-10877 (Alexandria, VA: IDA, February 2020), 24-25, accessible at https://search.dtic.mil/ under "AD1099456.".

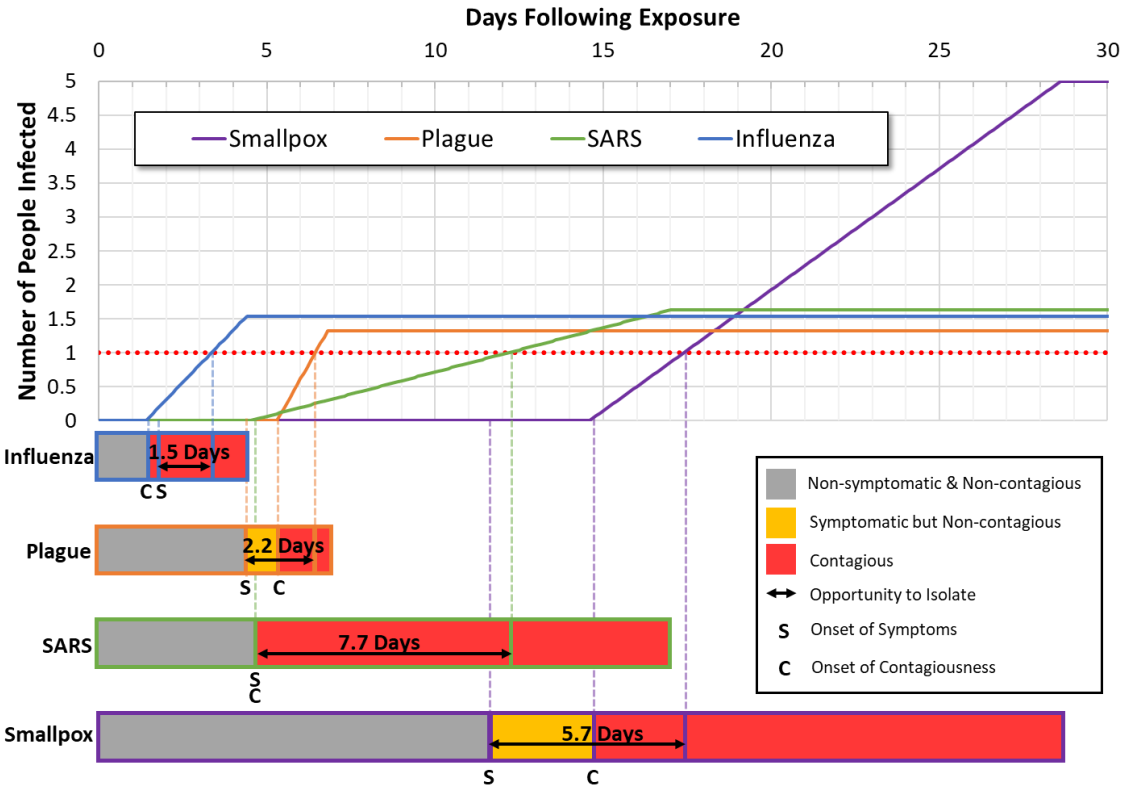

Figure 36. Time Window for Isolation for Various Diseases of Interest

- Although isolation of contagious individuals is standard medical practice, some of those individuals might be missed. In large-scale disease outbreaks, deployed medical units may have insufficient isolation space, limiting the number of people who can be promptly or effectively isolated. In these circumstances, isolation must occur more quickly than the example times in Figure 36, to offset individuals who are not isolated and who consequently infect others without limitation.
- Some diseases, like COVID-19, present numerous challenges to successful isolation of contagious individuals: 1) early symptoms can be very mild and non-specific, delaying recognition of illness and allowing individuals to continue activities that bring them into contact with others; 2) the disease may be contagious prior to symptom onset, so that a significant portion of transmission cannot be avoided in a regime where isolation is triggered by symptom onset; and 3) a significant fraction of infections may be asymptomatic yet still contagious to some extent. Figure 37 shows the consequences of these challenges for COVID-19.

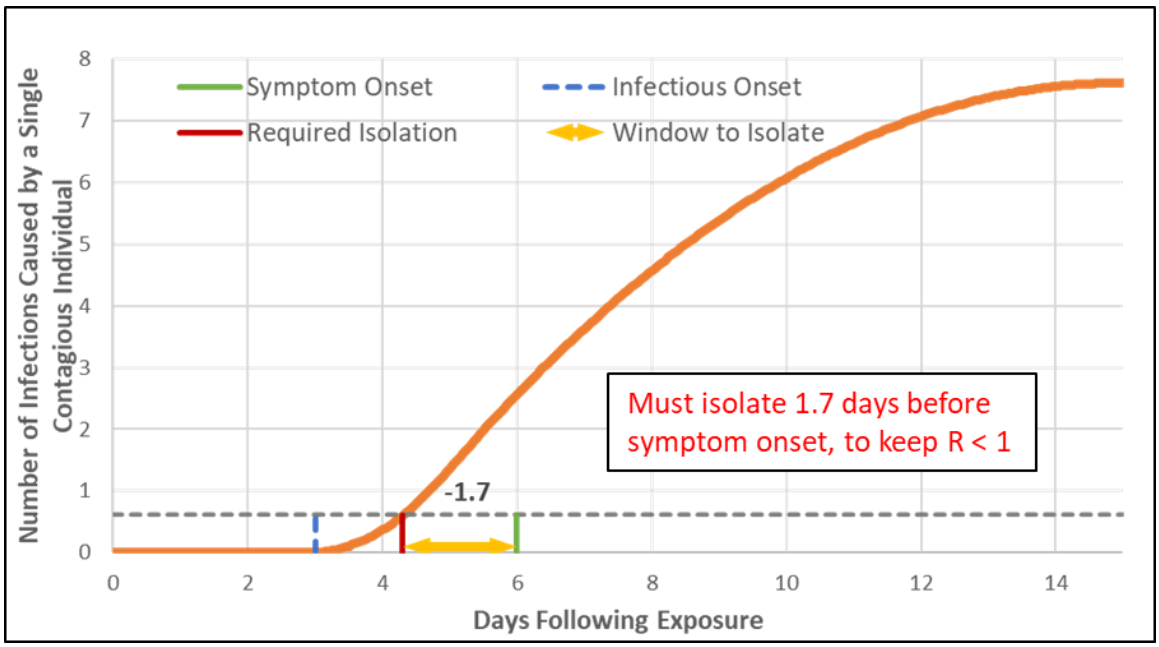

Figure 37. Mean Time Window for Isolation of an Individual with COVID-19, Assuming Asymptomatic Transmission is Uncontrolled[101]

- The negative time window for isolation of COVID-19 cases relative to mean symptom onset is driven by the combination of a high R_0 value (in this figure, assumed to be 5.9), pre-symptomatic transmission, and peak contagiousness prior to onset of symptoms. Moreover, the requirement for isolation shown here applies only to symptomatic cases. Since isolation is typically triggered by symptom onset, asymptomatic cases will not be isolated and will continue to transmit disease.
- When asymptomatic cases contribute to disease transmission, the number of people infected by symptomatic individuals must fall below one, to compensate. Thus the inability to isolate the entirety of the contagious population will increase the urgency of isolation for that portion that can be captured (i.e., those who will become symptomatic). This is similar to the issue with vaccines: reduced rates of compliance increase the degree of vaccine effectiveness among those who have been vaccinated.

4-115. Creating figures like Figure 35, Figure 36, and Figure 37 for a particular disease or outbreak of interest may be a useful way to communicate key disease characteristics to other staff elements or the commander.

4-116. Subject to availability, and depending on the disease, **diagnostic testing** can be used as an alternative mechanism for triggering isolation. Used in this way, testing can complement isolation triggered by symptom onset by identifying asymptomatic infections, and therefore increasing the fraction of contagious individuals who are isolated. It can also promote earlier recognition of disease cases, reducing the delay in isolation.

4-117. **Quarantine** is the segregation of healthy but potentially exposed individuals from the remainder of the healthy population until it can be determined that the segregated individuals are free of infection. The purpose of quarantine is to eliminate the possibility that contagious individuals will spread disease between the onset of their contagious period and the time at which they are isolated. The necessary duration of quarantine is typically determined by the upper bounds of the incubation period of the disease.

4-118. Quarantine can be implemented in any number of ways in an operational setting, including quarantine of individuals in place within their unit, confinement within a dedicated quarantine facility, and quarantine of an entire unit in rear or permissive areas. These three options differ significantly in terms of operational cost of

[101] Julia K. Burr et al., *Implementing COVID-19 Outbreak Control Measures: Disease-specific Requirements*, IDA Paper P-22725 (Alexandria, VA: IDA, October 2021), 13, accessible at https://search.dtic.mil/ under "AD1163146."

implementation. Selection of any one will depend on the imperatives of the disease in question and the tolerance that operational commanders will have for absorbing the costs of quarantine in any given operation.

- Quarantine in place is the most desirable option for managing an outbreak with minimal disruption to operations. However, for diseases with very short windows of opportunity for isolation, or for diseases with severe consequences for delayed medical treatment, quarantine in place may not be feasible.
- When quarantine in place is not feasible, individuals at risk of developing disease could be removed from their units and placed in dedicated quarantine facilities at locations proximate to isolation facilities.
- In some cases, units will experience sufficiently high disease casualty rates that they are no longer mission capable. In these cases, units could be moved offline and quarantined in rear or permissive areas.

4-119. Quarantine augments isolation in a number of ways. First, individuals in quarantine will already be separated from the susceptible population when they become symptomatic, so there is no transmission caused by delays in isolation. Second, if quarantine is implemented promptly, and individuals are quarantined before the end of the latent period, pre-symptomatic transmission will also be restricted. Finally, quarantine is likely to capture some fraction of asymptomatic cases, and prevent them from contributing to onward transmission.

4-120. As a contributor to the reduction of ***R***, quarantine will be effective when it captures a sufficient number of contagious individuals during their latent period, such that the associated reduction in disease transmission compensates for any limitations of isolation alone.

- Unlike isolation, which only encompasses symptomatic individuals or those who test positive for disease, quarantine affects healthy individuals who have some identified chance of being infected. Determining the subset of the population that has been exposed is inherently difficult, particularly in military populations with very high movement rates. In addition, those who *will* become ill are a subset of those who *might* become ill, and that differentiation is impossible to determine a priori with current technology. Therefore, to be effective, quarantine must encompass a number of individuals who will never become ill.
- If a very high percentage of individuals incubating disease must be quarantined to stop an outbreak, the prospective cost of missing even small numbers of such individuals is also very high. To ensure that quarantine captures sufficient numbers of individuals who will become ill, it would have to be broadly implemented and encompass nearly everyone within the exposed population. The number of unnecessarily quarantined individuals per incubating individual would be commensurately large. The inverse is true when the required percentage of individuals who must be quarantined is low.
- Disease mode of transmission and infectivity drive the fraction of incubating individuals who must be quarantined to reduce ***R*** sufficiently. Highly infectious respiratory diseases, such as measles, that spread through aerosolized droplet nuclei and particulates and are persistent in the environment can potentially expose very large numbers of people. Other diseases, such as Ebola, spread through direct physical contact with skin or bodily fluids and generally cause much smaller numbers of potential exposures.

4-121. One major question is how to implement quarantine in time to realize its potential benefit. Contact tracing is labor-intensive and can be time-consuming; even assuming that contacts would be quarantined immediately upon identification of an index case, in practical terms this process would take several days if done on an individual basis, and can quickly be overwhelmed in a large outbreak.

- As an alternative to contact tracing, medical staff can consider whether or not potentially exposed individuals can be broadly grouped based on the risk of acquiring disease from an index case; if so, quarantine strategies could be adopted that rely on some simple rules for identifying individuals likely to have been exposed.
- Stratification of military populations by risk of exposure for purposes of quarantine can begin at the level of small tactical units, where sleeping space, meals, and activities are most likely shared. The specific risk factors for disease transmission vary by disease and type of operation.

4-122. **Restriction of Movement (ROM) to Protect Disease-Free Units or Communities**. Commanders may wish to restrict contact between units or personnel that have not yet been affected by an outbreak and those that may have been affected, within or between contiguous AOs. The objective of such ROM is not necessarily to reduce the value of *R* but to prevent or delay the spread of disease to a particular population or unit to preserve

immediate mission capability, prevent international spread of disease, and/or protect home nations. For example, ROM may be a viable option when critical military objectives must be accomplished in the immediate future by specific units, when other control measures are unavailable or ineffective, or when a stopgap measure is needed until other control measures can be brought to bear.

4-123. The likelihood that a unit can remain disease-free for some period of interest is a function of the number of individuals who move into that population and the likelihood that those individuals will be incubating disease. These factors in turn are determined by $\boldsymbol{R_0}$ and the duration of the contagious period associated with the specific disease of interest. This relationship can be used to determine the maximum daily movement of individuals that can be allowed before the probability of an asymptomatic or pre-symptomatic individual entering the disease-free population exceeds some threshold risk level.

4-124. Figure 38 illustrates this concept for four diseases with varying contagious periods and $\boldsymbol{R_0}$ values. The figure shows the maximum number of individuals who can move daily from a population with some identified percentage of disease cases into a population without any disease cases, before a greater than 50 percent probability exists that an incubating case of disease moves into the disease-free unit within the time period of interest. In Figure 38, the curves represent time periods for keeping the unit disease-free for 3 days (red line), 5 days (blue line), or 7 days (green line).

- For example, if a commander wanted to ensure at least a 50 percent chance of a particular unit remaining SARS-free for the next 3 days, then he or she may decide to implement a policy restricting the movement of individuals from a population with 2 percent of the population symptomatic with SARS to no more than 24 individuals per day.

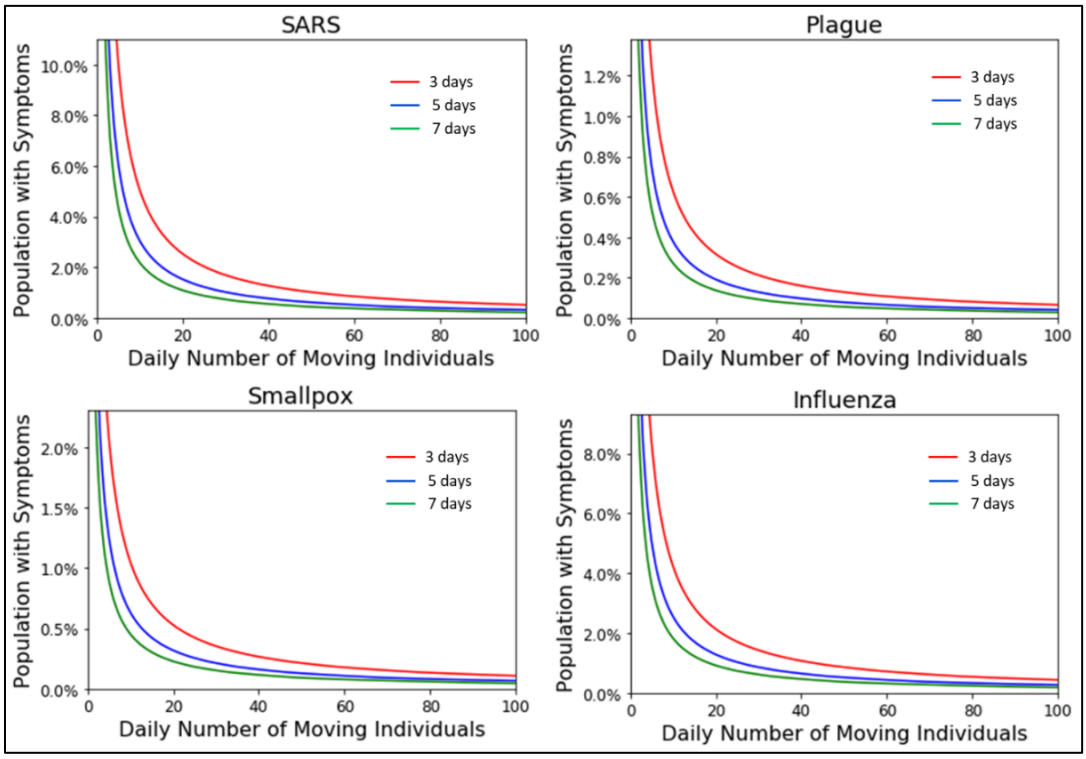

Figure 38. Maximum Movement of Personnel Allowed to Keep a Unit Disease-Free for a Period of Interest

- The shape of the curves in Figure 38 is similar across all four diseases, but the values shown on the y-axis are very different. As shown in the figure, the likelihood that even very small numbers of moving individuals will spread plague reaches 50 percent at extremely low rates of disease. For this disease, keeping a unit disease-free may be possible only if movement of personnel into that unit is almost

completely prohibited. Results for smallpox are very similar. For influenza and SARs, on the other hand, greater numbers of moving individuals can be allowed.

b. Disease Characteristics that Challenge Response Effectiveness

4-125. When implementing outbreak response measures, decision-makers need to understand the challenges associated with specific disease characteristics and how they influence the effectiveness of response. For the most part, these characteristics are static inputs and cannot be readily changed or manipulated. They provide the backdrop against which response measures are implemented and define the space where decisions and risk calculations can be made.

4-126. **Route of transmission and transmissibility**. Route of transmission is the mechanism by which a disease spreads from one person to another. Transmissibility is the ease with which a pathogen causes infection in the susceptible population. In combination, these two characteristics determine the value of $\boldsymbol{R_0}$. The higher the value of $\boldsymbol{R_0}$, the greater the challenge of forcing $\boldsymbol{R}$ below one, and the more demanding it will be to plan and execute an effective outbreak response.

- These disease characteristics influence the window of opportunity for isolation. To cause $\boldsymbol{R}$ to fall below one, individuals need to be isolated as soon as possible but no later than the point in time at which they, on average, infect one additional person. The mean rate at which contagious individuals infect others is determined by $\boldsymbol{R_0}$ and the duration of the contagious period. Diseases with high $\boldsymbol{R_0}$ values and short contagious periods will have shorter windows of opportunity for isolation than those with lower $\boldsymbol{R_0}$ values and longer contagious periods.
- Route of transmission and transmissibility determine the biological safety measures—personnel protective equipment (PPE), procedures for limiting staff/patient interactions, sanitation, waste management, and so forth—needed to successfully isolate contagious individuals. These factors also determine the disease-specific public health measures, such as social distancing, that might contribute to outbreak containment.

4-127. **Incubation period and latent period**.

- In the absence of a testing component of response, individuals who are incubating disease cannot be distinguished, prior to the onset of symptoms, from others who may have been exposed but are not incubating disease. In most circumstances, incubation period determines the earliest point at which an individual can be placed in isolation. The window of opportunity for isolation is shortened when the latent period is shorter than the incubation period and is extended when the latent period is longer than the incubation period—in both cases by an amount of time equal to the difference between these two time periods.
- These two periods, in combination, also influence the window of opportunity for quarantine. To be effective, quarantine must be executed before exposed individuals become contagious. As with isolation, the quarantine window is shortened when the latent period is shorter than the incubation period and is extended when the latent period is longer.
- The incubation period of a disease further determines how long those who are suspected of exposure must remain in quarantine before they either become ill or are confirmed to be disease-free. To the extent that individuals in quarantine cannot continue to perform their military tasks, the longer the incubation period of a disease, the greater the operational cost of quarantine.
- Incubation and latent period also heavily influence the window of opportunity for the use of MedCMs.

4-128. **Specificity of symptoms**. Many contagious diseases are non-specific in their early stages. They may initially present with flu-like symptoms, such as fever, headache, myalgia, and general malaise, and be difficult to differentiate in a clinical setting from common viral infections until the disease progresses to more severe and more identifiable symptoms.

- Diseases that begin with non-specific symptoms can inhibit outbreak response by confounding the development of situational awareness and sowing confusion and delay, particularly in the early stages of

an outbreak. Clinicians may not suspect that a highly contagious infectious disease is the causative agent of an illness until several cases have occurred and progressed to more clinically recognizable stages.

- When contagious individuals cannot be readily identified, delays in getting them to isolation will occur, and a substantial fraction of individuals may not be isolated within the required window of time, if they are isolated at all.
- The longer it takes to identify contagious individuals, the more contacts they can have within the susceptible population, complicating efforts to determine who should be quarantined.

4-129. Table 28 summarizes the previous discussion. If a disease characteristic impacts the values a parameter must take for an effective response, as discussed in earlier parts of this section, it is represented by a plus mark.

Table 28. Disease Characteristics that Challenge Response Effectiveness

Response Measure	Key Parameters	R_0	Incubation & Latent Periods	Specificity of Symptoms
MedCMs	Time to Implement		+	
	Efficacy	+		
Isolation	Delay in Reaching Isolation	+	+	
	Percent of Ill Who are Isolated	+		+
Quarantine	Probability of Incubating Individual Being Quarantined	+	+	+
	Operational Impact of Quarantine	+	+	+
Restriction of Movement	Probability that a Unit will Remain Free of Disease	+	+	

c. Operating Environment Challenges to Effective Outbreak Response

4-130. The spread of disease within a deployed military population and the ease with which measures can be implemented to effectively stop that spread are influenced by a number of characteristics of the OE. These characteristics will vary by operation, and, hence, the feasibility of implementing specific response measures in a manner that meets disease-specific requirements will also vary with operational factors.

4-131. **Rate and homogeneity of mixing**. In modern operations, military personnel are highly mobile and interact with many other force elements. The more that individuals move between units or locations, the faster and further a contagious disease can spread. As disease spreads and the population at risk grows, the scope of outbreak response measures must also expand, encompassing an ever-larger portion of the force.

- Within a deployed force, some personnel and units may move with significantly more frequency than others. Personnel from maintenance and supply units, for example, may move throughout an operating area and mix with other units more frequently than, say, those from a command element. Restricting the movement of such personnel or limiting direct person-to-person contact during necessary movement may be an effective component of outbreak response, but may also be operationally costly.
- In other types of operations, personnel movements may be more uniform. When mixing is truly homogeneous, each susceptible member of the population is equally likely to have contact with someone who is contagious. In these circumstances, no identifiable set of individuals is more likely to spread disease than others, making it more difficult to use ROM as an effective response.
    - When contact rates among individuals are not obviously stratified, it will be more difficult to identify those individuals who are likely to have contacted someone who is contagious, and by extension it will be more difficult to implement quarantine effectively.

  - Disease outbreaks in homogeneously mixed populations are likely to be larger and spread more quickly.[102] This situation means that the requirements for outbreak response may be greater and more urgent.

- In some operations, the military population at risk may routinely engage with outside populations, such as host nation civilians, Allied military personnel, or out-of-theater reinforcements. These other populations may serve as ongoing sources of contagion, thus limiting the effectiveness of any response measures as long as contact with these populations continues. However, in an ongoing outbreak of highly contagious disease, these populations would likely be subject to their own outbreak response measures. Decision makers need to understand the nature and adequacy of such measures when determining whether contact between these populations and the deployed military population should be restricted.

4-132. **Infrastructure within the area of operations**. Operational implementation of outbreak response measures will require some level of personnel movement and logistics support. In some operational environments, national infrastructure promotes rapid movement of personnel and resources. Elsewhere, transportation and communications networks may be less developed or may be degraded by ongoing conflict or natural disasters.

- The effectiveness of isolation and medical countermeasures implemented during an outbreak depends highly on time—the time it takes to disseminate medical countermeasures throughout the deployed force and the time it takes to deliver a symptomatic individual to isolation. Decision makers must account for any limitations in infrastructure that may impede the implementation of these measures within the required timelines.

- The time window for isolation, by contrast, is very short for some diseases. Given that forward medical treatment facilities most likely cannot effectively isolate highly contagious disease cases, there may be a limited number of destination facilities for these casualties, and these may be located far from the outbreak. Getting contagious individuals to these facilities in a timely manner may be challenging, particularly in areas where the transportation network is degraded.

- Damaged or undeveloped infrastructure may limit overall movement among the military population and restrain contact between contagious individuals and the susceptible population. These restraints can dampen the outbreak and make outbreak response somewhat less demanding. Ordinarily, restraints on movement would make identification of potentially exposed individuals easier. In turn, this would promote the effectiveness of quarantine and reduce its cost. However, the inverse is also true when those restraints are driven by poor infrastructure, because it inhibits outbreak investigation and the epidemiological work done to support contact tracing.

4-133. **Permissiveness of the operational environment**. The permissiveness of the OE influences freedom of maneuver within the AO. For outbreak response, an environment unrestrained by adversary action will make responses easier to implement. In operations where military forces are engaged in active combat or are acting as a barrier between other forces in conflict, the following operational restraints on movement may be similar to the physical restraints associated with degraded infrastructure:

- The dissemination of medical countermeasures and movement of individuals to isolation could be difficult or significantly delayed in an active combat environment.

- Isolation and treatment of complex contagious disease casualties may prove challenging if deployed medical treatment facilities are at or near capacity due to trauma casualties.

- Those isolation and quarantine facilities that do exist will likely be sited far from front lines for reasons of safety and security, thus increasing the distance that individuals must travel to reach those facilities. Combat itself can degrade infrastructure and exacerbate the challenges to effective response posed by the difficulty of moving personnel and materiel.

[102] Julia K. Burr et al., *The Application of Contagious Disease Epidemiological Models to Known Population Structure and Movement*, IDA Document D-5225 (Alexandria, VA: IDA, March 2016), 25, accessible at https://search.dtic.mil/ under "AD1014089."

- In some OEs, forward units may be isolated for a defined period of time, limiting the possibility that an outbreak of contagious disease will reach them. At the same time, organic medical capabilities in those units may be limited. Clinical diagnosis of disease cases may be unlikely, particularly in the early stages of an outbreak when situational awareness is low and/or when the early stages of disease are non-specific. Such circumstances could lead to fewer contagious disease cases being isolated within the required time.
- Quarantine will be much more difficult and potentially costly in a non-permissive environment. Contact tracing or other strategies to differentiate likely exposures from possible exposures may not be possible if the targeted individuals are in forward-deployed units. Forces engaged in active combat may not be able to self-monitor their health to support forward quarantine strategies.

4-134. **Sophistication of the adversary**. For operations against peer and near-peer adversaries, the challenges associated with non-permissive environments would be exacerbated. The movements required for effective implementation of medical response may be even more difficult, particularly in forward areas where tactical air superiority cannot be guaranteed. This situation may force reliance on ground transportation to move individuals into isolation or quarantine or to supply forward units with medical countermeasures.

- More sophisticated adversaries will also have greater capability to mount complex biological attacks and create outbreaks of contagious disease that are more difficult to stop. These attacks could generate larger numbers of casualties, begin in multiple locations, or involve pathogens that have been engineered to be resistant to medical countermeasures. Health risk assessments and medical intelligence in the OA support medical planners in anticipating such attacks, preparing for their consequences, and identifying them quickly should they occur.
- Sophisticated adversaries may also conduct mis-/disinformation campaigns that degrade the outbreak response effectiveness through poor compliance, or degrade communications, which would have myriad negative impacts on outbreak response.

4-135. **Scale of the operation**. The scale of military operations determines the size of the population at risk, the geographic size of the OA, the duration of the mission and associated reliance on resupply and rotation of personnel, and the strategic value of mission objectives.

- In general, the larger and more complex the structure of the population at risk (PAR) and movements between individual units and locations, the longer it takes for outbreaks to spread throughout the area of operations. This situation provides opportunities for restrictions of movement to be used as a short-term measure to protect specific units or locations in support of near-term operational objectives. At the same time, large ports of entry and centralized staging areas may promote the spread of disease if contagious individuals are present in those locations and infect large numbers of people who subsequently move to other areas.
- In larger operations, the distances across which individuals and material must be moved may be substantially increased, affecting the time it takes for medical countermeasures to reach the susceptible population and for contagious individuals to reach isolation.
- On the positive side, large-scale operations may deploy with a larger and more sophisticated medical footprint, including multiple hospitals and laboratory facilities. Such a capability will provide in-theater diagnostics and laboratory support for situational awareness and greater organic capacity for isolation and care of contagious patients.

4-136. Table 29 summarizes the OE characteristics that can challenge implementation of outbreak response, or make achievement of response requirements more difficult. Based on the previous discussion, when an OE characteristic has the potential to make achievement of response parameters more difficult, it is represented by a plus mark. Occasionally, as discussed, OE characteristics may have a positive influence on the effectiveness of response. These cases are represented by circles.

Table 29. Operational Environment Characteristics that Impact Effective Outbreak Response

Response Measure	Key Parameters	High Rates of Mixing	Poor Infrastructure in Area of Operations	Non-permissive Environment	Sophisticated Adversary	Large-scale Operation
MedCMs	Time to Implement		+	+	+	+
	Efficacy				+	
Isolation	Delay in Reaching Isolation		+	+	+	+
	Percent of Ill Who are Isolated			+	+	○
Quarantine	Probability of Incubating Individual Being Quarantined	+	+	+		+
	Operational Impact of Quarantine	+	+	+		+
Restriction of Movement	Probability that a Unit will Remain Free of Disease	+		○		○

4. Disease Screening and Surveillance Support to Situational Awareness

4-137. Disease surveillance and disease screening complement medical diagnosis in the production of SA. Disease screening is the active search for disease among apparently healthy individuals, for example for human immunodeficiency virus (HIV) before deployment. Screening can be done in many ways, such as laboratory diagnostics, questionnaires, or temperature checks. Disease surveillance is a systematic and post-hoc process of monitoring for disease in a population, for example by analyzing trends in weekly influenza-like illness or diarrheal illness.

4-138. The importance of situational awareness as an enabler of successful outbreak response cannot be overemphasized. Implementation of any response capability after the start of an outbreak—in other words, any response other than pre-exposure prophylaxis—requires knowledge that an outbreak is underway. Because the opportunity to blunt an outbreak curve is highest when it begins and decreases over time, situational awareness is critical for initiating timely and effective actions.

4-139. Yet at many key milestones in disease progression, the requisite knowledge can be difficult or even impossible to acquire. For example, during normal operations, diseases are likely to jump from one unit to another before any individuals become symptomatic. While outbreak response can still be effective if implemented after this jump occurs, they must be implemented at a point where there were very few symptomatic cases to trigger such a response. Moreover, these individuals must be differentiated from the background of ordinary infectious disease and identified as the precursors of a larger disease outbreak with significant operational risk. For novel pathogens with non-specific symptoms, in particular, this is an incredibly challenging problem for situational awareness.

4-140. An example of the challenges involved is shown in Figure 39.[103] Figure 39 shows the last day on which various candidate response options must be implemented to avoid exceeding 20 percent casualties among an assumed PAR of 2,800 in an outbreak of disease starting with ten initial infections—representing a small-scale biological attack—for four contagious diseases of interest. In Figure 39, only those options that can prevent

[103] Julia K. Burr et al., *Emerging Infectious Diseases Study*, IDA Paper P-5302 (Alexandria, VA: IDA, August 2016), 121, accessible at https://search.dtic.mil/ under "AD1165599."

combat ineffectiveness are shown in color; if an option could not be effectively used regardless of time of implementation, it is listed in gray text. Note that the larger the number of initial infections, the shorter the timelines for effective response.

4-141. The key disease characteristics that drive these results are latent and contagious periods. For those diseases capable of causing large-scale outbreaks from a single infection, wide-spread post-exposure prophylaxis is the only effective option if the disease also has short latent and contagious periods. For smallpox—even with its much higher R_0—and SARS, where both latent and contagious periods are substantially longer, a broader range of responses can be effective.

4-142. The goal of disease screening and surveillance in the context of an outbreak of operational significance is to acquire the information needed to enable timely medical and operational decision-making to protect the force and the mission. The medical staff must act as the filter that: (1) ensures disease screening and surveillance will provide timely and useful information, and (2) interprets disease screening and surveillance information and advises the commander accordingly.

4-143. Table 8 (in Chapter 3) provides several sources that collect, assess, and report disease surveillance information. While useful for monitoring ongoing outbreaks in proximate populations, and understanding existing health risks within the population, these sources are unlikely to provide the information needed to rapidly detect and respond to outbreaks within the required timeframe.

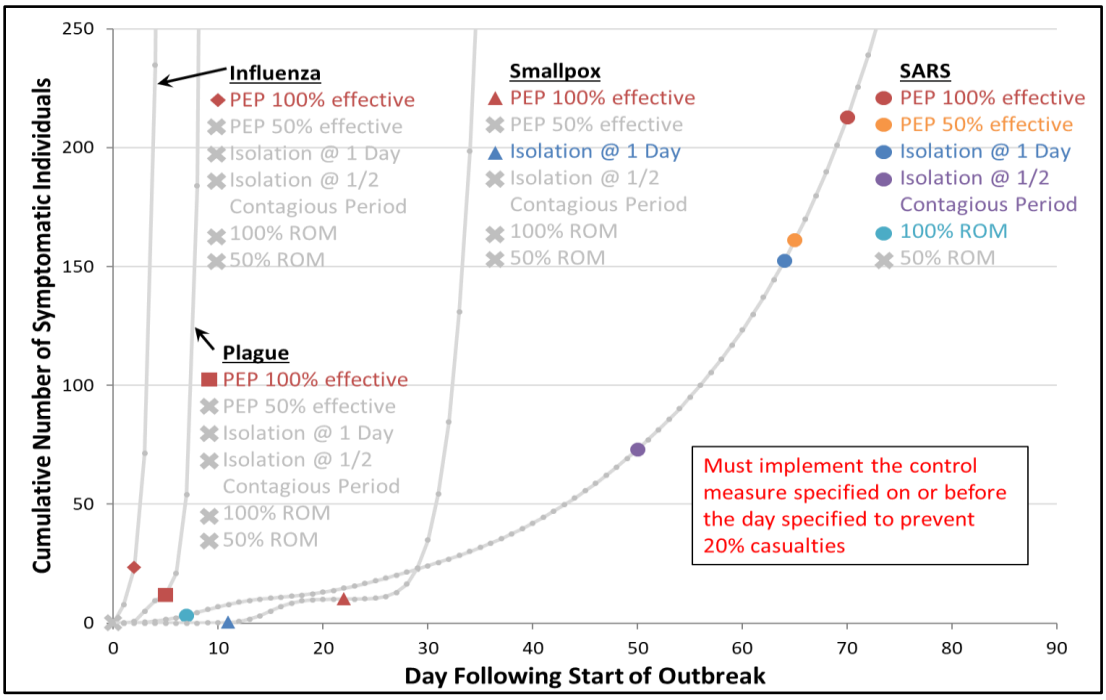

Figure 39. Latest Day on Which Response Must Be Implemented to Avoid 20 Percent Casualties in a PAR of 2,800 Over 90 Days: 10 Initial Infections

4-144. Accordingly, decision makers at all levels must emphasize the need for regular, consistent, and complete case reporting. Routine disease reporting mechanisms, timelines, and information used for reporting disease/non-battle injuries may be insufficient for this purpose; reporting frequency may be too long and the information needed for situational awareness may not be directly transmitted to those who need it in near-real time. Staffs may need to direct alternative procedures and reporting mechanisms to ensure that they receive timely and appropriate information. Staffs should also ensure that clinical and diagnostic laboratory facilities are included in the reporting chain and that they have access to all relevant laboratory reports and findings.

4-145. The exact frequency and types of reporting required will vary based on the situation. A general question that can guide the refinement of disease reporting is "what do I need to know, to support which decision, and

when do I need to know it?" The commander's decision cycle should bear heavily on disease screening and surveillance requirements and reporting.

4-146. During a disease outbreak, medical information and medical intelligence reporting should be continually collected, evaluated, and routinely updated. Medical staffs should use pre-established reachback mechanisms for accessing subject matter expertise on the disease in question and for conducting sophisticated laboratory analysis of clinical and environmental samples as indicated. Medical staffs should also consider requesting augmentation with epidemiologists and infectious disease specialists if they are not already present.

4-147. Medical staffs should coordinate with host nation health officials and those associated with other populations at risk within the area of operations and adjacent locations. The purpose of this coordination effort is to monitor the spread of the outbreak outside the military force and to observe the effectiveness of response measures implemented within those populations.

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Appendix B. Acronyms and Glossary

Acronyms

ABCT	Armored brigade combat team
ABDS	Army Biological Defense Strategy
ADP	Army Doctrine Publication
AE	Aeromedical evacuation
Africa CDC	African Centres for Disease Control and Prevention
AFHSD	Armed Forces Health Surveillance Division
AHS	Army Health System
AMedP	Allied Medical Publication
APHC	Army Public Health Command
AR	Army Regulation
ARDS	Acute respiratory distress syndrome
ASCC	Army service component command
ATP	Army Techniques Publication
AXP	Ambulance exchange point
BIDS	Biological Integrated Detection System
BSL	Bio-safety Level
BW	Biological weapon
C2	Command and control
C3	Command, control, and communications
CALL	Center for Army Lessons Learned
CARICOM	Caribbean Public Health Agency
CASEVAC	Casualty evacuation
CBRN	Chemical, biological, radiological, and nuclear
CCMD	Combatant command
CDC	Centers for Disease Control and Prevention
CDC-CAR	Centers for Disease Control and Prevention – Central American Region
CDR	Commander
COA	Course of action
CONOPS	Concept of operations
CONUS	Continental United States
COOP	Continuity of operations
COP	Common operating picture
COSC	Combat and operational stress control

COVID-19	Coronavirus Disease 2019
DA	Department of the Army
DDIL	Denied, disrupted, intermitted, and limited
DHHS	Department of Health and Human Services
DLA	Defense Logistics Agency
DNBI	Disease and non-battle injury
DOD	Department of Defense
DODI	Department of Defense Instruction
DoS	Department of State
DRSi	Disease Reporting System internet
DTRA	Defense Threat Reduction Agency
ECDC	European Centre for Disease Prevention and Control
EEE	Eastern equine encephalitis
EEFI	Essential element of friendly information
ENG	Engineering staff or units
ESP	Estimating Supplies Program [a module of MPTk]
ESSENCE	Electronic Surveillance System for Early Notification of Community-Based Epidemics
EUCOM	European Command
FCP-P&ID	Functional Campaign Plan for Pandemics and Infectious Diseases
FHP	Force health protection
FM	Field Manual
FPCON	Force protection condition
GCC	Geographic combatant command
GEIS	Global Emerging Infections Surveillance
GMFL	Global Medical Field Laboratory [formerly 1st Area Medical Laboratory]
HBCT	Heavy brigade combat team
HPCON	Health protection condition
HN	Host nation
HNS	Host-nation support
HQDA	Headquarters, Department of the Army
HSE	Health surveillance explorer
HSS	Health service support
IANPHI	International Association of National Public Health Institutes
IHR	International health regulations
ILI	Influenza-like illness
IR	Information requirement
JAG	Judge advocate general
JBPDS	Joint Biological Point Detection System
JCS	Joint Chiefs of Staff
JMPT	Joint Medical Planning Tool

JOE	Joint Operating Environment
JOMIS	Joint Operational Medicine Information System
JP	Joint Publication
JPMRC	Joint patient movement requirements center
LAB	Laboratory staff or units
LSCO	Large-scale combat operations
MA	Mortuary affairs
MACE	Medical and Casualty Estimator
MCM	Medical countermeasure
MCRW	Medical Contingency Requirements Workflow
MDO	Multi-domain operations
MEDCoE	Medical Center of Excellence
MEDCOM	U.S. Army Medical command
MedCOP	Medical Common Operating Picture
MEDEVAC	Medical evacuation
MEDINTEL	Medical intelligence
MEDLOG	Medical logistics
METT-TC	Mission, enemy, terrain and weather, troops available, time available, and civilian considerations
MOPP	Mission oriented protective posture
MPTk	Medical Planners' Toolkit
MRO	Medical regulating officer
MTF	Medical treatment facility
NATO	North Atlantic Treaty Organization
NCMI	National Center for Medical Intelligence
NEO	Noncombatant evacuation operations
OA	Operational area
OE	Operating environment
OED	Oxford English dictionary
OIE	World Organization for Animal Health
OPH	Operational public health staff or units
OPLAN	Operations plan
OSD	Office of the Secretary of Defense
P&ID	Pandemics and infectious diseases
PAD	Patient administration division
PCR	Polymerase chain reaction
PHE	Public health emergency
PHEM	Public health emergency manager
PHEO	Public health emergency officer
PHEIC	Public health emergency of international concern

PHRT	Public health response team
POLAD	Political advisor
PPE	Personal protective equipment
ROMO	Range of military operations
SAC	Statistical Analysis Cell
SARS	Severe acute respiratory syndrome
SBCT	Stryker brigade combat team
SEB	Staphylococcal enterotoxin B
SecDef	Secretary of Defense
STANAG	Standardization agreement
SIMLM	Single integrated medical logistics manager
SWO	Staff weather officer
TLAMM	Theater lead agent for medical materiel
TPMRC	Theater patient movement requirements center
TRANSCOM	Transportation Command
TTPs	Tactics, techniques, and procedures
USAMRICD	U.S. Army Medical Research Institute of Chemical Defense
USAMRIID	U.S. Army Medical Research Institute of Infectious Diseases
USTRANSCOM	U.S. Transportation Command
VEE	Venezuelan equine encephalitis
USAID	United States Agency for International Development
USG	United States government
UV	Ultraviolet
VET	Veterinary staff or units
VHF	Viral hemorrhagic fever
WAHIS	World Animal Health Information System
WEE	Western equine encephalitis
WHO	World Health Organization

Glossary[104]

Aerosol. A system of colloidal particles dispersed in the air or in a gas, such as mist, fog, or smoke. (OED)

Biological agent. A microorganism (or a toxin derived from it) that causes disease in personnel, plants, or animals or causes the deterioration of materiel. (JP 3-11)

Biological defense. Defense against outbreaks of operational significance.

Biological hazard. An organism, or substance derived from an organism, that poses a threat to human or animal health. (JP 3-11)

Biological weapon (BW). Biological agent loaded into a munition (e.g., missile warhead, aerosol sprayer). (FCP-P&ID)

[104] See also the DOD Dictionary of Military and Associated Terms, at https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf.

Contagious period. The time during which an infected individual can transmit disease to others.

Continuity of operations (COOP). The degree or state of being continuous in the conduct of functions, tasks, or duties necessary to accomplish a military action or mission in carrying out the national military strategy. (JP 3-0)

Controlled monitoring. The process by which trained healthcare professionals or appropriately trained DOD personnel directly observe the service members and volunteering DOD civilian employees, monitoring and evaluating daily for signs and symptoms consistent with the disease of interest. (adapted from FCP-P&ID)

Course of action (COA). 1. Any sequence of activities that an individual or unit may follow. 2. A scheme developed to accomplish a mission. (JP 5-0)

Detection. 1. In tactical operations, the perception of an object of possible military interest but unconfirmed by recognition. 2. In surveillance, the determination and transmission by a surveillance system that an event has occurred. 3. In arms control, the first step in the process of ascertaining the occurrence of a violation of an arms control agreement. 4. 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)

Deployment health surveillance. The regular or repeated collection, analysis, archiving, interpretation, and distribution of health-related data used for monitoring the health of a population or of individuals, and for intervening in a timely manner to prevent, treat, or control the occurrence of disease or injury, which includes occupational and environmental health surveillance and medical surveillance subcomponents. (JP 4-02)

Disease screening. Actively searching for disease among apparently healthy individuals.

Environmental health surveillance. See "occupational and environmental health surveillance."

Epidemic. The rapid spread of infectious, or other, disease to a large number of people in a given population within a short period of time; a threshold number of cases within a specific time frame is often pre-designated by experts to trigger notification. (Blue Book)

Epidemic curve. A pattern, often presented as a histogram, depicting an outbreak of disease; useful in identifying the transmission method or source, and in predicting the future rate of infection. (Blue Book)

Essential elements of friendly information (EEFI). A critical aspect of a friendly operation that, if known by a threat would subsequently compromise, lead to failure, or limit success of the operation and therefore should be protected from enemy detection. (FM 6-0)

Emerging infectious disease. Any previously unknown or previously controlled communicable disease or variant, or a known disease appearing in new geographic locations or populations, whose incidence and prevalence are suddenly rising. (adapted from the FCP-P&ID and the CDC's Emerging Infectious Diseases journal (https://wwwnc.cdc.gov/eid/page/background-goals))

Force health protection (FHP). 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. (JP 4-02)

Army-specific: comprises preventive and treatment aspects of medical functions that include: combat and operational stress control, dental services, veterinary services, operational public health, and laboratory services. (FM 4-02)

Force protection condition (FPCON). A Chairman of the Joint Chiefs of Staff-approved standard for identification of and recommended responses to terrorist threats against United States personnel and facilities. (JP 3-26)

Fomite. Objects, such as clothing, towels, and utensils that possibly harbor a disease agent and are capable of transmitting it. (Blue Book)

Health protection condition (HPCON) level. A framework to inform an installation's population of specific health protection actions recommended in response to an identified health threat, stratified by the scope and severity of the health threat. (DODI 6200.03)

Health service support (HSS). All services performed, provided, or arranged to promote, improve, conserve, or restore the mental or physical well-being of personnel. (JP 4-02)

Army-specific: Support and services performed, provided, and arranged by the Army Medicine to promote, improve, conserve, or restore the behavioral and physical well-being of personnel by providing direct patient care that include medical treatment (organic and area support) and hospitalization, medical evacuation to include medical regulating, and medical logistics to include blood management. (FM 4-02)

Health surveillance. The continuous, systematic collection, analysis, interpretation, and dissemination of health-related data to identify potential health risks and prevent, treat,reduce, or control disease and injury, which includes occupational and environmental health surveillance and medical surveillance subcomponents. . (JP 4-02)

Immunoassay. Detection and assay of substances by serological (immunological) methods; in most applications the substance in question serves as antigen, both in antibody production and in measurement of antibody by the test substance. (Blue Book)

Incubation period. The time between exposure and the first symptoms.

Individual protective equipment (IPE). The personal clothing and equipment provided to all military, government civilians, and contractors authorized to accompany the force required to protect an individual from chemical, biological, and radiological hazards and some nuclear hazards. (JP 3-11)

Infectious disease. Disease resulting from the presence and activity of a pathogenic microbial agent. (FCP-P&ID)

Information requirement. Items of information that need to be collected and processed to facilitate timely decision making (adapted from JP 3-0 definition for "commander's critical information requirement").

Isolation. Voluntary or compulsory separation and confinement of an individual known or suspected to be infected with a contagious disease agent (whether ill or not) to prevent further infections. (Blue Book)

Latent period. The time between exposure and the onset of contagiousness.

Medical regulating. The coordination for the movement of patients to match patients with an appropriate medical treatment facility. (JP 4-02)

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. (former JP 4-02)

Noncombatant evacuation operations (NEO). An operation whereby noncombatant evacuees are evacuated from a threatened area abroad, which includes areas facing actual or potential danger from natural or manmade disaster, civil unrest, imminent or actual terrorist activities, hostilities, and similar circumstances, that is carried out with the assistance of the Department of Defense. (JP 3-68)

Non-pharmaceutical interventions (NPI). Items such as ventilators, devices, PPE (i.e., face masks and gloves), and public health interventions (e.g., contact and transmission interventions, social distancing, and community shielding) to prevent and mitigate the health effects of biological agents, some of which may be FDA-regulated and some of which are not. Non-technical measures (e .g., social distancing, isolation, quarantine, PPE) to prevent illness and death due to an outbreak. (FCP-P&ID)

Occupational and environmental health surveillance. The regular or repeated collection, analysis, archiving, interpretation, and dissemination of occupational and environmental health-related data for monitoring the health of, or potential health hazard impact on, a population and individual personnel, and for intervening in a timely manner to prevent, treat, or control the occurrence of disease or injury when determined necessary. (DODD 6490.02E)

Outbreak. An occurrence of disease greater than expected for a particular time and place; outbreaks may be epidemics, affecting a region in a country or a group of countries, or a pandemic, affecting populations globally. (Blue Book)

Outbreak of operational significance. The spread of infectious disease that could degrade readiness such that it impacts a commander's decision-making process and potentially alters a chosen course of action or plans, increases risk, and/or results in a potentially overwhelming increase in requests for U.S. military assistance.

The outbreak could occur in humans, animals, or agriculture, and could be deliberate, accidental, or natural. (adapted from multiple sources)

Pandemic. Denoting a disease affecting or attacking the population of an extensive region, country, continent; extensively epidemic. (Blue Book)

Patient movement. The act of moving a sick, injured, wounded, or other person to obtain medical and/or dental treatment. (FM 4-02)

Personal protective equipment (PPE). Equipment such as gloves, respirators, hazardous material suits, and masks, that help protect personnel, including medical personnel, from exposure to a biological agent. (adapted from FCP-P&ID; note that although there is a JP 3-11 definition, it creates confusion between PPE and IPE, rather than distinguishing)

Polymerase chain reaction (PCR). An *in vitro* molecular biology method for enzymatically synthesizing and amplifying defined sequences of DNA. Can be used for improving DNA-based diagnostic systems for identifying unknown bio-agents. (Blue Book)

Preventive medicine. The anticipation, prediction, identification, prevention, and control of communicable diseases (including vector-, food-, and waterborne diseases), illnesses, injuries, and diseases due to exposure to occupational and environmental health threats, including nonbattle injury threats, combat and operational stress reactions, and other threats to the health and readiness of military personnel and military units. (FM 4-02)

Prophylaxis. Prevention of disease or of a process that can lead to disease. (Blue Book)

Quarantine. The compulsory separation and confinement, with restriction of movement, of healthy individuals or groups who have potentially been exposed to a contagious disease agent to prevent further infections should infection occur. (Blue Book)

Restriction of movement (ROM). Restriction personnel and/or unit movement to limit contact between units or personnel that have not yet been affected by an outbreak and those that may have been affected.

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

Standard precautions. A set of uniform or comprehensive measures designed to prevent the inadvertent transmission of communicable diseases between patient and healthcare workers. They are employed during *every* patient encounter, regardless of whether or not the patient is thought to harbor an infectious disease. (Blue Book—see its Appendix H for details)

Sterilization. Process that eliminates (removes) or kills all forms of life, including transmissible agents (bacteria [including spores], viruses, fungi) present on a surface, contained in a fluid, in medication, or in a substance such as biological culture media; achieved by applying heat, chemicals, irradiation, high pressure, and/or filtration. (Blue Book)

Transmission-based precautions. Measures implemented in addition to Standard Precautions, in select circumstances, to prevent the transmission of specific disease agents known or suspected to be present in a patient; may include (1) *Contact Precautions* to preclude disease transmission via blood, body fluids, or fomites; (2) *Droplet Precautions* when transmission via macroscopic respiratory droplets is a risk, or (3) *Airborne Precautions* when microscopic (~ 3-6 micron) "droplet nuclei" provide a possible vehicle of disease transmission. (Blue Book—see its Appendix H for details)

Zoonosis. An infection or infestation shared in nature by humans and other animals that are the normal or usual host; a disease of humans acquired from an animal source. (Blue Book)

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14. ABSTRACT

This guide provides reference material and technical information to assist U.S. Army medical staffs in supporting their commander in response to an outbreak of operational significance. It is addressed to Army medical staffs at echelons ranging from battalion to Army Service Component Command. The guide discusses: 1) types of anticipated commander decisions; 2) medical staff contributions that identify, anticipate, and satisfy information requirements (IRs); 3) potential medical-related Essential Elements of Friendly Information (EEFIs); 4) medical staff actions supporting decisions, information collection, and potential changes in plans; and 5) technical and medical information to assist medical staffs with biological defense tasks.

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