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November 2021
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IDA Paper P-22724
Log: H 21-000242

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About This Publication
This work was conducted by the Institute for Defense Analyses under contract HQ0034-14-D-0001, project CA-6-4777, "Medical CBRN Defense" for the U.S. Army Office of the Surgeon General (OTSG) and the Joint Staff, Joint Requirements Office for Chemical, Biological, Radiological, and Nuclear Defense (J-8/JRO). The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or the sponsoring organization.

Acknowledgments:
The authors wish to acknowledge the technical reviews by Dr. Jon Davis, Mr. Jamie Lindly, and Mr. Doug Schultz.

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Executive Summary

This Institute for Defense Analyses paper provides a qualitative overview of the impacts of chemical, biological, radiological or nuclear (CBRN) hazards on the movement of patients of all types through the military medical system to match them with available and appropriate medical capabilities, a process known as medical regulating. We characterize the CBRN impacts on medical regulating and discuss 11 potential response options based on a review of U.S. Army, Air Force, and Joint medical and CBRN doctrine; NATO medical doctrine; coronavirus disease 2019 (COVID-19) patient movement guidance; and research reports and journal articles related to medical regulating in a CBRN environment.

The literature indicates that major combat operations in an environment with CBRN hazards will present unique challenges to medical operations. CBRN incidents can generate a large number of different types of casualties that could overwhelm medical resources. In addition, contagious or contaminated patients could pose a risk to medical personnel and other patients. Furthermore, CBRN hazards where medical units operate could degrade medical evacuation (MEDEVAC) and health service support capabilities. We summarize these medical challenges of the CBRN environment as:

1. Mass casualties,
2. Different mix of patient types,
3. Contaminated or contagious patients, and
4. CBRN hazards where medical assets operate.

Each of these medical challenges of the CBRN environment could complicate the medical regulating process. For example, patient movement demands could overwhelm MEDEVAC assets, delaying patient care and increasing morbidity and mortality. The medical challenges could collectively result in medical treatment facility (MTF) bed shortfalls, medical personnel shortfalls, or medical materiel shortfalls, which are also correlated with negative patient outcomes. Lastly, patients undergoing evacuation or treatment could be harmed by exposure to contaminated or contagious patients or CBRN hazards in the environment. We refer to these consequences of the medical challenges as the five major adverse impacts on medical regulating, which we summarize as:

1. MEDEVAC shortfalls,
2. MTF bed shortfalls,

3. MTF personnel shortfalls,
4. Medical materiel shortfalls, and
5. CBRN exposure to patients.

From the literature, we identified 27 unique ways that the four medical challenges of the CBRN environment could cause the five adverse medical regulating impacts. Using the 27 causes, we mapped the challenges to the adverse impacts, as shown in Figure ES-1. Each line in the figure lists one or more causes connecting a medical challenge on the left to an adverse medical regulating impact on the right. For instance, mass casualties could cause MEDEVAC shortfalls if patients exceed available MEDEVAC capacity. Thicker lines indicate more ways a medical challenge could affect a component of the medical regulating process, but they do not imply a greater likelihood of occurrence or a greater impact. For example, Figure ES-1 lists four possible ways for contaminated or contagious patients to cause MEDEVAC shortfalls, but this does not imply that contaminated or contagious patients are more likely to cause MEDEVAC shortfalls than mass casualties are. Some of the 27 causes could apply in any CBRN environment, whereas some are applicable only to environments with certain CBRN hazard types. For instance, causes specific to contagious patients apply only to environments with biological hazards that can cause contagious disease.

Next, we identified and then assessed: 1) concepts that are unique to medical regulating in a CBRN environment and (2) solutions to existing medical regulating challenges that apply to a CBRN environment. The 11 concepts are:

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3. Change the theater patient movement (PM) policy
    a. Shorten the theater PM policy
    b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

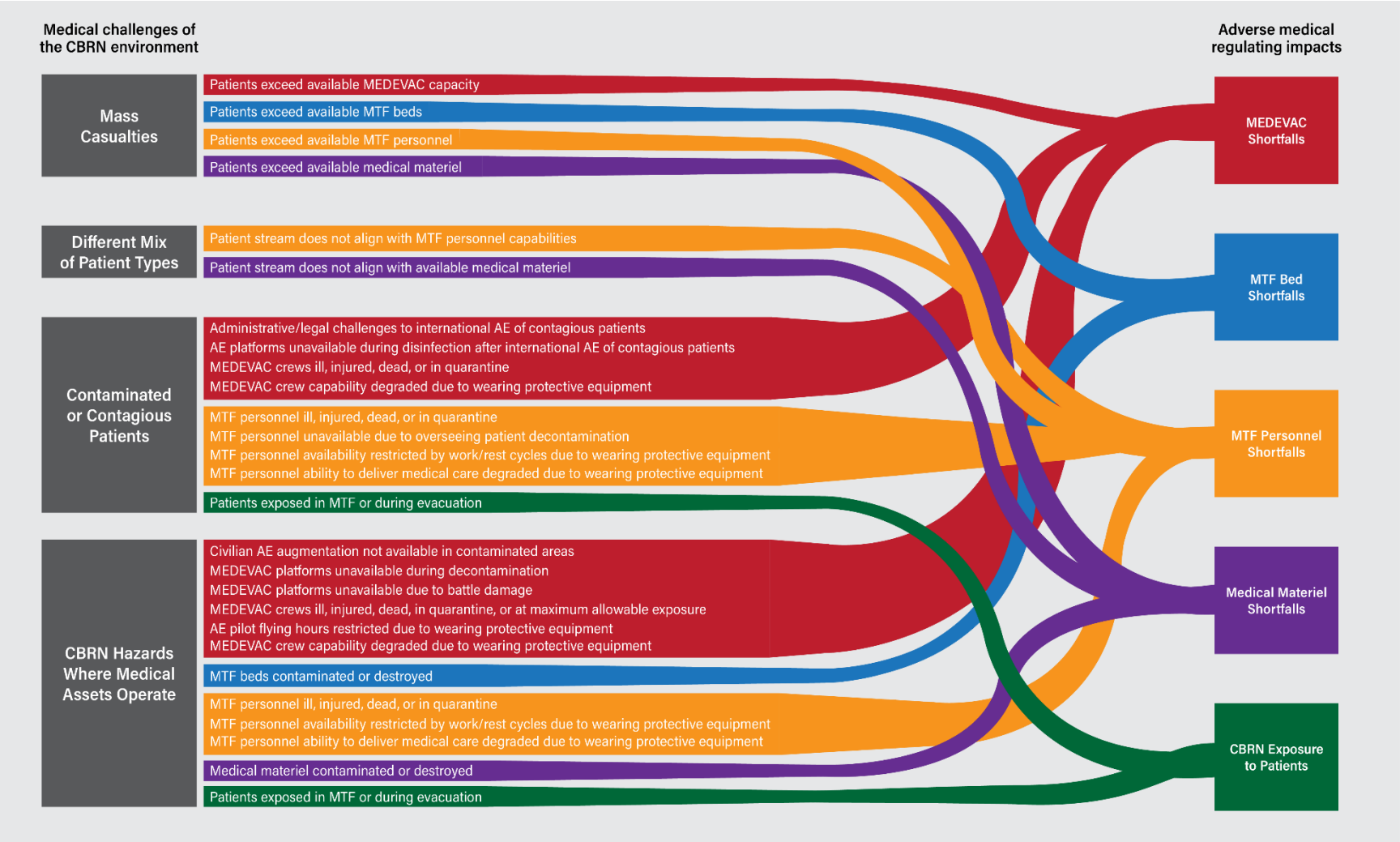

Figure ES-1. Operating in a CBRN Environment Introduces Medical Challenges that Can Adversely Impact the Components of the Medical Regulating Process

Table ES-1. Concepts to Prevent or Mitigate Adverse Medical Regulating Impacts Caused by CBRN Hazards

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Concepts to prevent (P) or mitigate (M) adverse medical regulating impacts											
		1	2	3a	3b	4	5	6	7	8	9	10	11
Mass Casualties	Patients exceed available MEDEVAC capacity				M	M	M	P					
	Patients exceed available MTF beds	M	M	M			M	P					
	Patients exceed available MTF personnel	M	M	M									
	Patients exceed available materiel materiel	M	M	M									
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	M	M	M				M					
	Patient stream does not align with available medical materiel	M	M	M									
Contaminated or Contagious Patients	Administrative/legal challenges to international AE of contagious patients				M		M	M				M	
	AE platforms unavailable during disinfection after international AE of contagious patients				M	M	M	M				P	
	MEDEVAC crews ill, injured, dead, or in quarantine				M	M	M	M				P	
	MEDEVAC crew capability degraded due to wearing protective equipment											P	
	MTF personnel ill, injured, dead, or in quarantine	M	M	M				P			P		
	MTF personnel unavailable due to overseeing patient decontamination	M	M	M									
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M									
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment												
	Patients exposed in MTF or during evacuation							P			P	P	P
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas				M	M	M	M					
	MEDEVAC platforms unavailable during decontamination				M	M	M	M	P				
	MEDEVAC platforms unavailable due to battle damage				M	M	M	M					
	MEDEVAC crews ill, injured, dead, in quarantine, or at maximum allowable exposure				M	M	M	M					
	AE pilot flying hours restricted due to wearing protective equipment				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF beds contaminated or destroyed	M	M	M			M			P			
	MTF personnel ill, injured, dead, or in quarantine	M	M	M						P			
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M						P			
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment									P			
	Medical materiel contaminated or destroyed	M	M	M						P			
	Patients exposed in MTF or during evacuation									P			

MEDEVAC shortfalls
MTF bed shortfalls
MTF personnel shortfalls
Medical materiel shortfalls
CBRN exposure to patients

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3a. Shorten the theater PM policy
3b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

For each concept, we qualitatively assessed the benefits, costs, operational constraints, and planning considerations. A concept's primary benefit in our analysis was to either prevent a medical challenge from causing an adverse medical regulating impact or mitigate the adverse impact after it occurred. Table ES-1 summarizes whether each concept can prevent ("P") or mitigate ("M") the adverse medical regulating impacts; a blank cell indicates that a concept neither prevents nor mitigates the adverse impact. The degree to which a concept prevents adverse impacts depends on the concept and the scale and effectiveness of its implementation. For example, telemedicine can prevent some unnecessary evacuations and thus help prevent MEDEVAC shortfalls, but some patients would still require MEDEVAC. Likewise, concepts vary in the level of mitigation offered. The scale of evacuation capacity augmentation, for instance, would influence its mitigating effect. Multiple concepts that address the same causes of adverse medical regulating impacts may be needed to sufficiently resolve the adverse medical regulating impacts.

We originally planned to use the Joint Medical Planning Tool (JMPT) to simulate the medical regulating process and derive some quantitative metrics of each concept's benefits and costs. However, JMPT results would be inextricably tied to the scenario, and thus not generally applicable. Further, there were limitations and challenges to modeling enough of the concepts that any results would be incomplete, and meaningful comparisons across concepts would be impossible. Although we decided that the effort to generate generally applicable quantitative results was not feasible, planners may be able to model the tradeoffs of certain concepts using JMPT to compare solutions specific to their planning scenario.

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Contents

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1. Introduction

T+ 00:00: A soldier is critically injured when his vehicle is struck and disabled. Within minutes, his unit medic provides first aid and submits a 9-line medical evacuation (MEDEVAC) request.

T+ 00:25: The soldier is evacuated by helicopter to a Role 2 medical treatment facility (MTF) with a forward resuscitative surgical detachment (FRSD). At arrival, his blood pressure is dangerously low from loss of blood. The surgical team removes his spleen and provides eight units of packed red blood cells to increase his blood pressure. MEDEVAC to the next level of care is requested.

T+ 03:00: The soldier arrives by helicopter at a Role 3 theater hospital. He is cold, acidotic (his blood is too acidic), and coagulopathic (his blood is not forming clots properly), which could be signs of shock or infection. He is taken straight to the operating room. Surgeons re-explore his abdominal cavity and perform damage control surgery. The soldier is warmed to 38 degrees Celsius.

T+ 06:00: He is transported to the hospital intensive care unit (ICU), where he receives CT scans of his spine and continues to require ongoing aggressive support. An "urgent" aeromedical evacuation (AE) request is placed.

T+ 10:00: A C-17 aircraft arrives from Germany, and a Critical Care Air Transport Team (CCATT) is alerted. The CCATT arrives at the ICU and transports the soldier to the aircraft.

T+ 12:00: The soldier is loaded on the aircraft, and the CCATT provides ICU-level care during the hours-long flight out of the theater.

T+ 24:00: When the aircraft lands, the soldier is transported by ground ambulance to a Role 4 MTF. He is taken to the operating room, where he receives life-saving definitive care.

This fictionalized description of a patient's journey from point of injury through definitive care at a Role 4 MTF is based on a presentation by Lt. Gen. Douglas Robb[1] and is an example of a medical regulating success story. *Medical regulating* comprises "the

[1] Douglas J. Robb, "Medical Support to the Warfighter: from Battlefield to Tertiary Care & Beyond," *The American Osteopathic Academy of Addiction Medicine,* October 5, 2018, https://www.aoaam.org/resources/Documents/2018%20Convention%20Slides/Friday%20-%2010-5-2018%20-%2011am%20-%20Excellence%20in%20Trauma%20Recovery%20-%20Lt%20General%20Robb.pdf.

actions and coordination necessary to arrange for the movement of patients through the roles of care and to match patients with a medical treatment facility that has the necessary health service support capabilities and available bed space."[2] The coordinated response of MEDEVAC teams and medical personnel at each role of care saved this patient's life. The regular occurrence of such success stories for U.S. and Allied soldiers in recent conflicts has led to the lowest battlefield case fatality rates in recent recorded conflict.[3]

An operational environment that includes chemical, biological, radiological, and nuclear (CBRN) threats and hazards presents challenges that could reduce the frequency of medical regulating success stories. When the fictional soldier was injured in a non-CBRN environment, a number of circumstances contributed to his successful outcome. He had prompt access to the most capable and efficient MEDEVAC capabilities. He was evacuated to MTFs where the appropriate bed and medical specialists were available. The medical personnel were familiar with the soldier's injuries and the appropriate treatments. Medical equipment and countermeasures were in sufficient supply when and where they were needed. Finally, during his evacuation and treatment, the soldier was at no risk of being further injured by exposure to a CBRN hazard. None of these conditions can be assumed in a CBRN environment.

No single U.S. or North Atlantic Treaty Organization (NATO) doctrinal publication systematically addresses all of the challenges associated with medical regulating in a CBRN environment and concepts to mitigate them. To provide medical planners and medical staffs a source of consolidated concepts for preventing or mitigating these medical regulating challenges, the U.S. Army Office of the Surgeon General tasked the Institute for Defense Analyses to assess the challenges of medical regulating in a CBRN environment and evaluate potential mitigations. The analysis encompasses Army in-theater medical assets and inter-theater and intra-theater patient movement controlled by the Combatant Commander and United States Transportation Command (USTRANSCOM).

This paper documents our evaluation of medical regulating in a CBRN environment. Chapter 2 enumerates the medical challenges of the CBRN environment and explains how each of those challenges can negatively impact various components of medical regulating. Chapter 3 evaluates concepts for preventing or mitigating the adverse medical regulating impacts and summarizes the benefits, costs, operational constraints, and planning considerations for each concept, all of which are elaborated on in Appendix A. Chapter 4

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2 Chairman of the Joint Chiefs of Staff, *Joint Health Services*, Joint Publication 4-02 (Washington, DC: Chairman of the Joint Chiefs of Staff, 11 December 2017, Incorporating Change 1, 28 September 2018), GL-11, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp4_02ch1.pdf.

3 Dana M. Blyth, Heather C. Yun, David R. Tribble, and Clinton K. Murray, "Lessons of War: Combat-related Injury Infections during the Vietnam War and Operation Iraqi and Enduring Freedom," *The Journal of Trauma and Acute Care Surgery* 79, no. 4 Suppl 2 (October 2015): S227, https://doi.org/10.1097/TA.0000000000000768.

summarizes the concept assessments in order to facilitate decision-making by medical planners and medical staffs planning for operations in a CBRN environment. It provides a table specific to each type of CBRN hazard detailing how the relevant concepts address the root causes of adverse impacts.

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2. Adverse Impacts of Operating in a CBRN Environment on Medical Regulating

A. Overview

1. Framework of the Adverse Medical Regulating Impacts of CBRN Hazards

This chapter presents a framework for understanding how medical challenges of the CBRN environment encumber the medical regulating process. We created this framework after reviewing literature from multiple sources related to medical regulating in a CBRN environment. In addition to U.S. Army, Air Force, and Joint medical and CBRN doctrine, we reviewed NATO medical doctrine, coronavirus disease 2019 (COVID-19) patient movement guidance, and relevant non-doctrinal reports and articles. The framework consists of four broad categories of CBRN challenges to medical staffs, which are the root causes of adverse impacts on the five component pieces of the medical regulating process. The remainder of this chapter defines these elements of the framework and characterizes how each medical challenge of the CBRN environment hinders medical regulating.

From the literature, we distilled four root causes of adverse medical regulating impacts in a CBRN environment, which are summarized well in a single source. NATO *Allied Joint CBRN Medical Support Doctrine* directs medical staffs to consider the following challenges in a CBRN environment:

- CBRN incidents may produce a large number of casualties.
- The types of casualties from a CBRN incident are not those normally managed in a military medical support system.
- Casualties in a CBRN environment may be contaminated or contagious and may constitute a significant hazard to medical personnel and facilities charged with caring for them unless appropriate precautions are implemented.
- MTFs and evacuation assets may have to operate in areas that are contaminated or that impose restrictions to limit movement of personnel and materiel.[4]

[4] North Atlantic Treaty Organization. *Allied Joint Chemical, Biological, Radiological, and Nuclear (CBRN) Medical Support Doctrine*, Allied Joint Medical Publication 7, Edition B, Version 1, Brussels, Belgium: NATO Standardization Office, January 2021, 2-8–2-9, DRAFT.

We will refer to these root causes as the *medical challenges of the CBRN environment* for the remainder of the paper and abbreviate them for our framework as: 1) mass casualties, 2) different mix of patient types, 3) contaminated or contagious patients, and 4) CBRN hazards where medical assets operate. This last category includes CBRN hazards from direct or indirect attacks on medical assets and residual contamination in areas where they must operate.

To break down the medical regulating process into its component parts, we analyzed the medical regulating definition from Joint U.S. doctrine (emphasis added):

> The actions and coordination necessary to arrange for the *movement of patients* through the roles of care and to match *patients* with a medical treatment facility that has the necessary *health service support capabilities* and available *bed space*.[5]

One medical regulating component is MEDEVAC, which is responsible for the *movement of patients* and comprises the platform, platform operators, and medical providers. The *patients* themselves are another component. The *health service support capabilities* can be divided into the next two components: medical personnel and medical materiel resources. Finally, *bed space* is called out as a separate component. While the MTF is mentioned in the medical regulating definition, its function is mainly to accommodate the beds, personnel, and medical materiel, so we excluded it from our list. Therefore, our framework consists of the following five components of medical regulating: 1) MEDEVAC, 2) MTF beds, 3) MTF personnel, 4) medical materiel, and 5) patients. The medical challenges of the CBRN environment could negatively affect the medical regulating components, resulting in 1) MEDEVAC shortfalls, 2) MTF bed shortfalls, 3) MTF personnel shortfalls, 4) medical materiel shortfalls, and 5) CBRN exposure to patients, which we will refer to as *adverse medical regulating impacts* for the remainder of this paper. Shortfalls could represent gaps between required and available capabilities or capacities.

From the literature, we identified twenty-seven unique ways that the four medical challenges of the CBRN environment could cause the five adverse medical regulating impacts. Using the twenty-seven causes, we mapped the challenges to the adverse impacts, as shown in Figure 1. Each line in the figure lists one or more causes connecting a medical challenge on the left to an adverse medical regulating impact on the right. For instance, mass casualties could cause MEDEVAC shortfalls if patients exceed available MEDEVAC capacity. Thicker lines indicate more ways a medical challenge could affect a component of the medical regulating process, but they do not imply a greater likelihood of occurrence or a greater impact. For example, Figure 1 lists four possible ways for contaminated or contagious patients to cause MEDEVAC shortfalls, but this does not imply that

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[5] JP 4-02, *Joint Health Services*, GL-11.

contaminated or contagious patients are more likely to cause MEDEVAC shortfalls than mass casualties are.

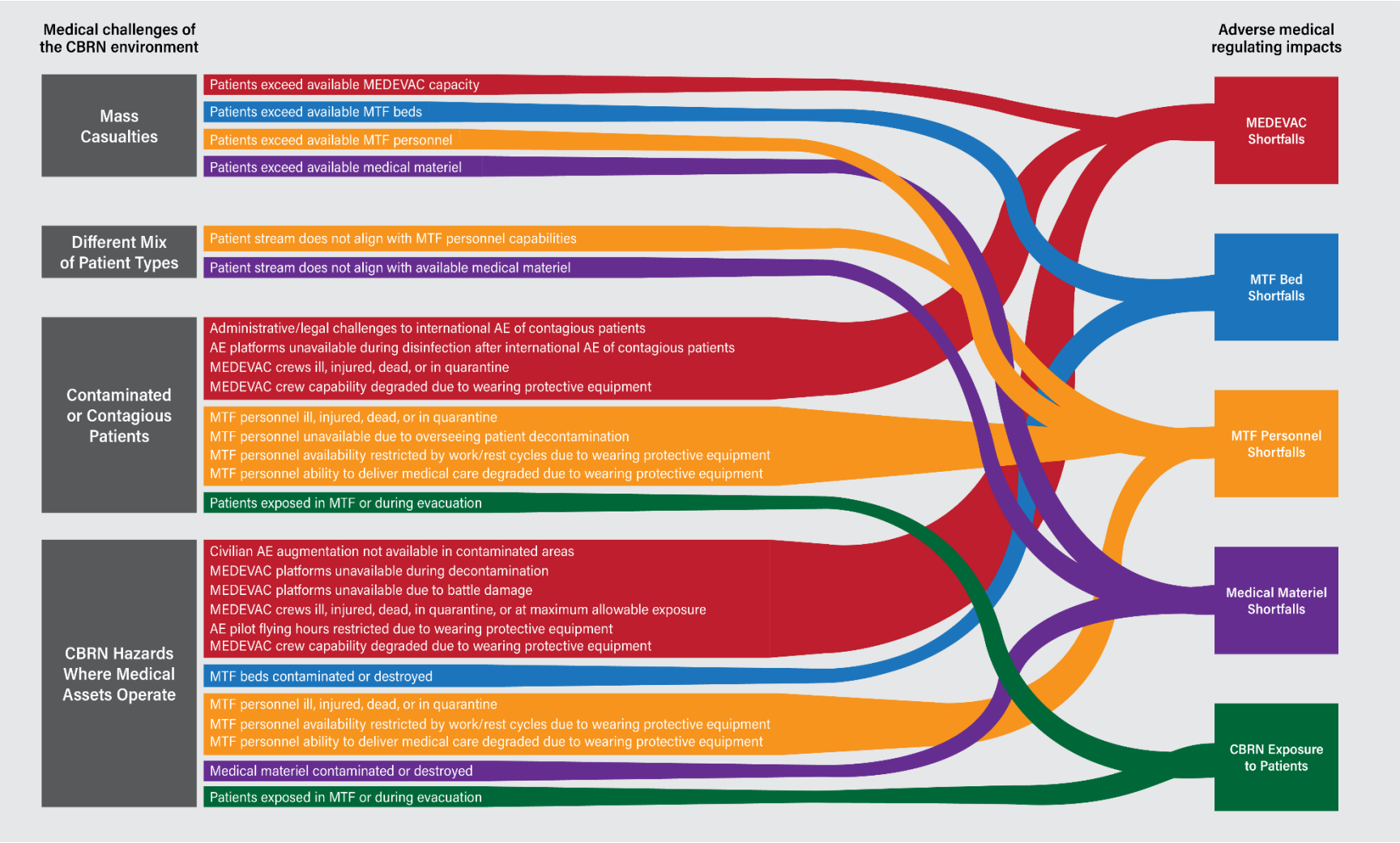

Figure 1. Framework for Understanding How the Medical Challenges Introduced by Operating in a CBRN Environment Can Adversely Impact the Components of the Medical Regulating Process

2. Downstream Costs of Adverse Medical Regulating Impacts

Poor patient outcomes are associated with each of the adverse medical regulating impacts shown in Figure 1. For instance, the results of a retrospective study for U.S. military casualties in Afghanistan from 2001 through 2014 suggests that MEDEVAC shortfalls leading to longer response times or reduced en route treatment capability are associated with higher morbidity and mortality. The authors concluded that "as transport time decreased and capabilities increased, casualties who would previously have been in the KIA [Killed in Action] mortality group survived outright or survived long enough that they shifted to the DOW [Died of Wounds] mortality group, and casualties who would previously have been in the DOW mortality group were also surviving."[6]

Shortfalls in hospital beds, medical personnel, and medical materiel resources are likewise correlated with negative patient outcomes. Shortages of ICU beds, general medical/surgical beds, and nurses were significantly associated with increased COVID-19 deaths in the U.S. in April 2020.[7] A more comprehensive look at 183 countries concluded that "[g]lobal COVID-19 mortality rates are likely affected by multiple factors, including hospital resources, personnel, and bed capacity."[8]

The last adverse medical regulating impact, CRBN exposure to patients, is also associated with harmful outcomes. Exposure of patients to CBRN hazards can either increase the severity of the injuries (for CBRN patients) or lead to combined injuries (for conventional trauma patients). For patients with combined injuries, there is a risk of increased mortality and morbidity due to interaction and synergistic effects.[9] CBRN exposure could change the patient's treatment requirements and therefore complicate the coordination of aligning patients to appropriate medical resources. Patients who were about to be discharged could be readmitted or require longer stays than anticipated, reducing available beds and adding to the MTF workload.

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6 Russ S. Kotwal et al., "The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties," *JAMA Surgery* 151, no. 1 (2016): 22, https://doi.org/10.1001/jamasurg.2015.3104.

7 Alexander T. Janke et al., "Analysis of Hospital Resource Availability and COVID-19 Mortality Across the United States," *Journal of Hospital Medicine* 16, no. 4 (April 2021): 211–214, https://doi.org/10.12788/jhm.3539.

8 Brendon Sen-Crowe, Mason Sutherland, Mark McKenney, and Adel Elkbuli, "A Closer Look into Global Hospital Beds Capacity and Resource Shortages during the COVID-19 Pandemic," *Journal of Surgical Research* 260 (April 2021): 56, https://doi.org/10.1016/j.jss.2020.11.062.

9 North Atlantic Treaty Organization, *Medical Management of CBRN Casualties*, Allied Medical Publication 7.1, Edition A, Version 1, NATO STANAG 2461, (Brussels, Belgium: NATO Standardization Office, June 2018), 7-5–7-6, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.1_EDA_V1_E_2461.pdf.

3. Chapter Scope and Organization

The remainder of this chapter is structured to align to the framework in Figure 1. It contains sections for each of the four medical challenges of the CBRN environment and sub-sections detailing each causal relationship to an adverse medical regulating impact. Sections may appear similar when the nature of the adverse impacts described is the same but the root causes differ. For instance, MEDEVAC crews could become ill, injured, dead, or in quarantine as a result of exposure to a contaminated or contagious patient or to CBRN hazards in the environment. The discussion is structured this way because the concepts to address adverse medical regulating impacts (in Chapter 3) are sometimes specific to the root cause. Some concepts, for example, prevent exposure from contaminated or contagious patients, whereas some prevent exposure from environmental hazards.

For each causal relationship shown in Figure 1, we assess whether it applies to all types of CBRN environment or whether it represents a problem created or exacerbated by only a subset of CBRN hazards. We discuss the nature of the various problems caused by CBRN incidents, but we do not describe the magnitude of each problem, which is often a function of scenario. Attacks could be small-scale or could cover large areas, including whole medical units. In our framework, the loss of entire medical units or facilities could be represented as a simultaneous loss of MTF beds, personnel, and medical materiel. In general, the discussion of medical challenges affecting MTFs in this paper applies to those facilities up to and including the theater hospitalization capability (Roles 1 through 3). Because definitive care (Role 4 MTFs) usually resides outside the operational area,[10] much of the discussion of the medical challenges of the CBRN environment and the potential solutions are not as applicable to Role 4 MTFs.

B. Adverse Medical Regulating Impacts of Mass Casualties

The first medical challenge of the CBRN environment is the prospect of managing a large number of casualties. The impacts of a CBRN incident on medical regulating depend on the scale of the incident, which can range from "a small number of casualties requiring unusual but manageable medical care" to a large-scale mass casualty (MASCAL) event.[11]

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[10] JP 4-02, *Joint Health Services*, I-6.

[11] AJMedP-7, *Allied Joint CBRN Medical Support Doctrine*, 2-8.

U.S. doctrine indicates that chemical,[12] biological,[13] and nuclear incidents[14] have the potential to expose large numbers of casualties to CBRN hazards and generate a large-scale MASCAL scenario. In contrast, the doctrinal counterpart for radiological casualties discusses several possible radiological threats, yet does not specify that any of them have a high likelihood of generating large numbers of military casualties due to radiological contamination or exposure.[15] One of the more likely radiological threats, an explosive radiological dispersal device (RDD), is unlikely to cause significantly more casualties than if the explosive device contained no radioactive material;[16] most casualties are likely to result from the explosion (i.e., blast and trauma injuries) rather than the radioactive material dispersed.[17]

Many uninjured individuals may report for medical treatment, even following a radiological or small-scale chemical or biological incident that does not cause many casualties.[18] After the 1995 Tokyo subway sarin attack, for instance, thousands of individuals presented to the medical system, but less than 20% required medical attention.[19] For this reason, medical planners should consider the potential for all types of CBRN environment to cause large numbers of individuals to report to the medical system.

By definition, a "MASCAL situation is one in which an excessive disparity exists between the casualty load and the medical capabilities and capacities locally available for

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12 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Treatment of Chemical Warfare Agent Casualties and Conventional Military Chemical Injuries*, Army Techniques Publication 4-02.85 (Washington, DC: Headquarters, Department of the Army, August 2016), C-1, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1001926.

13 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Treatment of Biological Warfare Agent Casualties*, Army Techniques Publication 4-02.84 (Washington, DC: Headquarters, Department of the Army, November 2019), 1-3, 1-17, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1008190.

14 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Treatment of Nuclear and Radiological Casualties*, Army Techniques Publication 4-02.83 (Washington, DC: Headquarters, Department of the Army, May 2014), 1-8, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=104161.

15 Ibid., 1-8.

16 U.S. Department of Homeland Security, "Radiological Dispersal Device Incident Response Planning: Incident Site Medical Management," 1, accessed May 15, 2021, https://www.hsdl.org/?view&did=765540.

17 ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 1-7; and U.S. Department of Health & Human Services, Radiation Emergency Medical Management (REMM), "Radiological Dispersal Devices (RDDs)," accessed October 5, 2021, https://remm.hhs.gov/rdd.htm.

18 JP 4-02, *Joint Health Services*, V-19.

19 Randal Beaton et al., "The Sarin Gas Attacks on the Tokyo Subway – 10 Years Later/Lessons Learned," *Traumatology* 11, no. 2 (June 2005): 108, https://doi.org/10.1177/153476560501100205.

its management."[20] Following a MASCAL event caused by CBRN hazards, the medical system "may not have the personnel, equipment, pharmaceuticals, and materiel needed to support CBRN casualties,"[21] leading to shortfalls in four of the components of medical regulating: MEDEVAC, MTF beds, MTF personnel, and medical materiel. In the remainder of this section, we briefly review some of the evidence from the literature indicating that the large number of casualties expected from a CBRN incident makes a shortfall in each of these four medical regulating components likely.

1. Patients Exceed Available MEDEVAC Capacity

A MEDEVAC shortfall is likely when MASCAL situations occur because "the number of casualties will normally overwhelm the available medical evacuation resources."[22] Multiple doctrinal sources indicate that a MASCAL situation will lead to a MEDEVAC shortfall and emphasize the need to consider concepts (e.g., casualty evacuation (CASEVAC) to be discussed in Chapter 3) to address this adverse medical regulating impact.[23]

2. Patients Exceed Available MTF Beds

In some mass casualty incidents, the major medical resource shortfall is the limited supply of hospital beds.[24] During the COVID-19 pandemic, one of the key challenges faced

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[20] North Atlantic Treaty Organization, *Medical Aspects in the Management of a Major Incident/Mass Casualty Situation*, Allied Medical Publication 1.10, Edition A, Version 1, NATO STANAG 2879 (Brussels, Belgium: NATO Standardization Office, December 2015), 1, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-1.10_EDA_V1_E_2879.pdf.

[21] AJMedP-7, *Allied Joint CBRN Medical Support Doctrine*, 5-11.

[22] Headquarters, Department of the Army, *Army Health System Support to Maneuver Forces*, Army Techniques Publication 4-02.3 (Washington, DC: Headquarters, Department of the Army, June 2014), A-6, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=104308.

[23] North Atlantic Treaty Organization, *Commander's Guide on Medical Support to Chemical, Biological, Radiological, and Nuclear (CBRN) Defensive Operations*, Allied Medical Publication 7.6, Edition A, Version 1, NATO STANAG 2873 (Brussels, Belgium: NATO Standardization Office, February 2018), 2-8, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.6_EDA_V1_E_2873.pdf; Headquarters, Department of the Army, *Sustainment*, Army Doctrine Publication 4-0 (Washington, DC: Headquarters, Department of the Army, July 2019), 3-11, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007565; and Headquarters, Department of the Army, *Army Health System*, Field Manual 4-02 (Washington, DC: Headquarters, Department of the Army, November 2020), 1-7, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1021296.

[24] Hysham Hadef, Jean-Claude Bartier, Herve Delplancq, and Jean-Pierre Dupeyron, "Using Baseline Data to Address the Lack of Hospital Beds during Mass-casualty Incidents," *Prehospital and Disaster Medicine* 23, no. 4 (August 2008): 378, https://doi.org/10.1017/s1049023x0000604x.

by several nations was the "shortage of available hospital beds and the lack of beds in intensive care units (ICUs) for critically ill patients."[25]

3. Patients Exceed Available MTF Personnel

MTF personnel are among the medical resources whose capacity may be exceeded by a large number of CBRN casualties.[26] U.S. doctrine warns that MTF personnel may be strained far beyond their normal capacity, with "one physician, with a small number of ancillary personnel, including nurses, medical technicians, and nonmedical personnel, [required] to care for several hundred patients."[27]

4. Patients Exceed Available Medical Materiel

In a MASCAL incident, the large number of patients can cause medical materiel shortfalls, as "stocks of materiel can be rapidly exhausted."[28] The medical materiel needed to manage a MASCAL situation is "high in quantity but low in diversity,"[29] meaning a few high-demand resources are likely to be responsible for the shortfalls.

C. Adverse Medical Regulating Impacts of Different Mix of Patient Types

The second medical challenge of the CBRN environment is the different mix of patient types caused by CBRN incidents. Whereas the mass casualties resulting from CBRN incidents could cause shortfalls because of the total number of patients, this medical challenge is characterized by the unique nature of patients and their different medical requirements compared to conventional trauma casualties.

> Management of the atypical illnesses and injuries sustained by CBRN casualties may require a different mix of medical personnel, equipment, pharmaceuticals or other consumables, and laboratory support than what is needed for conventional casualty management. Further, the rates at which these resources are used over time may also be different.[30]

The medical treatment requirements for patients caused by any type of CBRN incident could differ from those for conventional trauma patients, so this medical challenge

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[25] Pasquale De Nardo et al., "Multi-Criteria Decision Analysis to Prioritize Hospital Admission of Patients Affected by COVID-19 in Low-resource Settings with Hospital-bed Shortage," *International Journal of Infectious Diseases* 98 (2020): 494, https://doi.org/10.1016/j.ijid.2020.06.082.

[26] AMedP-7.6, *Commander's Guide on Medical Support to CBRN Defensive Operations*, 1-6–1-7.

[27] ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-17.

[28] AJMedP-7, *Allied Joint CBRN Medical Support Doctrine*, 6-2.

[29] AMedP-1.10, *Medical Aspects in the Management of a Major Incident*, 1-3.

[30] AMedP-7.6, *Commander's Guide on Medical Support to CBRN Defensive Operations*, 1-5.

applies to all types of CBRN environment. Chemical nerve agent patients, for example, require administration of a specific antidotal treatment within a short window following exposure (plus continuing antidote treatment for as long as several days). The treatment requirements for patients exposed in a biological agent attack "may be substantially different from those resulting from conventional … combat."[31] MTF personnel treating patients exposed to radiation will need access to appropriate dosimetry equipment and may need to administer some medical countermeasures, such as potassium iodide, within minutes to hours after exposure.[32] Burns, which are likely to be present on many casualties resulting from a nuclear detonation, "constitute the most difficult problem faced by the Military Health System"[33] and will consume considerable resources.

The different mix of patient types expected following a CBRN incident can lead to shortfalls in two components of medical regulating: MTF personnel and medical materiel. In the following sections, we summarize the literature on how each medical regulating component is adversely impacted by a different mix of patient types.

1. Patient Stream Does Not Align with MTF Personnel Capabilities

Even if there is space for patients at an MTF, patients may not be regulated to the MTF if there is a mismatch between patient needs and available specialties.[34] The mismatch of MTF personnel capabilities could take the form of a specialty not existing at an MTF, or the number of specialists could be insufficient due to the relative scarcity of patients needing that specialty in a typical stream of trauma patients.

Following a biological incident, for instance, "[t]here is likely to be great demand for intensive care facilities including both equipment and qualified medical personnel but the vast majority of patients will not require surgical procedures."[35] This is in contrast to a typical mass casualty situation, where most patients will require surgery.[36] This high demand for specialist care was evident during the COVID-19 pandemic, when many patients required ICU care and respiratory support, which was not a common proficiency

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31 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 2-4.

32 Kristi L. Koenig et al., "Medical Treatment of Radiological Casualties: Current Concepts," *Annals of Emergency Medicine* 45, no. 6 (June 2005): 650–651, https://doi.org/10.1016/j.annemergmed.2005.01.020.

33 ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 2-8.

34 Headquarters, Department of the Army, *Army Health System Support Planning*, Army Techniques Publication 4-02.55 (Washington, DC: Headquarters, Department of the Army, March 2020), 2-10, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1008962.

35 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-17.

36 Ibid., 1-17.

among physicians outside the ICU ward.[37] Likewise, an MTF staffed to treat conventional trauma patients would have fewer specialists available to manage uncommon patients.

2. Patient Stream Does Not Align with Available Medical Materiel

Due to the unique illnesses and injuries of CBRN patients, MTFs may not have the specialized equipment or materiel needed to meet the treatment requirements of CBRN casualties.[38] Example materiel resources that could experience shortfalls include laboratory equipment for diagnostics, mechanical ventilators, and nerve agent antidotes. In addition, for certain CBRN-specific consumables, such as individual protective equipment (IPE), protective masks, protective mask filters, and patient protective wraps, MTFs have either limited or no replacements available.[39]

D. Adverse Medical Regulating Impacts of Contaminated or Contagious Patients

The third medical challenge of the CBRN environment is the potential hazard posed by contaminated or contagious casualties. While the first two challenges correspond to demand for medical resources surpassing a fixed supply, this challenge could both diminish the supply of medical personnel and increase medical requirements. Contaminated and contagious casualties "may constitute a significant risk to the medical personnel on duty" and "can indirectly create added risks via the contamination of equipment and facilities or create an expanding operational burden because of the need to institute decontamination or infection-control procedures throughout all levels of care."[40] Contaminated or contagious patients have the potential to cause adverse impacts on three components of medical regulating: MEDEVAC shortfalls, MTF personnel shortfalls, and CBRN exposure to patients.

The risk to medical personnel and other patients from contaminated or contagious patients varies depending on the type of CBRN hazard. Patients with only vapor exposure to toxic industrial chemicals (TICs) or chemical warfare agents may pose a risk to others

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37 Antonio Pisano, Andrey Yavorovskiy, Luigi Verniero, and Giovanni Landoni, "Indications for Tracheal Intubation in Patients with Coronavirus Disease 2019 (COVID-19)," *Journal of Cardiothoracic and Vascular Anesthesia* 35, no. 5 (May 2021): 1276, https://doi.org/10.1053%2Fj.jvca.2020.11.062.

38 AMedP-7.6, *Commander's Guide on Medical Support to CBRN Defensive Operations*, 6-9.

39 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Health Service Support*, Army Techniques Publication 4-02.7 (Washington, DC: Headquarters, Department of the Army, March 2016), 3-6–3-7, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=106112.

40 AMedP-7.6, *Commander's Guide on Medical Support to CBRN Defensive Operations*, 1-5.

from the off gassing of vapors trapped in their hair or clothing.[41] However, "the primary hazard comes from liquid or dry agent on clothing or the off gassing of vapors from liquid contaminated garments and equipment."[42]

Patients contaminated in a biological attack could pose a hazard to the medical system in limited circumstances. In general, by the time individuals exposed to biological agents present to the medical system with symptoms of illness (often days after exposure), they are unlikely to have any remaining contamination on them.[43] Theoretically, other injuries could prompt patients to present to the medical system soon enough after exposure that viable agent could remain on their skin or clothing,[44] although the risk of infection to others from the reaerosolization of infectious particles is considered low.[45] Some toxins (e.g., ricin, T-2 mycotoxins) are stable enough in the environment that by the time of symptom onset, patients presenting to the medical system could still be contaminated with agent.[46] However, patients contaminated with toxins pose a negligible hazard, as toxins do not cause a vapor or (with the exception of T-2 mycotoxins) percutaneous hazard.[47]

During an intentionally-caused or naturally-occurring outbreak of contagious disease, patients could also present a contagious disease hazard to MEDEVAC crews, MTF personnel, and uninfected patients.[48] Unlike from externally contaminated patients, the source of the hazard from patients with a contagious disease is internal, so decontamination will not mitigate the risk. The spread of disease from contagious patients could be via aerosol transmission (e.g., smallpox, plague, COVID-19) or through contact with contaminated bodily fluids (e.g., Ebola, Marburg).

Patients injured in radiological and nuclear incidents will be contaminated only in limited circumstances. Exposure to radiation alone, such as from prompt nuclear radiation

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41 U.S. Army Medical Research Institute of Chemical Defense, *Medical Management of Chemical Casualties Handbook, Fourth Edition* (Aberdeen Proving Ground, MD: Chemical Casualty Care Division, USAMRICD, February 2007), 21, 213, https://www.globalsecurity.org/wmd/library/policy/army/other/mmcc-hbk_4th-ed.pdf.

42 ATP 4-02.7, *Health Service Support*, 5-9.

43 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, C-1; and U.S. Army Medical Research Institute of Infectious Disease, *USAMRIID's Medical Management of Biological Casualties Handbook, 9th Edition* (Frederick, MD: USAMRIID, 2020), 18, 147, https://www.usamriid.army.mil/education/bluebookpdf/USAMRIID's%20Blue%20Book%209th%20edition%20-%20PDF%20format.pdf.

44 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-13.

45 Anthony G. Macintyre et al., "Weapons of Mass Destruction Events with Contaminated Casualties: Effective Planning for Health Care Facilities," J*AMA* 283, no. 2 (January 2000): 243, https://doi.org/10.1001/jama.283.2.242.

46 USAMRIID, *Medical Management of Biological Casualties Handbook*, 106–128.

47 Ibid., 106.

48 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-20, E-2.

or radiological exposure devices, does not result in an individual being contaminated.[49] External contamination of an individual occurs when radioactive material, such as from nuclear fallout or an RDD, is deposited on the individual's body or clothing.[50] Individuals become internally contaminated if radioactive material is inhaled, ingested, or absorbed through the skin or a wound.[51] Due to the delayed onset of symptoms caused by radiation exposure, patients presenting with radiation-induced symptoms are unlikely to be externally contaminated. Patients presenting with external contamination will do so soon after exposure and the source of their injuries will likely be conventional trauma. While these patients will still require decontamination, the actual risk to medical personnel from the contamination is minimal.[52]

In general, patients with known contamination will undergo immediate decontamination at the point of injury prior to MEDEVAC, which is intended "to reduce gross contamination on designated in-theater evacuation assets."[53] However, they may still pose a hazard during MEDEVAC until they will undergo patient decontamination outside the receiving MTF. Detailed patient decontamination requirements and procedures for all types of CBRN hazards are presented in Army Techniques Publication (ATP) 4-02.7.[54]

1. Administrative/Legal Challenges to International Aeromedical Evacuation of Contagious Patients

The international AE of contagious patients is subject to a number of constraints that hinder the timely evacuation of these patients. First, evacuation of contagious patients "may be severely impeded due to international health regulations or nationally imposed restrictions of movement."[55] In addition, movement of contagious patients requires "approval of the destination country, overflight privileges, and approval of any country where the aircraft will land for servicing or where patients will remain overnight."[56] Such overflight and emergency landing rights were difficult to achieve during Operations

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49 JP 4-02, *Joint Health Services*, V-18.

50 ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 2-12.

51 Ibid., 2-12.

52 JP 4-02, *Joint Health Services*, V-18.

53 ATP 4-02.7, *Health Service Support*, 5-7.

54 Ibid., 5-1–5-80.

55 North Atlantic Treaty Organization, *Allied Joint Doctrine for Medical Support*, Allied Joint Publication 4.10, Edition C, Version 1, NATO STANAG 2228 (Brussels, Belgium: NATO Standardization Office, September 2019), 3-22, https://www.coemed.org/files/stanags/01_AJP/AJP-4.10_EDC_V1_E_2228.pdf.

56 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-21.

Enduring Freedom/Iraqi Freedom.[57] Finally, "prior approval must be given by the involved [Geographic Combatant Commands]; Commander, USTRANSCOM; and [Secretary of Defense] in consultation with medical authorities."[58]

2. Aeromedical Evacuation Platforms Unavailable During Disinfection after International Aeromedical Evacuation of Contagious Patients

Following an international AE of a contagious patient, the aircraft will be rendered unavailable for missions until disinfected.[59] Since most contagious patients are currently transported in isolation via a high-level containment transport system (described in Chapter 3), an estimate of the disinfection time without such a system is difficult to find, but older accounts indicate that the aircraft would be unavailable for at least several hours.[60] The temporary unavailability of the AE asset could result in a MEDEVAC shortfall if it were needed immediately for the next mission.

Although MEDEVAC platforms transporting contaminated patients from the point of injury to an MTF could become contaminated on the interiors, decontamination of the MEDEVAC platforms would likely be delayed until the MEDEVAC demand allowed because of the expected low level of contamination and the priority to complete the mission over performing thorough platform decontamination.[61] For that reason, we do not consider MEDEVAC platform unavailability due to decontamination to be an adverse impact of contaminated patients. External contamination of MEDEVAC platforms resulting from CBRN hazards in the environment is addressed separately in the section on adverse medical regulating impacts of CBRN hazards where medical assets operate.

3. MEDEVAC Crews Ill, Injured, Dead, or in Quarantine

If a CBRN incident is not recognized as chemical, biological, or radiological in nature, then contaminated patients are unlikely to have undergone any decontamination, and MEDEVAC crews are unlikely to be wearing mission-oriented protective posture (MOPP)

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57 Headquarters, Air Combat Command, *Contagious Casualty Management*, Air Force Tactics, Techniques, and Procedures 3-42.22 (Hampton, VA: Headquarters, Air Combat Command, May 2007), 5.

58 JP 4-02, *Joint Health Services*, A-13.

59 ATP 4-02.7, *Health Service Support*, 4-4.

60 Mark R. Withers and George W. Christopher, "Aeromedical Evacuation of Biological Warfare Casualties: A Treatise on Infectious Diseases on Aircraft," *Military Medicine* 165, no. 11 Suppl 3 (November 2000): 6, https://pubmed.ncbi.nlm.nih.gov/11143422.

61 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Passive Defense*, Army Techniques Publication 3-11.32 (Washington, DC: Headquarters, Department of the Army, May 2016), 2-52, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1000453.

Level 4. In this case, the patients presenting with contamination could pose a hazard to MEDEVAC crews. Since "the presence of external [radiological] contamination does not represent a significant exposure hazard to … attending medical staff,"[62] the main contamination hazards are chemical and biological. For these agents, "vapors and particles, even in small amounts, can pose a hazard to those working directly with the patients."[63]

In the case of an unknown chemical or biological attack, the patient would pose a hazard to MEDEVAC crews only if they were evacuated before the contamination dissipated or degraded from natural weathering. For persistent chemical agents and toxins, the onset of symptoms from the chemical or biological agent could precede the natural dissipation of the agent. For other agents, including most biological agents, patients would need to seek medical care for other symptoms (e.g., trauma injuries) prior to the agent degradation in order to pose a contamination hazard to MEDEVAC crews. The transfer of chemical or biological contamination from a patient to MEDEVAC personnel is most likely during evacuation from point of injury to the first MTF and could cause injury, illness, and possibly death, leading to a MEDEVAC crew shortfall.

For attacks suspected to be chemical or biological in nature, either through detectors alarming or the rapid onset of specific symptoms, patients would likely perform immediate decontamination and MEDEVAC crews would don MOPP Level 4, reducing the chances of MEDEVAC crew exposure and subsequent illness or injury.

Contagious patients, who are unlikely to contain any external contamination by the time they exhibit symptoms of illness, are another potential hazard to MEDEVAC crews. Experience with the COVID-19 outbreak in Europe indicated that "the disease transmission risk for aeromedical crew members is higher than for in-hospital healthcare providers," in part due to the need to perform "aerosol-generating procedures such as airway management and ventilation."[64] Unlike contaminated patients, who are likely to pose less of a risk to each subsequent MEDEVAC crew, any evacuation of a contagious patient from the initial MEDEVAC trip through an inter-theater evacuation could lead to MEDEVAC shortfalls if MEDEVAC crew are exposed and become ill, die, or require quarantine.

4. MEDEVAC Crew Capability Degraded due to Wearing Protective Equipment

MEDEVAC of contaminated and certain contagious patients would require medical providers to wear onerous protective equipment to prevent exposure. Because

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62 ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 2-12.

63 ATP 4-02.7, *Health Service Support*, 5-9.

64 Roland Albrecht et al., "Transport of COVID-19 and Other Highly Contagious Patients by Helicopter and Fixed-Wing Air Ambulance: A Narrative Review and Experience of the Swiss Air Rescue Rega," *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 28, no. 40 (2020): 1, https://doi.org/10.1186/s13049-020-00734-9.

contaminated patients could pose a threat to MEDEVAC crews until they undergo patient decontamination outside an MTF, even after immediate decontamination, "all ambulance crewmembers will need to wear MOPP while in their vehicles to protect them from possible cross contamination or any vapor hazards from agent on casualty MOPP."[65] Even though the risk of reaerosolization from biologically contaminated casualties is low, doctrine still recommends that MEDEVAC crews wear protective equipment (at least protective masks) if patients could be contaminated.[66] While most contagious patients can be appropriately managed using standard, contact, or droplet precautions, patients with smallpox or certain viral hemorrhagic fevers (e.g., Ebola, Marburg, Lassa) would require medical providers to use a powered air-purifying respirator (PAPR), hood, and encapsulating suit.[67]

The requirement for medical providers to don MOPP Levels 3 or 4 or a PAPR, hood, and suit to protect themselves from the hazard posed by contaminated or contagious patients imposes restrictions on their ability to treat casualties during MEDEVAC and reduces their overall effectiveness.[68] These protective ensembles can degrade medical provider performance in multiple ways: a) decremented auditory ability (providers cannot hear heart and lung sounds in the suit); b) decremented tactile sense (providers cannot readily palpate pulses); c) decreased ability to communicate with other members of the healthcare team and to detect patient alarms and warning devices; and d) decreased reaction time (providers cannot rapidly respond to emergencies if they must follow a deliberate and cautious doffing procedure).[69] MEDEVAC personnel wearing only a protective mask could still experience communication degradation.

5. MTF Personnel Ill, Injured, Dead, or in Quarantine

Applying the same logic as for MEDEVAC crews, MTF personnel could be at risk of exposure from contaminated patients if the contamination is not recognized, or from contagious patients. When patients are known to be contaminated, they are decontaminated prior to MTF entry in order to protect medical personnel.[70] However, if MTF personnel were unaware of a CBRN threat and contaminated patients did not exhibit symptoms of CBRN exposure, then these patients could theoretically enter the MTF and become "point

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65 ATP 3-11.32, *CBRN Passive Defense*, 2-76.

66 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-10–1-11.

67 Dr. Ted Cieslak, email message to author, June 21, 2021.

68 ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, B-2; and JP 4-02, *Joint Health Services*, V-19.

69 Dr. Ted Cieslak, email message to author, June 21, 2021.

70 JP 4-02, *Joint Health Services*, V-18; and ATP 3-11.32, *CBRN Passive Defense*, 2-35.

sources of vapor or spread liquid contamination in the shelter."[71] If this were to occur, the risk of causing illness, injury, or death to MTF personnel, as to MEDEVAC crews, would be greatest in the chemical and biological environments, since "the risk to medical personnel from [radiologically] contaminated patients is very low."[72]

Contagious patients could similarly pose a risk to MTF personnel, especially if contagion is not suspected. Even with knowledge of the ongoing COVID-19 pandemic, frontline healthcare workers faced a twelvefold increase in risk of testing positive for the disease compared to the general population in April 2020.[73] Any contact, especially frequent or repeated contact as might be expected in a CBRN MASCAL incident, with contaminated or contagious patients has the possibility to cause injury, illness, death, or the need to quarantine, all of which could contribute to an MTF personnel shortfall.

6. MTF Personnel Unavailable due to Overseeing Patient Decontamination

Following a known CBRN incident, "[p]atient decontamination must be in place near the MTFs at all roles of medical care."[74] In addition to their normal roles, MTF personnel are required to supervise nonmedical personnel augmenting patient decontamination and monitor the hospital for contamination.[75] Medical personnel will be required at "the triage area, dirty side [emergency medical technician] areas, litter and ambulatory decontamination areas, clean side of the hot line, and clean treatment area."[76] Because "MTFs are not staffed to simultaneously perform patient decontamination without degrading medical capabilities and capacities,"[77] the requirement to oversee patient decontamination may reduce the MTF personnel available to perform medical functions and will make the unit considerably less effective.[78]

While decontamination of patients exposed only to vapor nonpersistent agents or TICs may require minimal, if any, decontamination,[79] medical personnel would likely still be required to oversee a patient decontamination site following a known chemical incident unless contamination could be ruled out for all casualties soon after the incident. Similarly,

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71 ATP 3-11.32, *CBRN Passive Defense*, 2-35.

72 ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 4-3.

73 Long H. Nguyen et al., "Risk of COVID-19 among Front-line Health-care Workers and the General Community: A Prospective Cohort Study," *The Lancet Public Health* 5, no. 9 (September 2020): e478, https://doi.org/10.1016/S2468-2667(20)30164-X.

74 ATP 4-02.7, *Health Service Support*, 5-1.

75 Ibid., 3-6.

76 Ibid., 5-3.

77 Ibid., 5-3.

78 JP 4-02, *Joint Health Services*, V-19.

79 ATP 4-02.7, *Health Service Support*, 5-8.

patient decontamination would also take place for patients contaminated with radiological material, resulting from either an RDD or nuclear fallout.

If an attack with a biological agent (other than toxins) were not detected, it is unlikely that patients would be contaminated when they presented to the medical system with symptoms of illness, so no decontamination would be necessary.[80] If it were detected, then patients presenting before the agent had been deactivated by the environment (most likely patients with symptoms caused by something other than the biological agent) would be decontaminated at the MTF.[81] This logic applies to attacks with both agents that cause non-contagious disease and those that cause contagious disease. Contagious patients that are not externally contaminated do not need decontamination.

7. MTF Personnel Availability Restricted by Work/Rest Cycles due to Wearing Protective Equipment

MTF personnel involved in patient decontamination, which is prescribed for patients known or suspected to be contaminated in any type of environment,[82] are required to don MOPP Level 4.[83] To account for the additional heat generated, personnel are directed to decrease the work/rest ratio while operating in MOPP Level 4.[84] If MTF personnel choose not to increase rest time as recommended, then they are at greater risk of experiencing heat exhaustion.[85] The additional rest time imposed on MTF personnel by operating in MOPP Level 4 or the loss of MTF personnel due to heat exhaustion could reduce overall MTF personnel capacity and cause a shortfall.

Similarly, MTF personnel treating patients with certain contagious diseases (e.g., Ebola, Marburg, or Lassa viral hemorrhagic fevers, smallpox), should wear a PAPR, hood, and encapsulating suit, which could lead to heat exhaustion, especially in warm field environments if air-conditioned MTFs were not available.[86] By the same logic as above, MTF personnel availability could be restricted when treating contagious patients as a result of rest requirements instituted to prevent heat casualties.

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80 ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-14, C-1.

81 Ibid., 1-13–1-14.

82 ATP 4-02.7, *Health Service Support*, 5-8.

83 Ibid., 5-11.

84 ATP 3-11.32, *CBRN Passive Defense*, C-7.

85 ATP 4-02.7, *Health Service Support*, 3-2.

86 Dr. Ted Cieslak, email message to author, June 21, 2021.

8. MTF Personnel Ability to Deliver Medical Care Degraded due to Wearing Protective Equipment

As described above, MTF personnel would don MOPP Level 4 to conduct patient decontamination operations or a restrictive PAPR, hood, and encapsulating suit ensemble to treat certain contagious patients. These protective ensembles could degrade MTF personnel hearing, speaking, and tactile senses,[87] skills that are critical to treating contagious patients or to conducting triage or emergency medical treatment in the warm/dirty zone of a patient decontamination site. Because of these impediments, the effectiveness of MTF personnel wearing MOPP Level 4 will be reduced,[88] and they "will be severely restricted in their ability to treat casualties."[89]

9. Patients Exposed in MTF or During Evacuation

Just as patients could cause illness or injury to MEDEVAC crews or MTF personnel if their contamination or contagiousness was not suspected, they could also pose a risk to other patients in the medical system. This is unlikely to increase the number of casualties, since patients will already be lost to their units, but it could complicate patient treatment and increase the time until patients return to duty (RTD). For instance, patients with no previous CBRN exposure could develop illness or chemical injuries following exposure to a contaminated or contagious patient. Likewise, patients with mild CBRN symptoms could exhibit more severe symptoms because of a subsequent exposure from other patients. In addition to complicating the treatment of existing patients, in the case of a contagious disease, nosocomial transmission could increase the likelihood of transmitting disease to medical personnel.

E. Adverse Medical Regulating Impacts of CBRN Hazards where Medical Assets Operate

The final medical challenge of the CBRN environment is the presence of CBRN hazards in areas where medical units operate. This could be from direct or indirect attacks on medical assets or from the need to evacuate patients in contaminated areas. The impacts of casualties caused by CBRN hazards (their large numbers, unique treatment requirements, and hazardous nature) are addressed in the first three challenges; this challenge is focused on ways that CBRN attacks could cause additional harm to existing patients during evacuation or treatment and shortfalls in the other medical regulating components. Medical personnel casualties caused by exposure to CBRN hazards are considered here as losses to their medical units (and therefore causes of adverse medical

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87 Dr. Ted Cieslak, email message to author, June 21, 2021.

88 JP 4-02, *Joint Health Services*, V-19.

89 ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, B-2.

regulating impacts) rather than as patients to be managed (already covered by the first three challenges). All components of medical regulating could be adversely impacted by CBRN hazards where medical assets operate: MEDEVAC operations could be hindered,[90] clinical care could be inhibited,[91] and patients could be exposed. Many aspects of this challenge are similar to the challenge of contaminated patients, but the source of the CBRN hazard is different.

Direct or indirect attacks on medical assets with CBRN weapons could occur in any type of CBRN environment. The large scale of biological and nuclear attacks increases the likelihood that these types of attacks could expose medical units to CBRN hazards, resulting in significant battle damage in the case of a nuclear detonation. Non-nuclear explosive dissemination of any CBRN hazard could also cause destruction, although the risks of battle damage to medical regulating components may be comparable to those in a non-CBRN environment.

Contaminated areas could result from any type of CBRN environment, which is evident from the definition of contamination: "[t]he deposit, absorption, or adsorption of radioactive material, or of biological or chemical agents on or by structures, areas, personnel, or objects."[92] The duration of a residual CBRN contamination hazard depends on the type of CBRN incident. Persistent chemical warfare agents can remain a contamination hazard for up to several days or weeks, whereas nonpersistent chemical agents dissipate and/or lose their ability to cause casualties within 24 hours.[93]

"Biological agents generally have short-lived activity (< 24 hours) in the environment, since oxygen and exposure to sunlight kill most organisms. However[,] spores in dormant form, notably anthrax, may survive for decades and reactivate in warm, moist environments."[94] In addition, T-2 mycotoxins are "extremely stable in the environment" due to their heat and UV resistance.[95]

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90 Headquarters, Department of the Army, *Theater Hospitalization*, Army Techniques Publication 4-02.10 (Washington, DC: Headquarters, Department of the Army, August 2020), 5-14, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1020498.

91 Headquarters, Air Force A4 (Logistics, Engineering and Force Protection), *Operations in a Chemical, Biological, Radiological, and Nuclear (CBRN) Environment*, Air Force Manual 10-2503 (Arlington, VA: Headquarters, Air Force A4, May 2019), 28, https://static.e-publishing.af.mil/production/1/af_a4/publication/afman10-2503/afman10-2503.pdf.

92 ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, 1-4.

93 ATP 3-11.32, *CBRN Passive Defense*, 2-12; and USAMRICD, *Medical Management of Chemical Casualties Handbook*, 10.

94 Ibid., 2-6.

95 USAMRIID, *Medical Management of Biological Casualties Handbook*, 124.

Radiological hazards that might exist after an RDD or nuclear detonation will decay over time roughly according to the following rules. For a single radionuclide (e.g., from an RDD), after 10 half-lives for the radionuclide have elapsed, the remaining radioactive material will be less than 0.1 percent of its original activity, at which point for typical radioactive waste quantities, the original contamination is considered to have decayed away. For nuclear fallout, "[f]or every seven-fold increase in time following a nuclear bomb detonation (starting at or after 1 hour), radiation exposure rates will decline by a factor of 10 due to radioactive decay. … For example, approximately 7 hours after detonation, the radiation exposure rate will have decreased to about 10 percent of radiation exposure rate that existed 1 hour after detonation."[96]

Operating in a contaminated area could pose a hazard to MEDEVAC crews or patients if they are not protected. With protective equipment, chemical and biological contamination poses little hazard, but operations in fallout contamination could still expose MEDEVAC crews or patients to gamma radiation, which would penetrate protective equipment.

Studies have shown that chemical agent can be transferred from a contaminated road to the exterior of a vehicle and redeposited onto clean areas.[97] Due to this possibility, contaminated vehicles will normally be restricted to contaminated areas until thorough decontamination occurs.[98] At the same time, test data and modeling indicate that agent pickup and transfer to vehicles traversing areas contaminated with persistent nerve agent VX or Mustard-Lewisite agent (HL) is extremely inefficient (less than 0.01% of agent transfer to vehicle), even when making assumptions that lead to relatively high ground concentrations of agent and relatively high pickup and transfer.[99] Biological agent simulant studies "suggest that secondary reaerosolization would be difficult, but may pose a human health hazard."[100]

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96 ATP 3-11.32, *CBRN Passive Defense*, 2-6.

97 Debra A. Delgado, Steven L. Brimhall, and Richard E. Brewer, *Formal Test Report for the Agent Transfer Hazard to and from Vehicles (ATHV) Field Test*, DPG/JCP-98/005 (Dugway, UT: U.S. Army Dugway Proving Ground West Desert Test Center, July 1998).

98 Headquarters, Department of the Army, *Medical Evacuation*, Army Techniques Publication 4-02.2 (Washington, DC: Headquarters, Department of the Army, July 2019), 2-33, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007289.

99 Don A. Lloyd, *Chemical Challenges for Contamination Survivability Analyses*, IDA Paper P-4348 (Alexandria, VA: Institute for Defense Analyses, May 2009), ES-3, FOUO.

100 USAMRIID, *Medical Management of Biological Casualties Handbook*, 151.

1. Civilian Aeromedical Evacuation Augmentation Not Available in Contaminated Areas

While commanders can determine the extent to which military MEDEVAC platforms will conduct operations in a contaminated area, any civilian aircraft under Department of Defense (DOD) contracts "will not conduct operations on an air base that is … contaminated at the time of flight arrival."[101] The Civil Reserve Air Fleet (CRAF) is activated when DOD airlift capacity is exceeded, and upon full activation, "the civilian sector provides almost all of [Air Mobility Command's] passenger-lift capability and a significant portion of its cargo airlift."[102] This reliance on civilian capabilities could result in a MEDEVAC shortfall if military aircraft must be diverted from AE missions to other missions previously carried out by commercial aircraft.

Historically, CRAF missions included AE as well as cargo and passenger transports,[103] although the AE mission was not referenced in the CRAF discussion in Air Force Doctrine Publication (AFDP) 3-40.[104] If CRAF assets can still be used to evacuate patients, then contaminated air bases could pose an even more direct MEDEVAC shortfall, as civilian AE augmentation would be limited to air bases free of contamination.

2. MEDEVAC Platforms Unavailable During Decontamination

MEDEVAC platforms could be contaminated by a direct or indirect attack on medical units or possibly by operating in a contaminated area, although as discussed earlier, the extent of contamination in the latter case is low.[105] Before contaminated vehicles can become available to evacuate patients in clean areas, they will need to undergo thorough decontamination,[106] during which time they will be unavailable.

The timing of platform decontamination may depend on whether the platform is needed for continued operations in a contaminated area or if the more urgent missions are located outside the contaminated areas. In the case where the platform is needed to remain in the contaminated area, contaminated MEDEVAC platforms will likely delay thorough decontamination until all patients are evacuated from contaminated areas.[107] When the

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[101] U.S. Air Force, *Counter-Weapons of Mass Destruction Operations*, Air Force Doctrine Publication 3-40 (Maxwell Air Force Base, AL: LeMay Center for Doctrine, April 2016), 59, https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-40/3-40-AFDP-CCBRN.pdf.

[102] Ibid., 59.

[103] Tamar A. Mehuron, "The Current and Future State of CRAF," *Air Force Magazine*, February 2003, https://www.airforcemag.com/article/the-current-and-future-state-of-craf/.

[104] AFDP 3-40, *Counter-Weapons of Mass Destruction Operations*, 59–60.

[105] Lloyd, *Chemical Challenges for Contamination Survivability Analyses*, ES-3.

[106] ATP 4-02.2, *Medical Evacuation*, 2-33.

[107] ATP 3-11.32, *CBRN Passive Defense*, 2-70.

mission does not permit a thorough decontamination of externally contaminated vehicles within an hour of contamination (or within six hours if they are painted with chemical agent resistant coating), they should be washed down as part of operational decontamination.[108] This timeline applies to aircraft wash-downs as well as to those for ground vehicles,[109] but larger aircraft may take longer to wash down due to their size. While thorough decontamination is manpower-intensive and renders a unit temporarily incapable of continuing its mission, operational decontamination is intentionally hastier and will remove the unit from its mission for a shorter time. Although only a short-term absence from the mission, MEDEVAC platforms will nonetheless be unavailable during operational decontamination, which could contribute to a MEDEVAC shortfall.

3. MEDEVAC Platforms Unavailable due to Battle Damage

Any time a MEDEVAC platform sustains significant damage, it could result in a MEDEVAC shortfall during the time the vehicle is not operational. The likelihood of MEDEVAC platforms sustaining battle damage varies by the type of CBRN incident. Nuclear detonations could cause considerable battle damage to MEDEVAC platforms due to the large blast radius and the drag forces of the blast winds, which "are strong enough to displace even large objects, such as vehicles."[110] CBRN incidents other than nuclear detonations, however, are no more likely to result in battle damage to MEDEVAC platforms than conventional explosive attacks are. If non-explosive dissemination means are used, then there is no battle damage, and for explosively disseminated CBR hazards, the battle damage is no greater than the equivalent rounds without agent. For this analysis, we will consider the risk of MEDEVAC platforms sustaining battle damage to be greater than in a non-CBRN environment only for nuclear environments.

4. MEDEVAC Crews Ill, Injured, Dead, in Quarantine, or at Maximum Allowable Exposure

MEDEVAC crews operating in areas with CBRN hazards could become exposed and lost to their unit for three reasons. First, they could exhibit signs and symptoms of illness or injury and become casualties. This could apply following any type of CBRN incident, especially if MEDEVAC crews were not aware of the hazard and were not wearing MOPP Level 4. Second, they could be placed in quarantine after an exposure to a contagious biological agent, although this would require a series of unlikely events. MEDEVAC crews without the appropriate MOPP level would need to be unknowingly exposed by a covert attack. Situational awareness of their possible exposure would need to be gained during the

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[108] Ibid., 2-68.

[109] Ibid., D-75.

[110] ATP 4-02.83, *Treatment of Nuclear and Radiological Casualties*, 2-7.

range of the disease's normal incubation period. Further, the disease caused by the exposure would need to be transmissible human-to-human prior to symptom onset (such as COVID-19 or influenza); otherwise, MEDEVAC crews could continue to operate during the incubation period without quarantining. The third way MEDEVAC crews could be unavailable is that they could be prohibited from operating in an area where radiation is present once they have reached the radiation safety level (RSL) defined by the commander's operational exposure guidance.[111] Shortfalls in MEDEVAC personnel could occur if MEDEVAC crews were unavailable for any of these reasons.

5. Aeromedical Evacuation Pilot Flying Hours Restricted due to Wearing Protective Equipment

AE crews operating in areas with CBRN hazards may need to operate in MOPP Level 3 or 4 to protect themselves from exposure. Flying hours for AE pilots in these MOPP levels are limited to three hours per day, with exceptions "limited to a case by case basis."[112] Unless exceptions are approved, the requirement to operate in MOPP Level 3 or 4 may therefore result in MEDEVAC shortfalls if demand for AE exceeds the crew availability.

6. MEDEVAC Crew Capability Degraded due to Wearing Protective Equipment

Like all military personnel, MEDEVAC crews are required to don MOPP Level 4 following a CBRN attack to protect themselves from CBRN hazards.[113] All MEDEVAC crews operating in a contaminated area will therefore experience a degradation in capability as a result of wearing MOPP Level 4. Their ability to see, speak, and hear will be degraded by the protective mask and hood, their sense of touch will be limited due to the rubber gloves, and tasks requiring fine motor skills will be hampered.[114]

7. MTF Beds Contaminated or Destroyed

Although MTFs may be able to operate for a limited time in a nonpersistent agent environment, they are incapable of operating when contaminated by a persistent agent without a collective protection system.[115] MTFs that are not collectively protected "should

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[111] Medical Evacuation Concepts & Capabilities Division (MECCD) and School of Army Aviation Medicine (SAAM), "U.S. Army MEDEVAC Critical Care Flight Paramedic Standard Medical Operations Guidelines, CY20 Version," Ft. Rucker, AL: MECCD, January 2020, 81, https://www.milsuite.mil/book/groups/army-air-medevac-operations; and ATP 3-11.32, *CBRN Passive Defense*, 2-76.

[112] Ibid., 81.

[113] ATP 4-02.7, *Health Service Support*, 3-2.

[114] Ibid., 3-2.

[115] Ibid., 12-1.

stop receiving casualties when a persistent hazard is identified," triggering at least a temporary reduction in MTF bed capacity until the hazard is eliminated.[116]

Even if protected from contamination, MTF beds could be lost due to battle damage to the MTF. While such damage could occur in any CBRN environment, the CBRN incident likely to cause the greatest reduction in MTF bed capacity is a nuclear detonation due to its large area of destruction. The loss of MTF beds due to battle damage could contribute to MTF bed shortfalls

8. MTF Personnel Ill, Injured, Dead, or in Quarantine

Following a CBRN attack, MTF personnel could become losses to their units due to illness, injury, or the need to quarantine. MTF personnel at forward units are generally at higher risk than those in the rear. MTF personnel could exhibit symptoms of exposure within minutes for some chemical agents or toxins, but may not show symptoms for several days for most biological agents. If between exposure and symptom onset, MTF personnel became aware of their exposure to a contagious biological agent that caused disease that could be transmitted person-to-person prior to symptom onset (like COVID-19 or influenza), then they should be quarantined to avoid exposing others. Although MTF personnel are subject to operational exposure guidance like other military personnel,[117] the MTF provides protection from radiological contamination, including nuclear fallout, which can be brushed or washed off, allowing "protection while permitting casualty care to continue virtually uninterrupted."[118] Therefore, the loss of MTF personnel due to having reached their maximum allowable radiation exposure limit is unlikely. Lastly, MTF personnel could become casualties because of the prompt effects of a nuclear detonation. Whether due to illness, injury, quarantine, or death, the loss of MTF personnel following a CBRN exposure could lead to an MTF personnel shortfall.

9. MTF Personnel Availability Restricted by Work/Rest Cycles due to Wearing Protective Equipment

"In a CBRN incident, military personnel, including medical personnel, will be required to don MOPP IPE."[119] While the MOPP level depends on the threat, when a CBRN alarm activates or a threat is otherwise known or suspected to be present, MTF personnel don MOPP Level 4 and stay at that MOPP level until the all clear is given.[120]

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[116] Ibid., 3-14.

[117] ATP 3-11.32, *CBRN Passive Defense*, 2-30.

[118] ATP 4-02.7, *Health Service Support*, 3-12.

[119] Ibid., 3-2.

[120] Ibid., 3-9.

Since extensive use of MOPP Level 4 can lead to heat stress, personnel are directed to decrease the work/rest ratio while operating in MOPP Level 4.[121] Assuming this recommendation is followed by medical personnel, MTF personnel would rest for a greater fraction of each hour, reducing their ability to contribute to patient management. If the urgency of the mission is so great that medical personnel ignore the recommendation to rest, then there is a greater chance they succumb to heat exhaustion.[122] In the case of either the periodic rests or the longer period of time lost due to heat exhaustion, the reduction in patient treatment time could contribute to an MTF personnel shortfall.

10. MTF Personnel Ability to Deliver Medical Care Degraded due to Wearing Protective Equipment

If MTF personnel need to operate while wearing MOPP Level 4, not only could they become less effective due to increased periods of mandatory rest (or heat exhaustion), but during the periods of work, MOPP Level 4 could degrade their capabilities. The increased temperature, limited sense of touch, and possible psychological stress that can be caused by wearing MOPP Level 4 can all reduce the effectiveness of MTF personnel.[123] Since both patients and MTF personnel need to be protected in a CBRN environment, both groups are likely to be wearing MOPP Level 4, further contributing to the reduction in the level of patient care.[124] Capability degradation due to wearing MOPP Level 4 represents yet another way that operating in a CBRN environment can cause an MTF personnel shortfall.

11. Medical Materiel Contaminated or Destroyed

The loss of medical materiel is another possible adverse medical regulating impact that could result from operating in a CBRN environment. Medical equipment and other materiel could become unavailable for a number of reasons. The electromagnetic pulse produced by nuclear weapons could destroy electronic medical equipment.[125] Battle damage from nuclear or conventional explosions could also destroy some materiel or equipment. Chemical, biological, or radiological contamination or the chemical decontaminants could render some materiel unsafe to use for patient care and require its disposal. For sensitive medical equipment that could be harmed by chemical decontamination, "[a]ging (allowing the agent to off-gas) may be the only means of decontamination."[126] Even if medical supplies and materiel can be decontaminated, they

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[121] ATP 3-11.32, *CBRN Passive Defense*, C-7.

[122] ATP 4-02.7, *Health Service Support*, 3-2.

[123] Ibid., 3-2.

[124] Ibid., 3-8.

[125] Ibid., 12-1.

[126] Ibid., 12-1.

will be unavailable for patient treatment during that time. The destruction, disposal, or required decontamination of medical materiel could cause a medical materiel shortfall.

12. Patients Exposed in MTF or During Evacuation

Patients evacuated through or treated in a contaminated area are at risk of being exposed to CBRN hazards. The risks apply to both CBRN patients (who could increase their exposure) and conventional patients with no prior CBRN exposure. For patients in MTFs, "treatment procedures in an actively contaminated area involving an open wound or the respiratory tract are limited. Exposing open wounds and the respiratory tract can provide a route of entry for the CBRN agent."[127] Patients that were decontaminated or never exposed that must be evacuated from an MTF through a contaminated area should be provided MOPP gear or placed in patient protective wraps to prevent exposure.[128]

F. Summary

In this chapter, we described multiple ways that each of the four medical challenges of the CBRN environment can cause five adverse medical impacts: MEDEVAC shortfalls, MTF bed shortfalls, MTF personnel shortfalls, medical materiel shortfalls, and CBRN exposure to patients. Some of the causes of adverse medical impacts were common to all types of CBRN environment, and some applied only to certain CBRN hazards. Table 1 summarizes how the medical challenges associated with each type of CBRN hazard can cause adverse medical regulating impacts. The causes are color coded according to the resulting adverse medical regulating impact: red = MEDEVAC shortfalls, blue = MTF bed shortfalls, yellow = MTF personnel shortfalls, purple = medical materiel shortfalls, and green = CBRN exposure to patients.

A "Yes" in Table 1 indicates that a CBRN hazard could cause a medical regulating impact in the way described in the corresponding row, whereas a "No" indicates that the cause in the corresponding row is not applicable to that category of CBRN hazard. For biological agents causing non-contagious diseases, some causes were theoretically possible but would require a series of unlikely steps discussed earlier; these are marked as "Possible but unlikely." We did not judge CBRN hazards other than nuclear detonations to cause battle damage to MEDEVAC platforms to an extent beyond that expected in a non-CBRN environment. For that reason, we viewed MEDEVAC platforms being unavailable due to battle damage as applicable only to nuclear hazards, and we designated non-nuclear CBRN hazards as "No more likely than non-CBRN environment" to cause MEDEVAC shortfalls in this way in Table 1. Lastly, some CBRN hazards could cause an adverse medical regulating impact under some circumstances, which could depend on the form of the

[127] Ibid., 3-6.

[128] ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, C-5–C-6.

CBRN hazard (e.g., vapor, liquid), knowledge of an attack and the associated protective measures taken to prevent exposure, and the time after exposure of patient entry into the medical system. These instances are marked as “In some cases” in Table 1.

Table 1. How Various CBRN Hazards Can Cause Adverse Medical Regulating Impacts

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Applicability to various CBRN hazards				
		Chemical/Toxin	Biological: Non-contagious	Biological: Contagious	Radiological	Nuclear
Mass Casualties	Patients exceed available MEDEVAC capacity	Yes	Yes	Yes	Yes	Yes
	Patients exceed available MTF beds					
	Patients exceed available MTF personnel					
	Patients exceed available materiel materiel					
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	Yes	Yes	Yes	Yes	Yes
	Patient stream does not align with available medical materiel					
Contaminated or Contagious Patients	Administrative/legal challenges to international AE of contagious patients	No	No	Yes	No	No
	AE platforms unavailable during disinfection after international AE of contagious patients					
	MEDEVAC crews ill, injured, dead, or in quarantine	In some cases	Possible but unlikely	Yes	No	No
	MEDEVAC crew capability degraded due to wearing protective equipment	Yes	In some cases	In some cases	Yes	Yes
	MTF personnel ill, injured, dead, or in quarantine	In some cases	Possible but unlikely	Yes	No	No
	MTF personnel unavailable due to overseeing patient decontamination	Yes	In some cases	In some cases	Yes	Yes
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	In some cases	In some cases	In some cases	In some cases	In some cases
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment					
	Patients exposed in MTF or during evacuation	In some cases	Possible but unlikely	Yes	No	No
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas	Yes	Yes	Yes	Yes	Yes
	MEDEVAC platforms unavailable during decontamination					
	MEDEVAC platforms unavailable due to battle damage	No more likely than non-CBRN environment	No more likely than non-CBRN environment	No more likely than non-CBRN environment	No more likely than non-CBRN environment	Yes
	MEDEVAC crews ill, injured, dead, in quarantine, or at maximum allowable exposure	Yes	Yes	Yes	Yes	Yes
	AE pilot flying hours restricted due to wearing protective equipment					
	MEDEVAC crew capability degraded due to wearing protective equipment					
	MTF beds contaminated or destroyed					
	MTF personnel ill, injured, dead, or in quarantine					
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment					
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment					
	Medical materiel contaminated or destroyed					
	Patients exposed in MTF or during evacuation					

MEDEVAC shortfalls MTF bed shortfalls MTF personnel shortfalls Medical materiel shortfalls CBRN exposure to patients

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3. Concepts for Preventing or Mitigating Adverse Impacts of CBRN Challenges on Medical Regulating

A. Scope

This chapter uses the framework presented in Chapter 2 to evaluate concepts to address the adverse medical regulating impacts caused by operating in a CBRN environment. To derive these concepts, we reviewed the same categories of literature as we did to characterize the challenges: U.S. Army, Air Force, and Joint medical and CBRN doctrine; NATO medical doctrine; COVID-19 patient movement guidance; and non-doctrinal reports and articles related to medical regulating in a CBRN environment. We identified several solutions to existing medical regulating problems that also apply to a CBRN environment and some concepts that are unique to medical regulating in a CBRN environment.

We assessed concepts that addressed the adverse medical regulating impacts in two different ways. Some concepts, such as augmenting evacuation capacity, could *mitigate an adverse medical regulating impact* caused by one or more medical challenges of the CBRN environment. In this example, additional evacuation assets would be activated to compensate for MEDEVAC shortfalls. Concepts, such as isolating contagious patients during evacuation, could *prevent or reduce an adverse medical regulating impact* from being caused by a medical challenge of the CBRN environment. In this case, contagious patients would be prevented from causing MEDEVAC crew shortfalls or exposing other patients. By comparison, concepts that *prevent a medical challenge of the CBRN environment* from occurring were excluded from assessment. Although concepts addressing the employment of passive defense measures, such as detection, masking, and vaccination, may reduce patient loads and consequently ease medical regulating, these concepts are out of scope, as uninjured warfighters are not subject to medical regulating.

There were two responses to operating in a CBRN environment that we took as given rather than assessing them as concepts: 1) medical personnel, like all military personnel, would don MOPP gear appropriate to the CBRN threat[129] and 2) MTF personnel would deny suspected contaminated patients entry into the MTF until after decontamination.[130]

[129] ATP 4-02.7, *Health Service Support*, 3-2.

[130] Ibid., 12-15.

These actions arguably meet our concept selection criteria, and they are intended to prevent or mitigate some of the adverse medical regulating impacts. Nonetheless, we chose to treat them as assumed responses because some of the adverse medical regulating impacts described in Chapter 2 are uniquely caused by these responses, and we wanted to assess concepts to prevent or mitigate those adverse impacts.

The remainder of this chapter analyzes the 11 concepts listed below.

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3. Change the theater patient movement (PM) policy
    a. Shorten the theater PM policy
    b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

Readers may note that some familiar solutions are missing from this list. For instance, Air Force Tactics, Techniques, and Procedures (AFTTP) 3-42.22 notes that treatment in place (TIP) "may be required for patients with various contagious diseases."[131] It describes TIP as holding patients who otherwise would have been evacuated, while relying on reach-back support and augmentation of medical resources.[132] This description of TIP aligns very well with the combination of three concepts from the list above: 1) change theater patient movement policy, 2) use telemedicine, and 3) augment medical support capabilities. Similarly, deploying a specialized isolation facility could be thought of as a combination of two concepts: 1) augment medical support capabilities, and 2) designate an MTF for contagious patients only. Although any subset of the concepts described in this chapter could be used in combination, we did not specifically assess any solutions that consisted of multiple concepts.

[131] AFTTP 3-42.22, *Contagious Casualty Management*, 6.

[132] Ibid., 6–7.

B. Concept Assessment

In this section, we describe the concepts listed above in detail. For each concept, we discuss various implementation options, review whether the concept is consistent with U.S. and NATO doctrine, and summarize the concept's benefits, costs, operational constraints, and planning considerations. Benefits include those that directly prevent or mitigate an adverse medical regulating impact and those that benefit things other than the five components of medical regulating. Costs could include exacerbating another medical regulating impact and other drawbacks, such as financial costs and training requirements. Operational constraints are factors of the operational environment that influence when and whether a concept can be implemented effectively. Lastly, planning considerations are actions medical planners and medical staffs could take in advance to enable a concept to be implemented most effectively. For brevity, a table at the end of each concept summarizes the concept's benefits, costs, operational constraints, and planning considerations, but each entry in the table is hyperlinked to an associated section in Appendix A where the concept assessments are explained in detail.

All concept assessments are qualitative. We planned to use the Joint Medical Planning Tool (JMPT) to simulate the medical regulating process and derive some quantitative metrics of each concept's benefits and costs. However, there were limitations and challenges to modeling enough of the concepts that any results would be incomplete, and meaningful comparisons across concepts would be impossible. Consequently, we decided that the effort to generate limited quantitative results was not feasible.

1. Augment Medical Support Capabilities

Although the concept of augmenting medical capabilities to mitigate a shortfall is not unique to CBRN environments, it is applicable to all types of CBRN environment. Not only could any CBRN incident exacerbate an MTF bed, personnel or medical materiel shortfall, but doctrine specifically cites the quick provision of additional medical personnel and equipment as a necessity "if the level of care is to be maintained" in a CBRN mass casualty scenario. Contagious disease environments in particular are likely to require "a capability for rapid augmentation of both materiel (medical supplies, PPE (personal protective equipment), ventilators, tentage, etc.) and personnel" due to the preference to treat contagious patients in place rather than evacuate them. In this assessment, we considered four forms of medical support capability augmentation:

- Additional medical units or detachments,
- Host nation civilian medical capabilities,
- Medical materiel, and
- Nonmedical personnel or other medical personnel operating in a non-standard capacity.

a. Additional Medical Units or Detachments

Augmenting medical support capabilities using military medical units or detachments could encompass both "re-deployment of available in-theater assets to augment the local effort" and a request for augmenting capabilities from outside the theater.[133] The modular expansion of medical services used by the U.S. Air Force (USAF)[134] and being adopted by the U.S. Army with the ongoing conversion of combat support hospitals to hospital centers allows for the easy integration of hospital augmentation detachments with specific clinical specialties.[135]

Augmentation of medical support capabilities could also take the form of specialized medical augmentation teams, which offer expert knowledge and skills.[136] The USAF Medical Infectious Disease (ID) Team, for instance, can "provide expertise to identify, quantify, and mitigate operational risks when other fielded capabilities may be exceeded, [educate] deployed medical staff on infection control practices and procedures and contagious casualty management, and oversee operation of a contagious patient isolation unit."[137] U.S. Army capabilities include multiple Specialized Medical Response Capabilities (SMRC) teams that are capable of rapidly deploying in support of CBRN incidents.[138] These include teams specializing in investigational new drugs, radiological incidents, burn patients, and public health. The United States Army Medical Research Institute of Infectious Diseases (USAMRIID) has also historically maintained rapid response teams that can deploy on short notice to provide expertise on managing outbreaks or infectious disease patients.[139]

b. Host Nation Civilian Medical Capabilities

Another option for augmenting medical support capabilities is to partner with a host nation civilian hospital to use available capabilities within their facility (beds, personnel, and/or materiel). Although we did not find doctrinal validation of the use of host nation civilian medical personnel to augment U.S. medical personnel, a model for this concept has already been established in Kuwait, where U.S. service members have access to

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[133] Ibid., 4.

[134] Headquarters, Air Combat Command, *Expeditionary Medical Support (EMEDS) and Air Force Theater Hospital (AFTH)*, Air Force Tactics, Techniques, and Procedures 3-42.71 (Hampton, VA: Headquarters, Air Combat Command, August 2014), 7, https://static.e-publishing.af.mil/production/1/af_sg/publication/afttp3-42.71/afttp3-42.71.pdf.

[135] ATP 4-02.10, *Theater Hospitalization*, 1-4–1-5.

[136] JP 4-02, *Joint Health Services*, IV-15.

[137] AFTTP 3-42.22, *Contagious Casualty Management*, 11.

[138] ATP 4-02.7, *Health Service Support*, C-1.

[139] U.S. Army Medical Research Institute of Infectious Diseases, "Biodefense Solutions to Protect Our Nation," accessed 12 July 2021, https://www.usamriid.army.mil/images/USAMRIIDBrochure.pdf.

specialty services at Kuwait civilian medical facilities.[140] This peacetime partnership with Kuwait host nation hospitals "makes it possible for U.S. service members to receive both timely and quality medical care while remaining in theater."[141] A similar agreement could theoretically be established with host nation civilian medical facilities to assist in a MASCAL situation during a conflict. A risk of this option is that civilian hospitals may be overrun by civilian patients caused by the same CBRN incident that led to the military medical capability shortfall, diminishing their capacity to help.

c. Medical Materiel

Medical materiel augmentation requests could be made to mitigate specific medical materiel shortfalls or there could be specialized equipment sets prepackaged in case of a CBRN emergency. For instance, AFTTP 3-42.22 lists several pre-defined equipment sets that can be used to support a contagious casualty management event. These include packages for Hospital Medical Expansion Equipment, Contagious Casualty Management Equipment, and Infectious Disease Team Equipment.[142] The Army manages medical nuclear, biological, and chemical defense materiel as deployable force package sets.[143] Having already anticipated the likely shortfalls in the event of a CBRN incident and prepared the appropriate medical materiel is likely to streamline the augmentation of medical materiel when needed.

The timeliness of augmentation "will be dependent on whether there are pre-positioned assets or how [equipment] sets are postured in the TPFDL (Time Phased Force Deployment List)."[144] In order to increase the likelihood that augmentation arrives when needed, "medical planners should give strong consideration to pre-positioning required supplies in theater during deliberate and crisis action planning."[145]

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[140] Andy Thaggard, "Kuwait Land Forces Director of Military Medical Health Authority Visits U.S. Military Hospital - Kuw," *Army.mil*, May 8, 2019, https://www.army.mil/article/221555/kuwait_land_forces_director_of_military_medical_health_authority_visits_u_s_military_hospital_kuw.

[141] Nahjier Williams, "The Value of Military and Civilian Medical Partnerships in Kuwait," *U.S. Army Central*, April 24, 2019, https://www.usarcent.army.mil/News/Article/1825407/the-value-of-military-and-civilian-medical-partnerships-in-kuwait.

[142] AFTTP 3-42.22, *Contagious Casualty Management*, 12–13.

[143] Headquarters, Department of the Army, *Medical Logistics Policies*, Army Regulation 40-61 (Washington, DC: Headquarters, Department of the Army, January 2005), 49, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=520.

[144] AFTTP 3-42.22, *Contagious Casualty Management*, 12.

[145] Ibid., 6–7.

d. Nonmedical Personnel or Other Medical Personnel Operating in a Non-Standard Capacity

Yet another medical support capability augmentation option is to augment MTF personnel with nonmedical personnel or other medical personnel operating in a non-standard capacity, such as:

- Dental personnel performing triage, emergency medical treatment, or CBRN patient management;
- Veterinary personnel providing wound care, intubation, or intravenous infusion techniques to (human) patients; and
- Nonmedical personnel administering medical countermeasures, monitoring patient vital signs, or serving as litter bearers.

The goal of this form of medical personnel augmentation would be to "allow a limited number of professional [medical] personnel to care for the maximum number of patients."[146] Delegating some duties to "augmentees" could free up medical personnel to perform the specialized tasks for which they are most uniquely qualified.

Multiple U.S. doctrinal publications support the concept of augmenting medical personnel with dental personnel during a mass casualty event. ATP 4-02.19 asserts that "[d]ental personnel have the additional wartime role of augmenting medical personnel during mass casualty situations"[147] and explicitly cites CBRN casualty management as among the areas "[d]ental officers and personnel may be called upon to render assistance."[148] Similarly, Joint Publication (JP) 4-02 describes "augment[ing] medical assets during mass casualty situations" as the "secondary mission" of dental services.[149] Consistent with this concept, an example mass casualty plan in ATP 4-02.13 tasks dental officers with performing casualty care.[150]

Members of the veterinary services are also logical candidates to augment medical personnel as "the veterinarian's training and capability in emergency management, wound care/treatment, pharmaceutical and medical supplies, and knowledge of population and

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[146] ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-17.

[147] Headquarters, Department of the Army, *Dental Services*, Army Techniques Publication 4-02.19 (Washington, DC: Headquarters, Department of the Army, August 2020), 1-8, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1020499.

[148] Ibid., 1-8.

[149] JP 4-02, *Joint Health Services*, VI-5.

[150] Headquarters, Department of the Army, *Casualty Evacuation*, Army Techniques Publication 4-02.13 (Washington, DC: Headquarters, Department of the Army, June 2021), A-2, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1022529.

public health [could] be used to augment the capacity of the human healthcare system."[151] Although JP 4-02 does not mention veterinary services as having a role in augmenting medical personnel by treating patients during mass casualty scenarios, the concept is supported by the American Veterinary Medical Association (AVMA). The AVMA policy "Addressing the role of veterinary medicine in human health care following catastrophes involving mass human casualty" states, "Members of the veterinary profession possess medical skills and surgical capabilities that could greatly contribute to reducing human loss of life or limb and human suffering in a catastrophic event that overwhelms the human health care infrastructure."[152]

While nonmedical personnel will certainly have a role in augmenting medical personnel in mass casualty scenarios, the extent of their involvement in managing patients will depend on the requirements of the situation and the judgment of the augmented medical personnel. Doctrine specifies that nonmedical personnel, including minimally injured patients, could augment medical personnel "as runners, litter bearers, or guides to free up medical personnel so they can attend to medical tasks"[153] and "may be used to assist the treatment teams at the discretion of the treatment or triage officers."[154] This leaves open the possibility that nonmedical personnel could perform tasks usually under the purview of trained medical professionals, such as administering medical countermeasures or monitoring patient vital signs.

In a mass casualty scenario, medical personnel must balance the competing goals of providing medical care to as many patients as possible and ensuring patient care is performed by appropriately qualified providers. Even in a routine setting, medical personnel may delegate "the authority to perform a selected patient care task in a given situation" to "a competent individual."[155] Delegated tasks must meet the following criteria:

> (1) Frequently or routinely reoccur in the daily care of a patient or group of patients (that is, vital signs, intake and output, select exercises/activity routines, preparation for or conducting certain diagnostic procedures or tests, and so forth).
>
> (2) Do not require the individual to exercise independent judgment.

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[151] "Addressing the Role of Veterinary Medicine in Human Health Care following Catastrophes Involving Mass Human Casualty," American Veterinary Medical Association Website, accessed January 27, 2021, https://www.avma.org/resources-tools/avma-policies/addressing-role-veterinary-medicine-human-health-care-following-catastrophes-involving.

[152] Ibid."

[153] ATP 4-02.3, *Support to Maneuver Forces*, A-4.

[154] ATP 4-02.13, *Casualty Evacuation*, A-3.

[155] Headquarters, Department of the Army, *Clinical Quality Management*, Army Regulation 40-68 (Washington, DC: Headquarters, Department of the Army, February 2004), 21, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=66994.

(3) Do not require complex and/or multi-dimensional application of the clinical or nursing process.

(4) Have predictable results and minimal potential risk to the patient.

(5) Use an established and unchanging procedure (that is, protocol, [clinical practice guideline], or standing operating procedure).[156]

In context, delegation is meant to be limited to health care personnel, but the same principles would apply to delegating patient care activities to nonmedical personnel. Understanding that "[t]here may be significant differences in the methods of providing basic medical care in mass casualty situations,"[157] the determination of which patient care activities are appropriate to delegate may fall to the professional judgment of augmented medical personnel and would likely depend on the specific scenario and the degree to which the medical system is overwhelmed. When patients drastically exceed the capacity of medical personnel to care for them, the provision of non-standard care may be better than no care at all.

Table 2. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Augmenting Medical Support Capabilities

Benefits
• Mitigates MTF bed shortfall by increasing bed capacity • Mitigates MTF personnel shortfall due to patients exceeding available MTF personnel by increasing the number of personnel available to manage patients • Mitigates MTF personnel shortfall due to misalignment of MTF personnel capabilities with patient needs by introducing specialist capabilities (augmentation by specialized medical augmentation teams) • Mitigates medical materiel shortfall by increasing supply of medical materiel
Costs
• Increases sustainment requirements (additional medical units or detachments) • Requires time for augmentation to become available after request • Entails opportunity cost of deploying medical resources instead of other requirements • Requires identification and training of dental, veterinary, or nonmedical personnel augmentees • Precludes dental, veterinary, or nonmedical personnel augmentees from performing their regular duties
Operational Constraints
• Non-permissive environments may preclude augmenting medical support capabilities using civilian medical capabilities

[156] Ibid., 21.

[157] ATP 4-02.84, *Treatment of Biological Warfare Agent Casualties*, 1-17.

Planning Considerations
• Negotiate a mutual assistance agreement prior to operation to use host nation civilian medical capabilities • Consider which medical materiel will be needed for each type of CBRN incident and preposition in-theater

2. Use Lateral or Skip Evacuation

The military medical system is organized to provide continuity of care from point of injury to definitive care, achieved by moving patients through an integrated, progressive system of MTFs. Each type of medical facility "contributes a measured, logical increment of care appropriate to its location and capabilities."[158] Patients typically follow a linear path through the medical system, from battalion-level First Responder Care (Role 1) through brigade-level Forward Resuscitative Care (Role 2), Theater Hospitalization (Role 3), and Definitive Care (Role 4) as needed.

Lateral evacuation is the transfer of a patient from one MTF to another that provides the same level of care, say from one Role 2 facility to another Role 2 facility. At lower levels of care, movements of this type could expand the deployed medical system's capacity to hold patients requiring short-term care. Mild nerve agent casualties, for example, can RTD within eight days of injury; most chemical mustard casualties suffering from mild ocular or skin exposures can RTD even sooner.[159] At higher levels of care, transfer of patients from one hospital to another can help distribute patient load among the resources available to care for them.

Skip evacuation is the bypassing of intermediate levels of care when moving a patient from one level of care to a higher one, for example from Role 1 to Role 3. Movements of this type will improve the efficiency of managing biological or radiological patients whose condition is initially mild, but expected to become serious or life threatening. For these patients, following a linear path through all levels of care would unnecessarily consume resources at intermediate facilities that essentially function as waypoints in the movement chain. Since each level of care will have all of the capability of every level below it, skip evacuation can ameliorate patient loads at intermediate levels of care, particularly in MASCAL situations. Finally, skip evacuation can be used to expedite the application of highly specialized or limited issue medical capabilities needed to manage CBRN casualties that are available only at Role 3 and Role 4.

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[158] JP 4-02, *Joint Health Services*, I-2.

[159] North Atlantic Treaty Organization, *NATO Planning Guide for the Estimation of CBRN Casualties*, Allied Medical Publication 7.5, Edition A, Version 1, NATO STANAG 2553 (Brussels, Belgium: NATO Standardization Office, October 2017), 4-11–4-32, https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.5_EDA_V1_2553.pdf.

Table 3. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Using Lateral or Skip Evacuation

Benefits
• Mitigates MTF bed shortfall by increasing the supply of available beds • Mitigates MTF personnel shortfall by increasing the supply of MTF personnel • Mitigates MTF personnel shortfall due to misalignment of MTF personnel capabilities with patient needs by transporting patients to specialists • Mitigates medical materiel shortfall by increasing the supply of available medical resources
Costs
• Exacerbates MEDEVAC shortfall by increasing demand on MEDEVAC platforms • Increases requirements for tracking and coordinating medical resources
Operational Constraints
• Requires available capacity and capability at nearby MTFs
Planning Considerations
• Consider synergistic effect with designating an MTF for contagious patients only and isolating contagious patients during evacuation

3. Change the Theater PM Policy

Changing the theater patient movement policy[160] is a concept that can help balance demands on theater patient treatment resources and intertheater evacuation resources in order to mitigate a capacity shortfall in either treatment or evacuation resources. The theater PM policy, determined by the geographic combatant commander prior to an operation, establishes "the maximum number of days that patients may be held within the command for treatment prior to further movement or return to duty. Patients who cannot return to duty within the specified number of days are evacuated to the next higher level of care for further treatment."[161] The policy is intended to balance "the treatment capability available at each level of care against the required medical PM assets"[162] and is designed to be flexible and change during the operation as needed to maintain that balance.[163]

To strike a balance between medical treatment and evacuation demands, the theater PM policy can be adjusted to be longer or shorter, depending on which part of the medical

[160] The preferred term in NATO is *theatre patient holding policy*, which is defined as "a command decision for planning purposes, that indicates the maximum number of days that a patient will be allowed to remain in the theatre of operations for treatment, recovery and return to duty." "NATOTerm," s.v. "theatre patient holding policy," accessed December 14, 2020, https://nso.nato.int/natoterm.

[161] JP 4-02, *Joint Health Services*, VI-11.

[162] Ibid., VI-13.

[163] Ibid., VI-11.

system is overburdened. If MEDEVAC capacity is exceeded, then extending the theater PM policy could reduce the demand for evacuation by holding some additional patients in theater until they fully recover. In contrast, shortening the theater PM policy if treatment capacity is exceeded could reduce the demand on MTFs by evacuating patients that would have otherwise recovered in theater and freeing bed space for additional patients. Both lengthening and shortening the theater PM policy increase demand on one part of the medical system (treatment or evacuation) with excess capacity to ease pressure on the other part that is over capacity.

Table 4. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Shortening the Theater PM Policy

Benefits
• Mitigates MTF bed shortfall by decreasing MTF bed demand • Mitigates MTF personnel shortfall by decreasing demand on MTF personnel • Mitigates medical materiel shortfall by decreasing demand on MTF materiel resources
Costs
• Exacerbates MEDEVAC shortfall by increasing MEDEVAC demand • Increases need for replacement personnel • Increases demand on treatment resources outside of theater
Operational constraints
• Requires that some patients RTD between original and shortened policies • May be challenging in environments with contested airspace

Table 5. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Lengthening the Theater PM Policy

Benefits
• Mitigates MEDEVAC shortfall by decreasing MEDEVAC demand • Minimizes disease spread outside of theater (contagious biological environment) • Reduces need for replacement personnel • Decreases demand on treatment resources outside of theater
Costs
• Exacerbates MTF bed shortfall by increasing MTF bed demand • Exacerbates MTF personnel shortfall by increasing demand on MTF personnel • Exacerbates medical materiel shortfall by increasing demand on MTF materiel resources • Increases requirements for nonmedical logistics support
Operational Constraints
• May require augmentation with specialized medical capabilities • Requires that some patients RTD between original and lengthened policies

4. Augment Evacuation Capacity

Medical planners should prepare to rapidly augment evacuation capacity in any operation, but especially when operating in a CBRN environment, as multiple CBRN challenges can contribute to MEDEVAC shortfalls. When planning for augmentation, medical planners "should consider using all means of evacuation,"[164] including additional military MEDEVAC assets and alternatives to dedicated military medical platforms. This analysis considered the following means of augmenting evacuation capacity, which are further described below:

- MEDEVAC via additional dedicated military platforms,
- MEDEVAC via dedicated private/commercial platforms, and
- CASEVAC via nonmedical military platforms.

U.S. doctrine supports the augmentation of theater evacuation capacity with USTRANSCOM assets when "theater PM [patient movement] assets are unable to execute all PM requirements."[165] The preferred means of evacuating casualties is via MEDEVAC ground/air ambulance platforms, which are "platforms exclusively employed for the evacuation and en route care of wounded, injured, or ill casualties and for the transport of medical personnel and equipment by military medical personnel."[166] If additional military MEDEVAC assets are not available, both U.S. and NATO doctrine support the utilization of contract commercial air ambulance assets to augment evacuation capacity.[167]

Whereas MEDEVAC is limited to the use of dedicated platforms with dedicated medical crews, CASEVAC can range from "nondedicated, but tasked, platforms [ground or air] augmented with medical equipment and providers to platforms of opportunity without medical equipment or providers."[168] The use of nonmedical platforms to provide additional evacuation capacity is promoted in doctrine when "increased casualty rates overwhelm medical resources."[169] MEDEVAC is preferred over CASEVAC because "[t]he provision of en route care on medically equipped vehicles or aircraft greatly

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[164] ATP 4-02.2, *Medical Evacuation*, 2-29.

[165] JP 4-02, *Joint Health Services*, A-3.

[166] ATP 4-02.2, *Medical Evacuation*, 1-6.

[167] JP 4-02, *Joint Health Services*, A-4; and North Atlantic Treaty Organization, *Allied Joint Medical Doctrine for Medical Evacuation*, Allied Joint Medical Publication 2, Edition A, Version 1, NATO STANAG 2546 (Brussels, Belgium: NATO Standardization Office, August 2018), 1-4, https://www.coemed.org/files/stanags/02_AJMEDP/AJMedP-2_EDA_V1_E_2546.pdf.

[168] FM 4-02, *Army Health System*, 1-6.

[169] ADP 4-0, *Sustainment*, 3-11.

enhances the patient's potential for recovery and may reduce long-term disability by maintaining the patient's medical condition in a more stable manner."[170]

Table 6. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Augmenting Evacuation Capacity

Benefits
• Mitigates MEDEVAC shortfall by increasing evacuation capacity and reducing time patients wait for evacuation
Costs
• Increases sustainment requirements (MEDEVAC via additional dedicated military platforms) • May increase mortality among patients evacuated via CASEVAC • Requires time for augmentation to become available after request (MEDEVAC via dedicated military or private/commercial platforms) • Entails financial costs of contract (MEDEVAC via dedicated private/commercial platforms)
Operational Constraints
• Non-permissive environments may preclude augmenting evacuation capacity via aircraft or private/commercial platforms
Planning Considerations
• Pre-plan for CASEVAC • Negotiate contracts with private/commercial MEDEVAC services prior to the operation on a contingency basis • Consider synergistic effect of using private/commercial MEDEVAC platforms with contagious patient isolation capabilities

5. Expand Patient Staging Facility Capacity

A patient staging facility is a temporary holding capability where stabilized patients[171] are collocated under medical supervision and prepared for intertheater aeromedical evacuation to a Role 4 MTF. NATO doctrine refers to this capability as a casualty staging unit (CSU), and the U.S. capability is called the En Route Patient Staging System (ERPSS) and is a USAF asset. Patient staging facilities are typically collocated with an MTF or at an airfield.[172] Each patient staging facility has a patient holding capacity defined by the

[170] ATP 4-02.2, *Medical Evacuation*, 1-6.

[171] A stable patient is "[o]ne who, in the best clinical judgment of the responsible medical provider, can withstand a bed-to-bed evacuation of up to 12 hours for intratheater movement and 48 hours intertheater and is unlikely to require intervention beyond the scope of standard ERC [en route care] capability during the evacuation." JP 4-02, *Joint Health Services*, A-12.

[172] ATP 4-02.2, *Medical Evacuation*, 6-8; ATP 4-02.55, *Army Health System Support Planning*, J-10; Headquarters, Air Mobility Command, *En Route Patient Staging System*, Air Force Tactics,

number of beds available and the maximum amount of time patients can be held. Expanding the patient staging facility capacity to accommodate more patients or hold patients longer could help overcome some of the challenges of medical regulating in a CBRN environment.

Expanding the patient staging facility capacity is particularly beneficial when both the MTFs and MEDEVAC assets are overloaded. Expansion would allow MTFs to transfer stabilized patients in order to free up beds and treat the backlog of patients even if no MEDEVAC assets were immediately available to evacuate those patients. In the case of a MEDEVAC shortfall but not an MTF shortfall, however, patients should be held in the MTF until MEDEVAC becomes available, as the patient staging facility lacks specialized capabilities present in the MTF, such as "laboratory, surgical, x-ray, or blood bank capabilities"[173] and does not support critically ill patients.[174] Likewise, in the case of an MTF shortfall but not a MEDEVAC shortfall, patient staging facility expansion is not necessary, since patients will not need to wait long for MEDEVAC at the patient staging facility.

Consistent with this concept of expanding capacity, the U.S. developed the ERPSS "with a building construct that allows medical planners to right size the facility requirements based on PM requirements. The ERPSS builds from a 10-bed mobile facility (FFEPS). As workload changes, or is projected to change, UTC [unit type code] packages (personnel and equipment) may be deployed in small increments and combined with previously deployed ERPSS UTCs to increase capability."[175] Additional bed extension/augmentation packages can increase patient staging capacity to 50, 100, or 200 patients.[176]

As the number of beds increases, the maximum patient holding time also increases. "The length of stay in an ERPSS facility may be from 2 to 72 hours. Holding times differ

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Techniques, and Procedures 3-42.57 (Scott Air Force Base: Headquarters, Air Mobility Command, August 2016), 8, 57, https://static.e-publishing.af.mil/production/1/af_sg/publication/afttp3-42.57/afttp3-42_57.pdf; North Atlantic Treaty Organization, *Patient Evacuation and Flow Management*, Allied Medical Publication 2.3, Edition A, Version 1 (Brussels, Belgium: NATO Standardization Office, February 2020), 1-10, DRAFT; North Atlantic Treaty Organization, *Allied Joint Medical Planning Doctrine*, Allied Joint Medical Publication 1, Edition A, Version 1, NATO STANAG 2542 (Brussels, Belgium: NATO Standardization Office, September 2018), 3-16, https://www.coemed.org/files/stanags/02_AJMEDP/AJMedP-1_EDA_V1_E_2542.pdf; and AJMedP-2, *Allied Joint Medical Doctrine for Medical Evacuation*, 4-2.

[173] ATP 4-02.55, *Army Health System Support Planning*, J-10.

[174] AFTTP 3-42.57, *En Route Patient Staging System*, 8.

[175] Ibid., 9.

[176] AFTTP 3-42.57, *En Route Patient Staging System* (p. 12) and ATP 4-02.2, *Medical Evacuation* (p. 6-8) state the maximum capacity as 200, while ATP 4-02.55, *Army Health System Support Planning* (p. J-10) and JP 4-02, *Joint Health Services* (p. A-A-8) report a maximum capacity of 250.

depending on the size and location of the staging facility. At the 10-bed initial stage, holding times are limited by the amount of space and supplies in this initial package. Two to four hours is the preferred hold time; not to exceed six hours. At the larger staging facilities (50 to 100 bed), holding times will vary depending on the operational capability of the location and the flight schedules, but should be limited to no more than 72 hours."[177]

The concept of expanding the patient staging facility is not directly addressed by NATO doctrine. While Allied Medical Publication (AMedP) 2.3 states that "CSUs may be augmented / enhanced with a critical care, surgical, aviation medicine or medical supply capability if required,"[178] this augmentation is more of a capability enhancement than an expansion of capacity to hold more patients or increase holding time.

Table 7. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Expanding Patient Staging Facility Capacity

Benefits
• Mitigates MEDEVAC shortfall by increasing the time patients can be held outside an MTF in the case of delayed MEDEVAC • Mitigates MEDEVAC shortfall due to administrative/legal challenges to international AE of contagious patients by decreasing the burden on MTF of AE delays • Mitigates MTF bed shortfall by increasing alternate patient holding capacity • Removes the patient staging facility as a bottleneck in the MEDEVAC system and increases MEDEVAC throughput • Increases capacity for staging contagious patients separately
Costs
• Requires time to deploy and become operational • Increases sustainment requirements
Operational Constraints
• Requires space to expand staging facility footprint • Is limited by maximum expanded patient holding capacity and time

6. Use Telemedicine

The DOD defines telemedicine as "rapid access to shared and remote medical expertise by means of telecommunications and information technologies to deliver health services and exchange health information for the purpose of improving patient care."[179]

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[177] ATP 4-02.2, *Medical Evacuation*, 6-8.

[178] AMedP-2.3, *Patient Evacuation and Flow Management*, 1-10.

[179] Office of the Chairman of the Joint Chiefs of Staff (CJCS), *DOD Dictionary of Military and Associated Terms* (Washington, DC: The Joint Staff, January 2021), 214, http://www.jcs.mil/Doctrine/DOD-Terminology.

This analysis considered three distinct applications of telemedicine, in which medical personnel consult virtually with:

- Patients for routine care or health monitoring
- Medical personnel at an MTF (reach-back)
- Unit medics in a prolonged field care environment

The first telemedicine application involves virtual patient care to service members, including forward-deployed troops, where they reside or are currently located. Such patient care can include routine preventive care, outpatient care for minor ailments, and remote health monitoring of individuals in quarantine or convalescence. This concept addresses adverse impacts caused by operating in a contagious biological environment in which the health risks of in-person medical care are greater. Minimizing the in-person care delivered to both potentially contagious individuals and those unlikely to be contagious reduces the risk of exposure to susceptible medical personnel and patients.

The second telemedicine application consists of medical personnel at an MTF consulting with remote medical personnel to exploit their expertise, commonly referred to as reach-back. Technology exists that spans the spectrum from audio only reach-back assistance to augmented reality in which a remote specialist can make annotations that are visible in a surgeon's field of view during surgery.[180] Generalists at lower roles of care (e.g., Role 1 or 2 MTF) could reach back to specialists at higher roles of care (e.g., Role 3 MTF), or in-theater medical personnel could reach back to individuals out of theater with specialized CBRN medical expertise, such as subject matter experts (SMEs) at USAMRIID or the United States Army Medical Research Institute of Chemical Defense (USAMRICD). This concept requires only that a remote medical provider have greater expertise than the medical personnel at the patient's location, which could be true in any type of CBRN environment (as well as non-CBRN environments). The success of this concept is enhanced by identifying ahead of time which experts to consult for each type of CBRN patient and knowing how to contact them quickly.

The third telemedicine application entails the provision of remote medical expertise to unit medics, combat lifesavers, or warfighters performing self- or buddy aid in a prolonged field care environment. Like with some of the other telemedicine applications, the medical interventions that can be undertaken with this concept may require resources (e.g., medical countermeasures, medical equipment) or skills that are not available in the field. Nevertheless, the U.S. Army is developing capabilities to enable combat medics in

[180] Edgar Rojas-Muñoz et al., "Evaluation of an Augmented Reality Platform for Austere Surgical Telementoring: A Randomized Controlled Crossover Study in Cricothyroidotomies," *npj Digital Medicine* 3, no. 1 (May 2020): 1–9, https://doi.org/10.1038/s41746-020-0284-9.

the field to communicate with specialists in the case of delayed MEDEVAC,[181] and these communications could theoretically extend to other unit members if needed. Limited test results using a telemedicine platform intended to help transfer surgical expertise remotely via augmented reality demonstrated the potential for improved surgical performance of medical personnel in an austere or prolonged field care environment.[182] Since prolonged field care may be required in a non-CBRN environment, it could also occur in the presence of any CBRN threats or hazards. This concept could therefore apply to any type of CBRN environment.

Telemedicine is consistent with U.S. and NATO doctrine and policy,[183] although developments to facilitate its application in theaters of combat operations are still ongoing. Since 2004, the U.S. military has performed asynchronous teleconsultations via e-mail for various clinical specialty services including burn and trauma, infectious disease, and toxicology.[184] As technology has advanced, the forms of reach-back have expanded to include "secure/unsecure e-mail, telephone, websites, and video conferencing."[185] During the COVID-19 pandemic, MTFs conducted virtual health appointments[186] and implemented protocols for self-quarantined patients to send daily temperature checks to their Health Care Providers and conduct virtual video chat check-ups.[187] Although recent U.S. and Allied operations have generally enjoyed air superiority and freedom to MEDEVAC patients when needed, NATO doctrine states that "[s]elected military personnel should be able to provide advanced and prolonged field care" and that such care may require support by telemedicine.[188]

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[181] Christian Lowe, "The Army is Preparing its Medics for a War without MEDEVAC Helos," *We Are The Mighty*, May 28, 2018, https://www.wearethemighty.com/articles/the-army-is-preparing-its-medics-for-a-war-without-medevac-helos.

[182] Rojas-Muñoz et al, "Augmented Reality Platform."

[183] JP 4-02, *Joint Health Services*, IV-8, IV-15; and AJP 4.10, *Allied Joint Doctrine for Medical Support*, 2-10.

[184] John McManus et al., "Teleconsultation Program for Deployed Soldiers and Healthcare Professionals in Remote and Austere Environments," *Prehospital and Disaster Medicine* 23, no. 3 (June 2008): 210; and Jane S. Hwang et al., "Utilization of Telemedicine in the US Military in a Deployed Setting," *Military Medicine* 179, no. 11 (November 2014): 1347, https://doi.org/10.7205/milmed-d-14-00115.

[185] JP 4-02, *Joint Health Services*, IV-27.

[186] DOD Office of Inspector General, *Evaluation of Department of Defense Medical Treatment Facility Challenges During the Coronavirus Disease-2019 (COVID-19) Pandemic*, DODIG-2020-133 (Alexandria, VA: DOD Office of Inspector General, September 2020), 13, https://www.oversight.gov/sites/default/files/oig-reports/DODIG-2020-133_Redacted.pdf.

[187] U.S. Army Garrison Humphreys, "USAG-Humphreys (South Korea) COVID-19 Response Playbook" (U.S. Army Garrison Humphreys, March 17, 2020), 7, https://www.redcea.com/covid19/Shared%20Documents/U.S.%20DoD%20(Departamento%20de%20Defensa%20EE.UU.)/8th%20Army%20(Korea)/USAG%20Humphreys%20COVID%2019%20Playbook%20UNCLASS.PDF.

[188] AJP 4.10, *Allied Joint Doctrine for Medical Support*, 3-17.

Table 8. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Using Telemedicine

Benefits
• Prevents or mitigates MEDEVAC shortfall by decreasing demand on MEDEVAC resources (virtual consultation with patients or reach-back) • Mitigates MEDEVAC shortfall by increasing medical capabilities far-forward in case of prolonged field care • Prevents MTF bed shortfall by decreasing demand on MTF beds (virtual consultation with patients) • Mitigates MTF personnel shortfall due to misalignment of MTF personnel capabilities with patient needs by supplementing medical personnel capabilities with the knowledge of virtual experts (reach-back) • Prevents MTF personnel shortfall due to illness or quarantine by decreasing risk of medical personnel exposure to contagious patients (virtual consultation with patients) • Prevents CBRN exposure to patients by minimizing the number of patients that have contact at MTFs (virtual consultation with patients)
Costs
• Requires technology investments • Increases data security and privacy challenges • Requires training
Operational Constraints
• Requires sufficient and reliable information technology infrastructure • Is limited by availability of medical resources to implement recommended interventions
Planning Considerations
• Pre-establish contact with designated subject matter experts • Plan for information technology requirements • Consider synergistic effect with augmenting medical materiel

7. Limit the Number of MEDEVAC Platforms in Contaminated Areas and Prioritize Ground Ambulances

One concept to minimize the required decontamination of MEDEVAC platforms is limiting the number of MEDEVAC platforms that operate in contaminated areas. After a CBRN incident, "[i]t is expected that a certain number of both ground and air ambulances will become contaminated."[189] Commanders must then decide the extent to which they will

[189] Headquarters, Department of the Army, *Aviation Tactical Employment*, Army Techniques Publication 3-04.1 (Washington, DC: Headquarters, Department of the Army, May 2020), 10-12, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1009144.

commit further evacuation assets to the contaminated areas.[190] They must strike a balance between committing sufficient MEDEVAC platforms to promptly evacuate all patients from the contaminated areas and retaining enough platforms to sustain MEDEVAC operations in the clean environment.

> Depending on the situation, there may already be adequate numbers of vehicles, watercraft, and aircraft operating within the affected areas to transport the number of casualties sustained. Full use of these assets should be made while keeping the safety and operational exposure of the personnel operating them in mind. These platforms (if not otherwise damaged) can respond relatively quickly to transport the wounded to designated areas where they can undergo patient decontamination and receive medical treatment.[191]

Once a MEDEVAC asset has been committed to a contaminated area, "it is highly unlikely it will be able to be spared long enough to undergo a complete decontamination."[192] Minimizing the number of vehicles that are confined to a contaminated area until they can be thoroughly decontaminated provides greater flexibility for regulating patients outside the contaminated areas.

Doctrine is clear that "[g]round ambulances are the preferred means to evacuate the casualties in contaminated forward areas, when feasible."[193] The main reason for this prioritization is that, compared to air ambulances, "[g]round ambulances are more plentiful and easier to decontaminate."[194] While this concept does not mean that air ambulances should not be used if needed, ground ambulances should be prioritized if doing so will not adversely affect the patients' medical condition.[195]

It is likely that a number of air ambulances will already be contaminated.[196] This concept is not advocating the use of ground ambulances over the already contaminated air ambulances. Rather, if some air ambulances are already contaminated, they "should be repeatedly used in the contaminated area until all casualties have been evacuated."[197]

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[190] JP 4-02, *Joint Health Services*, V-18; ATP 4-02.7, *Health Service Support*, 4-1.

[191] ATP 4-02.7, *Health Service Support*, 4-1.

[192] ATP 3-04.1, *Aviation Tactical Employment*, 10-12.

[193] ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, 1-14.

[194] ATP 4-02.2, *Medical Evacuation*, 2-33.

[195] Ibid., 2-33.

[196] ATP 3-04.1, *Aviation Tactical Employment*, 10-12.

[197] ATP 4-02.85, *Treatment of Chemical Warfare Agent Casualties*, 1-14.

However, "[i]ntroducing uncontaminated aircraft into a contaminated area should be avoided, whenever possible."[198]

Table 9. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Limiting the Number of MEDEVAC Platforms in Contaminated Areas

Benefits
• Prevents MEDEVAC shortfall due to MEDEVAC platforms being unavailable during decontamination, especially among higher value air ambulances
Costs
• Exacerbates MEDEVAC shortfall due to patients exceeding available MEDEVAC capacity • Increases requirements for tracking and coordinating medical resources
Operational Constraints
• Requires the ability to distinguish between clean and contaminated areas and MEDEVAC platforms
Planning Considerations
• Consider synergistic effect with augmenting evacuation capacity via CASEVAC

8. Collectively Protect MTFs

Collective protection (COLPRO) is "the protection provided to a group of individuals that permits relaxation of individual chemical, biological, radiological, and nuclear protection."[199] COLPRO systems generally comprise some kind of shelter (usually a tent), an agent-resistant fabric liner, an entry/exit airlock system, an air filter/blower system, and a power source.[200] Collectively protected MTFs are designed to protect patients and medical personnel from chemical and biological agents and radiological particles.[201] Unless hardened, COLPRO MTFs are not protective against the effects (blast, thermal, and radiation) of nuclear weapons.[202] In addition, COLPRO MTFs provide "an

[198] ATP 3-04.1, *Aviation Tactical Employment*, 10-12.

[199] Office of the CJCS, *DOD Dictionary*, 37.

[200] Edgewood Chemical Biological Center, *CBRN Handbook: An Industrial Base Product Guide for Chemical, Biological, Radiological, and Nuclear Items for the U.S. Army* (Rock Island, IL: Edgewood Chemical Biological Center, June 2009), 23–72.

[201] North Atlantic Treaty Organization, *Collective Protection in a Chemical, Biological, Radiological and Nuclear Environment (CBRN - COLPRO)*, Allied Tactical Publication 70, Edition A, Version 1, NATO STANAG 2515 (Brussels, Belgium: NATO Standardization Office, April 2014), 3-1, https://nso.nato.int/nso/nsdd/main/list-promulg; and ATP 4-02.7, *Health Service Support*, 12-2.

[202] Ibid., 1-2.

environmentally controlled, clean surgical environment while offering some CBRN survivability for low density, critical care equipment."[203]

Doctrine describes various systems designed for different purposes. The Chemical and Biological Protective Shelter (CBPS) is a vehicle-mounted COLPRO system that is employed at Role 1 and Role 2 MTFs that must be mobile with the brigade combat team.[204] Collectively protected Role 3 MTFs, such as the Army's Chemically Protected Deployable Medical Systems (CP DEPMEDS) and the Air Force's Collectively Protected Expeditionary Medical Support (CPEMEDS), are protected by an agent-resistant liner installed during MTF construction.[205]

Table 10. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Collectively Protecting MTFs

Benefits
• Prevents MTF bed shortfall due to contaminated beds by protecting MTF beds from CBRN hazards
• Prevents MTF personnel shortfall due to illness, injury, or quarantine by protecting MTF personnel from CBRN hazards
• Prevents MTF personnel shortfall due to increased rest periods when wearing protective equipment by protecting MTF personnel from CBRN hazards
• Prevents MTF personnel shortfall due to degraded capability when wearing protective equipment by protecting MTF personnel from CBRN hazards
• Prevents medical materiel shortfall due to contamination by protecting medical materiel in the MTF from CBRN hazards
• Prevents CBRN exposure to patients by protecting patients inside MTF from CBRN hazards
• Protects MTF personnel, materiel, and patients from non-CBRN environmental factors
Operational Constraints
• Must be operational prior to CBRN hazard in the environment

9. Designate an MTF for Contagious Patients Only

To reduce the risk of disease spread in a contagious disease environment, "specific facilities could be designated as "contagion" facilities for the sole purpose of managing contagious casualties."[206] This would entail evacuating contagious patients to one or more designated MTFs and all non-contagious patients to the remaining MTFs, most likely at the Role 3 level. If forces are expected to incur contagious disease casualties early in an

[203] ATP 4-02.10, *Theater Hospitalization*, 5-12.

[204] ATP 4-02.7, *Health Service Support*, 12-2.

[205] Ibid., 12-9.

[206] AJMedP-7, *Allied Joint CBRN Medical Support Doctrine*, 1-9.

operation, then this concept could be implemented in the theater planning process, and a contagion MTF could be designated from its inception. Alternatively, a conventional MTF might be designated as the contagion MTF while already in use by all patient types. In this case, patients already in the medical system would need to be transferred to their corresponding MTF. The choice of an MTF to designate for contagious patients should consider a number of factors, including the accessibility of specialists and medical materiel, the relative numbers of contagious and non-contagious patients, and the proximity of the designated MTF to contagious casualties and the remaining MTFs to non-contagious casualties.

Table 11. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Designating an MTF for Contagious Patients Only

Benefits
• Prevents MTF personnel shortfall due to illness or quarantine because MTF personnel in non-contagion MTFs are not at risk of exposure from contagious patients • Prevents CBRN exposure to patients because patients in non-contagion MTFs are not at risk of exposure from contagious patients
Costs
• Exacerbates MEDEVAC shortfall by increasing demand for MEDEVAC of non-contagious patients currently in a newly designated contagion MTF • Exacerbates MEDEVAC shortfall because average MEDEVAC time may increase compared to policy of patients going to nearest MTF • Exacerbates MTF bed shortfall by limiting beds available for balancing patient load between MTFs
Operational Constraints
• Requires the ability to distinguish between contagious and non-contagious patients
Planning Considerations
• Pre-select an MTF to designate for contagious patients (or decide on selection criteria) • Consider synergistic effect with deploying specialized medical augmentation teams, using telemedicine, and using lateral or skip evacuation

10. Isolate Contagious Patients During Evacuation

Although the preference is to treat highly contagious patients on-site, rather than transport them from the outbreak area,[207] there will be circumstances where a "limited capability to transport contagious casualties"[208] will be required. For instance, the USAF assumes that "[n]ational security, global health or political considerations will necessitate movement of an index case(s) or small numbers of contagious casualties to definitive

[207] ATP 4-02.7, *Health Service Support*, 4-4.

[208] AFTTP 3-42.22, *Contagious Casualty Management*, 5.

diagnosis and/or care."[209] In addition to intertheater movements, "[m]edical evacuation of patients within an area of responsibility (AOR) will likely need to take place, especially if contagious cases are identified at field units with minimal patient holding capability."[210]

Multiple materiel solutions exist for transporting highly contagious patients in isolation to reduce the risk to medical personnel and other patients. Solutions include "open transport systems that allow direct patient management through the medical crew wearing PPE (e.g., [filtering face piece]2/3 mask, goggles or face shield, gloves and protective gown) throughout the transport, or closed transport systems (so-called air transport isolator systems)."[211] Closed transport systems "separate the patient from the medical crew," whereas open systems "provide a portable isolation facility large enough for both the patient and attending medical staff wearing [PPE]."[212]

The concept of isolating contagious patients during evacuation is consistent with both U.S. and NATO doctrine. The DOD maintains the Transport Isolation System (TIS), an open transport system "designed and approved for loading onto C-17 and C-130 military aircraft; each system (aluminum frame with clear plastic liner that maintains a negative pressure isolation environment) is capable of moving multiple patients simultaneously, and 2 such systems can be accommodated on the larger C-17 platform."[213] To supplement the TIS and "address a joint urgent operational need to move large numbers of COVID-19 patients should the need for that capability arise,"[214] the USAF recently developed another open transport system called the Negatively Pressurized Conex (NPC). NATO Allies Great Britain and Italy use a closed transport system called the Trexler Air Transport Isolator.[215] To standardize materiel solutions across NATO nations, NATO Smart Defense project 1.1045 proposed new capability codes for patient transport systems "capable of providing trained medical personnel, and individual or collective (reverse) protection to enable safe medical evacuation of CBRN patients including contamination and highly contagious

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[209] Ibid., 5.

[210] Ibid., 6.

[211] Albrecht et al. "Transport of COVID-19," 2.

[212] Ibid., 2.

[213] Shawn G. Gibbs et al., "Review of Literature for Air Medical Evacuation High-Level Containment Transport," *Air Medical Journal* 38, no. 5 (October 2019): 363, https://doi.org/10.1016%2Fj.amj.2019.06.006.

[214] Air Mobility Command, "Negatively Pressurized Conexes Ready to Save Lives" (Scott Air Force Base: Air Mobility Command, June 29, 2020), https://www.af.mil/News/Article-Display/Article/2240539/negatively-pressurized-conexes-ready-to-save-lives.

[215] Albrecht et al., "Transport of COVID-19," 2; and Gibbs et al., "Review of Literature," 363.

diseases."[216] Proposed capabilities include tactical MEDEVAC via "deployed ground transportation, rotary, in-theatre fixed wing aeromedical evacuation and inland surface ways" as well as strategic MEDEVAC via "deployable fixed wing aeromedical evacuation and maritime transport."[217]

The capability to evacuate contagious patients in isolation could also be commercially contracted instead of or in addition to a native capability. Commercial aircraft equipped with a high-level containment transport system and trained medical personnel are often used for patients exposed to or infected with a highly contagious infectious disease.[218] Recent DOD force health protection guidance indicated that such commercial MEDEVAC platforms should be the primary means of transporting COVID-19 patients.[219]

Table 12. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Isolating Contagious Patients During Evacuation

Benefits
• Mitigates MEDEVAC shortfall due to administrative/legal challenges to international aeromedical evacuation of contagious patients by minimizing risk of disease spread during transport and reducing administrative/legal opposition to overflight or emergency landing rights • Prevents or reduces MEDEVAC shortfall due to aeromedical evacuation platforms unavailability during disinfection by minimizing disinfection required of platforms after evacuation of contagious patients • Prevents MEDEVAC shortfall due to crew illness or quarantine by isolating contagious patients to protect MEDEVAC crews from exposure • Prevents MEDEVAC shortfall from degraded crew capability due to wearing protective equipment by eliminating requirement for enhanced PPE during aeromedical evacuation with some systems • Prevents contagious spread to susceptible patients by isolating contagious patients
Costs
• Entails financial cost to purchase and maintain • Requires individual and unit level training

[216] Mark E. Bohannon et al., *Report of the Project Team for Smart Defence Project 1.1045, Volume 1, Historical Record*, IDA Document NS D-10974 (Alexandria, VA: Institute for Defense Analyses, January 2020), E-11.

[217] Ibid., E-13.

[218] U.S. Transportation Command, *Patient Movement of Contaminated, Contagious or Potentially Exposed Casualties*, USTRANSCOM Instruction 41-02 (Belleville, IL: U.S. Transportation Command Surgeon General, July 11, 2019), p. 2; and ATP 4-02.7, *Health Service Support*, 4-4.

[219] Matthew P. Donovan, *Force Health Protection Guidance (Supplement 5) – Department of Defense Guidance for Movement and Medical Treatment of COVID-19 Patients, Symptomatic Persons Under Investigation, or Potentially Exposed COVID-19 Persons* (Washington, DC: Office of the Under Secretary of Defense for Personnel and Readiness, April 7, 2020).

• Requires time to become operational • Requires the disposal of contaminated waste • Increases requirements for tracking and coordinating medical resources
Operational Constraints
• Is limited in capacity of patients that can be transported safely
Planning Considerations
• Consider lead time for procurement of systems

11. Evacuate Contagious Patients Only with Other Contagious Patients

Evacuating contagious patients only with other patients with the same disease is a concept designed to minimize the spread of contagious disease through the medical system. Segregating contagious from non-contagious patients is consistent with DOD and United States Government (USG) guidance for recent contagious diseases, at least at the strategic air evacuation level. Force health protection guidance from early 2020 stipulates that the "[s]imultaneous transport of non-COVID-19 patients with COVID-19 positive patients should not occur."[220] For strategic air evacuation of patients with Ebola virus disease (EVD), the Centers for Disease Control and Prevention (CDC) recommends that "[o]ther patients who do not have EVD should not be onboard."[221] This concept could be used for any contagious disease of operational significance to minimize the spread of that disease from contagious patients to non-contagious patients during MEDEVAC.

Table 13. Summary of the Benefits, Costs, Operational Constraints, and Planning Considerations of Evacuating Contagious Patients Only with Other Contagious Patients

Benefits
• Prevents CBRN exposure to patients by avoiding contact with contagious patients
Costs
• May exacerbate MEDEVAC shortfall due to patients exceeding available MEDEVAC capacity if MEDEVAC platforms are unable to be utilized at full capacity • Increases requirements for tracking and coordinating medical resources
Planning Considerations
• Consider synergistic effect with using lateral or skip evacuation and designating an MTF for contagious patients only

[220] Donovan, *Force Health Protection Guidance*, 3 of Attachment 1 ("Department of Defense Guidance on Air Medical Transport for COVID-19 Positive Patients and/or COVID-19 Exposed Persons.")

[221] "Guidance on Air Medical Transport (AMT) for Patients with Ebola Virus Disease (EVD)," Centers for Disease Control and Prevention Website, last updated January 27, 2015, https://www.cdc.gov/vhf/ebola/clinicians/emergency-services/air-medical-transport.html.

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4. Discussion

In Chapter 2, we described a framework for understanding the ways that medical challenges of the CBRN environment cause adverse medical regulating impacts. In Chapter 3, we used this framework to assess 11 concepts that could prevent or mitigate the adverse impacts on medical regulating. In this chapter, we summarize the concept assessments in order to facilitate decision-making by medical planners and medical staffs planning for operations in a CBRN environment.

Tables 14 through 17 provide medical planners a shortlist of concepts relevant to the adverse medical regulating impacts for each category of CBRN hazard. They summarize whether each concept can prevent (marked with a "P") or mitigate (marked with an "M") the various causes of adverse medical regulating impacts; a blank cell indicates that a concept neither prevents nor mitigates the associated cause. Concepts are roughly grouped by those that mitigate shortfalls in medical treatment resources, then those that mitigate MEDEVAC shortfalls, and finally those that prevent various adverse impacts.

A separate summary table exists for each category of CBRN hazard, except that Table 14 addresses both chemical and non-contagious biological hazards, because the same concepts could apply to either category; Table 1 and Chapter 2 stipulate whether causes that could be addressed by these concepts apply all the time or only in some cases. Tables 14 through 17 are unique to the particular CBRN hazard category in two ways. First, they contain only the causes of adverse medical regulating impacts relevant to the CBRN hazard category, as specified in Table 1. Second, they indicate which concepts are relevant to that CBRN hazard category. However, with the exception of some applications of telemedicine (concept #6) and the last three concepts (#9–11), which apply only to contagious biological hazards, the concepts are broadly applicable to all types of CBRN hazards.

Table 14. Concepts to Prevent or Mitigate Adverse Medical Regulating Impacts Caused by Chemical or Non-Contagious Biological Hazards

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Concepts to prevent (P) or mitigate (M) adverse medical regulating impacts											
		1	2	3a	3b	4	5	6	7	8	9	10	11
Mass Casualties	Patients exceed available MEDEVAC capacity				M	M	M	P					
	Patients exceed available MTF beds	M	M	M			M						
	Patients exceed available MTF personnel	M	M	M									
	Patients exceed available materiel materiel	M	M	M									
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	M	M	M				M					
	Patient stream does not align with available medical materiel	M	M	M									
Contaminated or Contagious Patients	MEDEVAC crews ill, injured, or dead				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF personnel ill, injured, or dead	M	M	M									
	MTF personnel unavailable due to overseeing patient decontamination	M	M	M									
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M									
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment												
	Patients exposed in MTF or during evacuation												
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas				M	M	M	M					
	MEDEVAC platforms unavailable during decontamination				M	M	M	M	P				
	MEDEVAC crews ill, injured, or dead				M	M	M	M					
	AE pilot flying hours restricted due to wearing protective equipment				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF beds contaminated	M	M	M			M			P			
	MTF personnel ill, injured, or dead	M	M	M						P			
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M						P			
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment									P			
	Medical materiel contaminated	M	M	M						P			
	Patients exposed in MTF or during evacuation									P			

MEDEVAC shortfalls
MTF bed shortfalls
MTF personnel shortfalls
Medical materiel shortfalls
CBRN exposure to patients

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3a. Shorten the theater PM policy
3b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

Table 15. Concepts to Prevent or Mitigate Adverse Medical Regulating Impacts Caused by Contagious Biological Hazards

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Concepts to prevent (P) or mitigate (M) adverse medical regulating impacts											
		1	2	3a	3b	4	5	6	7	8	9	10	11
Mass Casualties	Patients exceed available MEDEVAC capacity				M	M	M	P					
	Patients exceed available MTF beds	M	M	M			M	P					
	Patients exceed available MTF personnel	M	M	M									
	Patients exceed available materiel materiel	M	M	M									
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	M	M	M				M					
	Patient stream does not align with available medical materiel	M	M	M									
Contaminated or Contagious Patients	Administrative/legal challenges to international AE of contagious patients				M		M	M				M	
	AE platforms unavailable during disinfection after international AE of contagious patients				M	M	M	M				P	
	MEDEVAC crews ill, dead, or in quarantine				M	M	M	M				P	
	MEDEVAC crew capability degraded due to wearing protective equipment											P	
	MTF personnel ill, dead, or in quarantine	M	M	M				P			P		
	MTF personnel unavailable due to overseeing patient decontamination	M	M	M									
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M									
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment												
	Patients exposed in MTF or during evacuation							P			P	P	P
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas				M	M	M	M					
	MEDEVAC platforms unavailable during decontamination				M	M	M	M	P				
	MEDEVAC crews ill, dead, or in quarantine				M	M	M	M					
	AE pilot flying hours restricted due to wearing protective equipment				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF beds contaminated	M	M	M			M			P			
	MTF personnel ill, dead, or in quarantine	M	M	M						P			
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M						P			
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment									P			
	Medical materiel contaminated	M	M	M						P			
	Patients exposed in MTF or during evacuation									P			

MEDEVAC shortfalls
MTF bed shortfalls
MTF personnel shortfalls
Medical materiel shortfalls
CBRN exposure to patients

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3a. Shorten the theater PM policy
3b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

Table 16. Concepts to Prevent or Mitigate Adverse Medical Regulating Impacts Caused by Radiological Hazards

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Concepts to prevent (P) or mitigate (M) adverse medical regulating impacts											
		1	2	3a	3b	4	5	6	7	8	9	10	11
Mass Casualties	Patients exceed available MEDEVAC capacity				M	M	M	P					
	Patients exceed available MTF beds	M	M	M			M						
	Patients exceed available MTF personnel	M	M	M									
	Patients exceed available materiel materiel	M	M	M									
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	M	M	M				M					
	Patient stream does not align with available medical materiel	M	M	M									
Contaminated or Contagious Patients	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF personnel unavailable due to overseeing patient decontamination	M	M	M									
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M									
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment												
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas				M	M	M	M					
	MEDEVAC platforms unavailable during decontamination				M	M	M	M	P				
	MEDEVAC crews injured, dead, or at maximum allowable exposure				M	M	M	M					
	AE pilot flying hours restricted due to wearing protective equipment				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF beds contaminated	M	M	M			M			P			
	MTF personnel injured or dead	M	M	M						P			
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M						P			
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment									P			
	Medical materiel contaminated	M	M	M						P			
	Patients exposed in MTF or during evacuation									P			

MEDEVAC shortfalls
MTF bed shortfalls
MTF personnel shortfalls
Medical materiel shortfalls
CBRN exposure to patients

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3a. Shorten the theater PM policy
3b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

Table 17. Concepts to Prevent or Mitigate Adverse Medical Regulating Impacts Caused by Nuclear Hazards

Medical challenge of the CBRN environment	Way that medical challenge of the CBRN environment causes adverse medical regulating impact	Concepts to prevent (P) or mitigate (M) adverse medical regulating impacts											
		1	2	3a	3b	4	5	6	7	8	9	10	11
Mass Casualties	Patients exceed available MEDEVAC capacity				M	M	M	P					
	Patients exceed available MTF beds	M	M	M			M						
	Patients exceed available MTF personnel	M	M	M									
	Patients exceed available materiel materiel	M	M	M									
Different Mix of Patient Types	Patient stream does not align with MTF personnel capabilities	M	M	M				M					
	Patient stream does not align with available medical materiel	M	M	M									
Contaminated or Contagious Patients	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF personnel unavailable due to overseeing patient decontamination	M	M	M									
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M									
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment												
CBRN Hazards Where Medical Assets Operate	Civilian AE augmentation not available in contaminated areas				M	M	M	M					
	MEDEVAC platforms unavailable during decontamination				M	M	M	M	P				
	MEDEVAC platforms unavailable due to battle damage				M	M	M	M					
	MEDEVAC crews injured, dead, or at maximum allowable exposure				M	M	M	M					
	AE pilot flying hours restricted due to wearing protective equipment				M	M	M	M					
	MEDEVAC crew capability degraded due to wearing protective equipment												
	MTF beds contaminated or destroyed	M	M	M			M			P			
	MTF personnel injured or dead	M	M	M						P			
	MTF personnel availability restricted by work/rest cycles due to wearing protective equipment	M	M	M						P			
	MTF personnel ability to deliver medical care degraded due to wearing protective equipment									P			
	Medical materiel contaminated or destroyed	M	M	M						P			
	Patients exposed in MTF or during evacuation									P			

MEDEVAC shortfalls
MTF bed shortfalls
MTF personnel shortfalls
Medical materiel shortfalls
CBRN exposure to patients

1. Augment medical support capabilities
2. Use lateral or skip evacuation
3a. Shorten the theater PM policy
3b. Lengthen the theater PM policy
4. Augment evacuation capacity
5. Expand patient staging facility capacity
6. Use telemedicine
7. Limit the number of MEDEVAC platforms in contaminated areas and prioritize ground ambulances
8. Collectively protect MTFs
9. Designate an MTF for contagious patients only
10. Isolate contagious patients during evacuation
11. Evacuate contagious patients only with other contagious patients

Tables 14 through 17 indicate that for each category of CBRN hazard, one or more causes of each adverse medical regulating impact could be prevented or mitigated. The degree to which a concept prevents (or reduces) adverse impacts depends on the concept and the scale and effectiveness of its implementation. For example, telemedicine could be used to avoid some unnecessary evacuations and thus help prevent MEDEVAC shortfalls, but some patients would still require MEDEVAC. Likewise, concepts vary significantly in the level of mitigation offered. The scale of evacuation capacity augmentation, for instance, would greatly influence its mitigating effect. Multiple concepts that address the same causes of adverse medical regulating impacts may be needed to sufficiently resolve the adverse medical regulating impacts.

Although not shown in the summary tables above, concepts could also exacerbate an adverse medical regulating impact while preventing or mitigating others. Five concepts, listed in Table 18, had some risk of exacerbating at least one adverse medical regulating impact.

Table 18. Concepts that Could Exacerbate Adverse Medical Regulating Impacts (and the Impacts Exacerbated)

- Designate an MTF for contagious patients only (MEDEVAC and MTF bed shortfalls)
- Lengthen theater patient movement policy (MTF bed, MTF personnel, and medical materiel shortfalls)
- Shorten theater patient movement policy (MEDEVAC shortfalls)
- Use lateral or skip evacuation (MEDEVAC shortfalls)
- Evacuate contagious patients only with other contagious patients (MEDEVAC shortfalls)

To help planners compare the relative effectiveness of various concepts at preventing or mitigating adverse medical regulating impacts, we planned to use JMPT to simulate the medical regulating process and derive some quantitative metrics of each concept's benefits and costs. However, there were limitations and challenges to modeling enough of the concepts that any results would be incomplete, and meaningful comparisons across concepts would be impossible. Although we decided that the effort to generate generally applicable quantitative results was not feasible, planners may be able to model the tradeoffs of certain concepts using JMPT to compare solutions specific to their planning scenario.

Appendix A.
Concept Assessment Details

A. Augment Medical Support Capabilities

1. Benefits

a. Mitigates MTF Bed Shortfall by Increasing Bed Capacity

Augmenting medical support capabilities by either deploying additional medical units or using host nation medical capabilities mitigates an MTF bed shortfall by increasing the number of beds available for holding or treating patients. The degree to which the augmentation mitigates the shortfall depends on the size of both the shortfall and the augmentation. This concept is scalable, and any combination of the implementation methods could be used together to increase the bed capacity enough to completely mitigate the shortfall.

b. Mitigates MTF Personnel Shortfall due to Patients Exceeding Available MTF Personnel by Increasing the Number of Personnel Available to Manage Patients

Any of the medical support augmentation options that include additional personnel could mitigate a shortfall in MTF personnel capacity by allowing overwhelmed medical staff to delegate some patient care activities to others. In the case of augmentation by host nation or deployed U.S. medical personnel, the patient load could simply be reduced for MTF personnel. For augmentation by dental, veterinary, or nonmedical personnel, MTF personnel could delegate some tasks but would still be required to supervise augmentees since "the professional responsibility and accountability for the overall care provided, and for associated patient outcomes, remains with the delegating individual."[222] The degree to which MTF personnel would be freed up would depend on the level of oversight required of the augmentees. Due to their medical knowledge and experience, dental and veterinary personnel would require less supervision than nonmedical personnel would, and they could perform more complicated tasks. Regardless of the skill level of the augmentees, the additional personnel should increase the capacity of overwhelmed MTF personnel and allow more patients to be treated.

[222] AR 40-68, *Clinical Quality Management*, 21.

c. Mitigates MTF Personnel Shortfall due to Misalignment of MTF Personnel Capabilities with Patient Needs by Introducing Specialist Capabilities (Augmentation by Specialized Medical Augmentation Teams)

If MTF personnel were augmented by specialized medical augmentation teams, such as the USAF Medical Infectious Disease Team or an Army SMRC team, then the specialists could provide any skills and knowledge to manage CBRN patients that the MTF personnel were lacking. Specialist treatment of patients would improve the standard of care and mitigate an MTF personnel capability shortfall.

d. Mitigates Medical Materiel Shortfall by Increasing Supply of Medical Materiel

Medical support capability augmentation by deployment of military medical units or by using civilian hospital capabilities could address a medical materiel shortfall as part of the larger set of medical capabilities brought to bear. Alternatively, if the medical support shortfall was specific to medical materiel, then this could be mitigated directly via medical materiel resupply. As long as the needed medical resources arrived in time and in working condition, the mitigating effect would be the same whether the medical materiel was packaged as a set or sent individually, prepositioned or deployed from outside the theater.

2. Costs

a. Increases Sustainment Requirements (Additional Medical Units or Detachments)

Augmentation of medical capabilities by deploying additional medical units or detachments into theater would increase the sustainment requirements.

b. Requires Time for Augmentation to Become Available After Request

Each of the medical support augmentation options will require time to implement. The timing of deployment of additional medical units, detachments, or materiel depends on the Time Phased Force Deployment Data (TPFDD) and may take days. Since distributing medical materiel from within theater is likely to be quicker than deploying materiel from outside the theater, doctrine urges medical planners to consider prepositioning supplies in-theater.[223] If mutual assistance agreements have been coordinated in advance, making use of available civilian hospital capacity may be the quickest option if it is available. Augmentation of medical personnel with dental, veterinary, or nonmedical personnel would depend on the time for those augmentees to reach the MTFs with personnel shortfalls.

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[223] AFTTP 3-42.22, *Contagious Casualty Management*, 6–7.

c. Entails Opportunity Cost of Deploying Medical Resources Instead of Other Requirements

As with any concept that involves deploying assets into theater, augmenting medical support capabilities by deployment into theater involves an opportunity cost. Deploying medical personnel or materiel could displace movements of nonmedical equipment or supplies and could delay movement of forces, as combatant commanders (CCDRs) must "balance and regulate the flow of forces with the flow of sustainment."[224]

d. Requires Identification and Training of Dental, Veterinary, or Nonmedical Personnel Augmentees

As with many things, proper planning and training are essential to mission success when augmenting medical assets during mass casualty situations.[225] ATP 4-02.19 describes how medical units should include augmentees (in this case dental personnel) "in the planning and rehearsal of mass casualty situations."[226]

> [T]he role of the dentist and supporting personnel should be established by the medical unit ahead of time, based on the comfort level and training of the assigned dentist. This role should be included in an established standard operating procedure (SOP) and thoroughly rehearsed with the medical unit. If the dentist is chosen to triage casualties, the medical unit must ensure the dentist rehearses with and understands the surgical team's guidance and priorities.[227]

Medical units should follow this same process used for dentists to identify in advance and plan for any other personnel to augment their unit in a mass casualty event. This planning should include designating tasks to augmentees, providing clear instructions for when and how to complete delegated tasks, and stipulating what augmentees can and cannot do.

e. Precludes Dental, Veterinary, or Nonmedical Personnel Augmentees from Performing Their Regular Duties

Individuals assigned to augment medical personnel would be unavailable to perform their normally assigned duties. The impact of their absence depends on their mission and its urgency. Doctrine is clear that "in the aftermath of a CBRN attack, dental treatment operations will cease" and "the resources of the dental unit are redirected toward support

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[224] Chairman of the Joint Chiefs of Staff, *Deployment and Redeployment Operations*, Joint Publication 3-35 (Washington, DC: Chairman of the Joint Chiefs of Staff, January 10, 2018), II-6, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_35.pdf.

[225] JP 4-02, *Joint Health Services*, VI-5.

[226] ATP 4-02.19, *Dental Services*, 1-8.

[227] Ibid., 1-8.

of any mass casualty situation that may have been generated at an adjacent MTF."[228] In contrast, following a CBRN incident, veterinary personnel will likely be engaged treating military working dogs or other government-owned animals, inspecting storage facilities and subsistence items, and providing technical guidance on their decontamination as needed,[229] making their reassignment more costly. The cost of taking personnel away from nonmedical units is less predictable and would depend on whether their units were still engaged in an operation or were already combat ineffective due to having lost too many unit members.

3. Operational Constraints

a. Non-Permissive Environments May Preclude Augmenting Medical Support Capabilities Using Civilian Medical Capabilities

A permissive environment is an "[o]perational environment in which host nation military and law enforcement agencies have control, as well as the intent and capability to assist operations that a unit intends to conduct."[230] Without the assistance and support of the host nation, augmentation by civilian medical assets may not be feasible.

4. Planning Considerations

a. Negotiate a Mutual Assistance Agreement Prior to Operation to Use Host Nation Civilian Medical Capabilities

When planning for an operation in a permissive environment, medical planners should consider establishing or advocating for the establishment of mutual assistance agreements with host nation civilian medical facilities. Knowing with a level of certainty that civilian facilities would be made available if necessary leaves medical planners with multiple courses of action to augment medical capabilities in the case of shortfalls. The agreement should also specify any licensing or credentialing requirements for U.S. personnel to be able to provide care (on U.S. military patients) in the host nation facilities.

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[228] ATP 4-02.7, *Health Service Support*, 3-15.

[229] Ibid., 6-1–6-9.

[230] Chairman of the Joint Chiefs of Staff, *Joint Operations*, Joint Publication 3-0 (Washington, DC: Chairman of the Joint Chiefs of Staff, 11 January 2017, Incorporating Change 1, 22 October 2018), GL-14, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_0ch1.pdf.

b. Consider Which Medical Materiel Will Be Needed for Each Type of CBRN Incident and Preposition In-Theater

Different CBRN incidents will require different types of medical materiel. A review of mass casualty events found that often "the equipment specifically stored for disaster use did not match the actual needs. For example, stretchers and blankets were the most used and requested equipment after the terrorist attack in Norway, but the stored equipment was mainly surgical equipment."[231] The odds of a mismatch in the type of medical materiel stockpiled and requested could be avoided through analysis. Medical planners should determine materiel requirements based on estimates of the number of patients each type of CBRN incident could produce and the associated medical materiel requirements of each patient. AMedP-7.5 describes a methodology to help medical planners generate CBRN casualty estimates "to identify medical resource requirements, such as pharmaceuticals, medical devices, medical supplies, bed types, and personnel specialties, for each role of medical treatment."[232] Once anticipated medical materiel needs are determined, "medical planners should give strong consideration to pre-positioning required supplies in-theater during deliberate and crisis action planning."[233]

B. Use Lateral or Skip Evacuation

1. Benefits

a. Mitigates MTF Bed Shortfall by Increasing the Supply of Available Beds

Lateral and skip evacuation could be used effectively when the capacity of MTFs in the linear treatment pathway has been exceeded. Moving patients to nearby MTFs with available bed space, or to higher levels of care, could level the burden of patient care across the deployed medical system and ensure that limited resources could be applied efficiently.

b. Mitigates MTF Personnel Shortfall by Increasing the Supply of MTF Personnel

Use of lateral and skip evacuation could help mitigate MTF personnel shortfalls by moving patients to nearby MTFs with underutilized personnel. Available MTF personnel outside the normal linear treatment path could be used when patients exceed MTF personnel capacity at the local level.

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[231] Hugelius, Karin, Julia Becker, and Annsofie Adolfsson, "Five Challenges When Managing Mass Casualty or Disaster Situations: A Review Study," *International Journal of Environmental Research and Public Health* 17, no. 9 (2020): 3074, https://doi.org/10.3390%2Fijerph17093068.

[232] AMedP-7.5, *Estimation of CBRN Casualties*, 1-3.

[233] AFTTP 3-42.22, *Contagious Casualty Management*, 6–7.

c. Mitigates MTF Personnel Shortfall due to Misalignment of MTF Personnel Capabilities with Patient Needs by Transporting Patients to Specialists

Treatment of CBRN patients may require specialized medical expertise not found at all levels of care, such as infectious disease physicians and radiation specialists. Lateral and skip evacuation could ensure patients receive specialized care as quickly as possible.

d. Mitigates Medical Materiel Shortfall by Increasing the Supply of Available Medical Resources

Lateral and skip evacuation could effectively overcome insufficiencies in quantity or type of equipment and materiel at any given MTF by moving patients to facilities where needed equipment and materiel are available.

2. Costs

a. Exacerbates MEDEVAC Shortfall by Increasing Demand on MEDEVAC Platforms

Lateral and skip evacuation could exacerbate MEDEVAC capacity shortfalls as it would generally require transport of patients over longer distances. With longer transport distances and times, the time until a MEDEVAC platform could be available for its next mission would increase.

b. Increases Requirements for Tracking and Coordinating Medical Resources

In combination, the typical linear treatment path through successive roles of care and the co-location of evacuation assets with MTFs simplifies patient regulating at the tactical level. Within a brigade, for example, movement of patients from battalion-level Role 1 MTFs to brigade-level Role 2 facilities can be regularly accomplished with a defined set of evacuation platforms using common patient movement requests and streamlined information management and collaboration among local MTFs. The use of lateral and skip evacuation would complicate the patient regulating process and broadly expand the requirement for collaboration and information sharing throughout the area of operations.

Specifically, lateral and skip evacuation would require a medical regulating process with the capability and capacity to:

- Assign, track, and administratively control patients and MEDEVAC assets across multiple brigades, or at the component command/joint force level;
- Ensure broad awareness of MEDEVAC asset location, especially for low density assets such as bio-containment, and be able to predict the demand for its use; and

- Ensure that MEDEVAC assets used to move patients to facilities outside of brigade control are maintained, supported, and returned.

3. Operational Constraints

a. Requires Available Capacity and Capability at Nearby MTFs

The use of lateral or skip evacuation is designed to mitigate shortfalls in capacity or capability by transferring patients to nearby facilities with available capacity or needed capabilities. CBRN-induced MASCAL events would rapidly limit the availability of underutilized medical resources within the area of operations. If MTFs outside the normal linear evacuation path were equally overwhelmed and lacking needed expertise or medical materiel, then the benefits of lateral or skip evacuation would be nonexistent.

4. Planning Considerations

a. Consider Synergistic Effect with Designating an MTF for Contagious Patients Only and Isolating Contagious Patients During Evacuation

Lateral and skip evacuation could be used in conjunction with concepts for designating an MTF for contagious patients only and isolation of contagious patients. Evacuating contagious patients directly to a designated isolation facility, for example, would reduce the risk to MTFs, medical personnel, and trauma patients resulting from the movement of contagious patients through the typical hierarchy of MTFs.

C. Change the Theater PM Policy

1. Shorten the Theater PM Policy

a. Benefits

1) Mitigates MTF Bed Shortfall by Decreasing MTF Bed Demand

A primary benefit of shortening the theater PM policy is to lessen the burden on MTFs by reducing the demand for beds in theater. "When unplanned increases in patients occur (due perhaps to an epidemic or heavy combat casualties), a temporary reduction in the policy may be necessary … to relieve the congestion caused by the patient increases."[234] With more patients being evacuated out of theater, shortening the theater PM policy

[234] ATP 4-02.2, *Medical Evacuation*, 4-1.

following a CBRN incident will reduce occupancy of hospital beds and help mitigate any MTF bed shortfall.[235]

2) Mitigates MTF Personnel Shortfall by Decreasing Demand on MTF Personnel

Another benefit of shortening the theater PM policy is that by reducing "the volume of patients being held in the theater hospital system,"[236] medical personnel requirements are decreased. Fewer requirements on medical personnel would help mitigate shortfalls in treatment capacity due to personnel coverage issues.

3) Mitigates Medical Materiel Shortfall by Decreasing Demand on MTF Materiel Resources

A shorter theater PM policy "will reduce some demand on limited resources such as Class I (subsistence) to sustain patients by reducing the number of patients held in MTFs. The more limitations (or shortages), the shorter the theater evacuation policy."[237] Shortening the theater PM policy by reducing the number of patients treated in theater and thus the medical materiel requirements, helps mitigate any medical materiel shortfalls.

b. Costs

1) Exacerbates MEDEVAC Shortfall by Increasing MEDEVAC Demand

A consequence of shortening the theater PM policy to ease the burden on MTFs is a "greater demand for intertheater USAF and intratheater evacuation resources."[238] Since fewer patients are held in theater until recovery, "[a] reduction in the evacuation policy increases the number of patients requiring intertheater evacuation."[239] Due to the resulting increase in evacuation asset requirements, shortening the theater PM policy could exacerbate MEDEVAC shortfalls.

2) Increases Need for Replacement Personnel

"For each patient who is evacuated from theater to CONUS [continental United States], a fully trained and equipped replacement must be provided."[240] By causing more

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[235] Ibid., 4-3.

[236] Ibid., 4-1.

[237] Ibid., 4-3.

[238] Ibid., 4-3.

[239] Ibid., 4-1.

[240] ATP 4-02.55, *Army Health System Support Planning*, 2-8.

patients to be evacuated from theater, a shortened theater PM policy "[i]ncreases the requirements for replacements to meet the rapid personnel turnover which could be expected."[241]

3) Increases Demand on Treatment Resources Outside of Theater

While the burden of treating patients in theater is lessened by shortening the theater PM policy, the overall patient treatment requirements remain the same as under the original policy. The policy change "reduce[s] theater bed requirements and increase[s] the number of beds required elsewhere."[242] The transfer of the burden from in-theater to out-of-theater treatment resources applies not only to beds, but to medical personnel and materiel resources as well.

c. Operational Constraints

1) Requires That Some Patients RTD Between Original and Shortened Policies

Any reduction in the theater PM policy in response to a CBRN incident must be shortened by enough time that some patients will be evacuated under the new policy that would have returned to duty under the original policy. Moreover, the number of patients affected by the policy change directly determines the magnitude of the impact of this concept (both benefits and costs). The estimated distributions of times to return to duty for many CBRN patient types provided in AMedP-7.5 can be used to estimate both the size of the patient population affected by a proposed shortening of the theater PM policy and the potential impact of the policy change.[243]

2) May Be Challenging in Environments with Contested Airspace

In some operational environments, such as large-scale combat operations, lack of air superiority would make MEDEVAC more difficult and require that "patients stay at a MTF for longer periods of time than previously required."[244] Such restrictions on MEDEVAC would effectively preclude shortening the theater PM policy, which would increase MEDEVAC demand in an environment where it already could not be met.

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[241] ATP 4-02.2, *Medical Evacuation*, 4-3.

[242] JP 4-02, *Joint Health Services*, VI-11.

[243] AMedP-7.5, *Estimation of CBRN Casualties*.

[244] ATP 4-02.10, *Theater Hospitalization*, 1-3.

2. Lengthen the Theater PM Policy

a. Benefits

1) Mitigates MEDEVAC Shortfall by Decreasing MEDEVAC Demand

A major benefit of lengthening the theater PM policy is that it "may decrease the demand on the intratheater evacuation assets and system,"[245] which could mitigate a MEDEVAC shortfall. In addition to lessening the burden on intratheater MEDEVAC assets, especially those evacuating patients from the Role 3 MTF to the patient staging facility, a longer theater PM policy would reduce the demand on intertheater evacuation assets, as patients recovering in theater would not need evacuation out of theater.

The reduction in MEDEVAC demand from lengthening the theater PM policy could be especially great in CBRN environments due to the simultaneous presentation of many patients with similar symptom progression timelines that CBRN incidents can generate. Following a CBRN incident,

> large numbers of casualties may have injuries or illnesses of moderate severity and would be expected to return to duty soon after the established maximum length of stay. In such cases, extending the duration of the theatre patient holding policy or making targeted exceptions to policy to avoid the need to evacuate the patients would make sense.[246]

2) Minimizes Disease Spread Outside of Theater (Contagious Biological Environment)

During an outbreak of contagious disease, extending the theater PM policy for known or suspected contagious disease patients could help contain the risk of disease spread. An extended theater PM policy for contagious disease patients may be part of a larger restriction of movement strategy that prohibits their evacuation from the theater until they are no longer contagious.[247] Since the movement of infected individuals increases the likelihood of disease spread, restricting the movement of contagious disease patients limits their ability to spread the disease outside of the theater.

3) Reduces Need for Replacement Personnel

In addition to reducing the burden of evacuating patients out of theater, extending the theater PM policy also "retain[s] patients in theater longer increasing the potential for their

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[245] ATP 4-02.2, *Medical Evacuation*, 4-3.

[246] AJMedP-7, *Allied Joint CBRN Medical Support Doctrine*, 5-19.

[247] AMedP-7.6, *Commander's Guide on Medical Support to CBRN Defensive Operations*, 6-10.

return to their unit."[248] This benefit applies only to CBRN incidents that generate casualties who will RTD relatively quickly, such as mild nerve agent or distilled sulfur mustard casualties who can RTD within eight days of injury.[249]

4) Decreases Demand on Treatment Resources Outside of Theater

Because of the in-theater treatment of more patients through recovery, lengthening the theater PM policy decreases requirements for beds, medical personnel, and medical materiel outside of the theater.[250] Fewer medical resources are needed to treat fewer patients evacuated out of theater.

b. Costs

1) Exacerbates MTF Bed Shortfall by Increasing MTF Bed Demand

The main cost of lengthening the theater PM policy is the shift of the burden from MEDEVAC to treatment and the resulting exacerbation of existing MTF capacity challenges. "As a result of a longer theater evacuation policy, there is a greater requirement for bed space and medical treatment at Role 2 and Role 3."[251] This concept will increase the demand for bed spaces in theater and could create or exacerbate a bed shortfall in MTFs.

2) Exacerbates MTF Personnel Shortfall by Increasing Demand on MTF Personnel

Just as lengthening the theater PM policy has the potential to create or exacerbate an MTF bed shortfall, this change would likewise increase demands on medical personnel treating the additional patients in theater. If medical personnel were unable to keep up with the added demands on their time, then the extended theater PM policy would cause a medical personnel shortfall.

3) Exacerbates Medical Materiel Shortfall by Increasing Demand on MTF Materiel Resources

With a longer theater PM policy, more patients are treated in theater, and medical materiel resources are consumed at a higher rate. Medical logisticians use a "pounds-per-

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[248] ATP 4-02.2, *Medical Evacuation*, 4-3.

[249] AMedP-7.5, *Estimation of CBRN Casualties*, 4-11–4-32.

[250] ATP 4-02.2, *Medical Evacuation*, 4-3.

[251] Ibid., 4-2–4-3.

Soldier-per-day and pounds per wounded in action admitted computation"[252] to estimate medical materiel requirements based on the planned theater PM policy.[253] Lengthening the theater PM policy thus "[i]ncreases the requirements for medical logistics (medical supplies, equipment, and equipment maintenance)."[254] Unless the increased demand for MTF resupply or equipment repair can be met, the theater PM policy change would introduce or exacerbate a medical materiel shortfall.

4) Increases Requirements for Nonmedical Logistics Support

Just as it adds to medical materiel requirements, a longer theater PM policy increases the requirements for nonmedical logistics support.[255] Since certain nonmedical requirements, such as field feeding and field sanitation (providing food and disposing of waste), are a function of the size of the population in theater, the greater number of patients treated in theater would accordingly increase the nonmedical logistics requirements.

c. Operational Constraints

1) May Require Augmentation with Specialized Medical Capabilities

The Army concept of *essential care in theater* retained in theater

> only those medical care resources required to provide essential care to decrease morbidity, mortality, and long-term disability, to stabilize patients for further evacuation, and/or to return to duty those patients who could recover within the stated theater evacuation policy.[256]

As a result, "deployed hospitals are not designed to provide definitive, rehabilitative, and convalescent care/services," [257] and the theater PM policy typically does not exceed seven days.[258] Lengthening the theater PM policy would likely require augmentation of medical

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[252] Headquarters, Department of the Army, *Army Medical Logistics*, Army Techniques Publication 4-02.1 (Washington, DC: Headquarters, Department of the Army, October 2015), C-10, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=105716.

[253] Ibid., C-1.

[254] ATP 4-02.2, *Medical Evacuation*, 4-3.

[255] Ibid., 4-3.

[256] Headquarters, Department of the Army, *Casualty Care*, Army Techniques Publication 4-02.5 (Washington, DC: Headquarters, Department of the Army, May 2013), v, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=103276.

[257] ATP 4-02.2, *Medical Evacuation*, 4-4.

[258] ATP 4-02.5, *Casualty Care*, C-10.

resources,[259] and in particular, "[o]perations of short duration and with a low potential for conflict"[260] may require augmentation sooner than seven days.

2) Requires That Some Patients RTD Between Original and Lengthened Policies

In order to have any impact (positive or negative), the theater PM policy must be extended by enough time that some patients will return to duty under the new policy that would not have returned to duty under the original policy. As an example, extending the theater PM policy from three days to seven days would have no impact unless some patients would be expected to RTD between days three and seven. Besides the maximum number of days that patients are held in theater under the original and extended policies, the number of patients that are affected by changing the theater PM policy depends on the types of patients in the theater medical system and the distribution of their treatment and recovery times. AMedP-7.5 provides estimates of the expected distribution of times to return to duty for numerous CBRN patient types, which can help inform the impact of a theater PM policy extension following a CBRN incident.[261]

D. Augment Evacuation Capacity

1. Benefits

a. Mitigates MEDEVAC Shortfall by Increasing Evacuation Capacity and Reducing Time Patients Wait for Evacuation

Augmenting evacuation capacity may mitigate a MEDEVAC shortfall "by providing additional evacuation capacity when [the] number of casualties (workload) or reaction time exceeds the capabilities of MEDEVAC assets."[262] Additional evacuation platforms of any type (nonmedical or dedicated medical military or commercial) would increase the number of patients able to be transported at the same time, which would reduce patient wait times and help mitigate excess MEDEVAC workload. Even if the workload did not exceed MEDEVAC capacity, augmentation via nonmedical military platforms (i.e., CASEVAC) is likely to reduce the time patients wait because the CASEVAC platforms may be closer or more available.

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[259] ATP 4-02.2, *Medical Evacuation*, 4-4.

[260] Ibid., 4-2.

[261] AMedP-7.5, *Estimation of CBRN Casualties*.

[262] FM 4-02, *Army Health System*, 1-7.

2. Costs

a. Increases Sustainment Requirements (MEDEVAC via Additional Dedicated Military Platforms)

If evacuation capacity were augmented by deploying additional military MEDEVAC platforms, then the additional capability would increase sustainment requirements.

b. May Increase Mortality Among Patients Evacuated via CASEVAC

The provision of medical care associated with MEDEVAC "greatly enhances the patient's potential for recovery and may reduce long-term disability by maintaining the patient's medical condition in a more stable manner."[263] When evacuating patients via CASEVAC, the level of en route medical care that can be provided (if any) is limited by the skill level of the individual providing care, medical equipment available, number of casualties being transported, and accessibility of casualties.[264] Ideally, a combat medic or combat lifesaver[265] is able to accompany a nonmedical evacuation platform and provide some medical treatment en route, although this may not always be the case. If en route care cannot be provided, augmentation via CASEVAC platforms rather than waiting for evacuation via MEDEVAC may result in increased mortality rates.[266] Besides the risks associated with lack of en route care, use of CASEVAC platforms, which retain their legal combatant status "includes the acceptance of additional risk to the patient (who is a non-combatant) by virtue of being transported on a combatant platform that can be made the object of attack."[267]

c. Requires Time for Augmentation to Become Available After Request (MEDEVAC via Dedicated Military or Private/Commercial Platforms)

Whereas CASEVAC uses vehicles of opportunity and is therefore an immediate option for augmenting evacuation capacity, augmentation via dedicated MEDEVAC platforms may involve a significant time delay. In-theater assets may be redirected for a more rapid response, but it may be days before additional MEDEVAC assets can be deployed to theater. In addition to the time to identify and task available resources and the preparation and travel time, private/commercial MEDEVAC platforms may be delayed further if contracts are not already established prior to the operation.

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[263] ATP 4-02.2, *Medical Evacuation*, 1-6.

[264] Ibid., 1-7.

[265] "The combat medic can provide emergency medical intervention, whereas the combat lifesaver can only monitor the casualty and ensure that the basic lifesaving first aid tasks are accomplished." Ibid.

[266] ATP 4-02.13, *Casualty Evacuation*, 7-3.

[267] JP 4-02, *Joint Health Services*, A-2.

d. Entails Financial Costs of Contract (MEDEVAC via Dedicated Private/Commercial Platforms)

Any agreements with private contract carriers to augment evacuation capacity would come at some financial expense. Phoenix Air was paid $200,000 apiece to MEDEVAC two American missionaries with Ebola virus disease from Liberia to Atlanta in 2014.[268] Other insurance specialist estimates for the cost to MEDEVAC Ebola patients from West Africa to the U.S. ranged from $72,000 to $104,000 per person.[269] While the cost to evacuate patients requiring special isolation during transport is likely greater than for non-contagious patients, any MEDEVAC contract will involve some expense.

3. Operational Constraints

a. Non-Permissive Environments May Preclude Augmenting Evacuation Capacity via Aircraft or Private/Commercial Platforms

As stated earlier, a permissive environment is an "[o]perational environment in which host nation military and law enforcement agencies have control, as well as the intent and capability to assist operations that a unit intends to conduct."[270] The loss of constant friendly air superiority in non-permissive environments, which is expected in large-scale combat operations, could restrict air evacuation options and increase reliance on ground vehicles.[271] Augmenting evacuation capacity with additional aircraft when air superiority is not guaranteed and existing aircraft are unable to be utilized may do little to mitigate MEDEVAC shortfalls.

Non-permissive environments may also limit the extent to which private/commercial MEDEVAC options are available to augment evacuation capacity. Civilian aircraft under DOD contracts "will not conduct operations on an air base that is under attack, potentially under attack, and/or contaminated at the time of flight arrival."[272]

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[268] Cameron McWhirter and Betsy McKay, "Special Planes Are Lifeline for Ebola Patients," *The Wall Street Journal*, last updated March 13, 2015, https://www.wsj.com/articles/special-planes-are-lifeline-for-ebola-patients-1426276096.

[269] Carolyn Cohn, "Medical Evacuation Services Balk at Flying Out Ebola Patients," *Reuters*, October 11, 2014, https://www.reuters.com/article/us-health-ebola-evacuation/medical-evacuation-services-balk-at-flying-out-ebola-patients-idINKCN0HZ1TZ20141011?edition-redirect=in.

[270] JP 3-0, *Joint Operations*, GL-14.

[271] Operations Group, National Training Center, *Preparing for Large Scale Combat Operations* (Fort Leavenworth, KS: Center for Army Lessons Learned, January 29, 2021), 28, https://usacac.army.mil/sites/default/files/publications/18100.pdf.

[272] AFDP 3-40, *Counter-Weapons of Mass Destruction Operations*, 59.

4. Planning Considerations

a. Pre-Plan for CASEVAC

Medical planning documents must include contingencies for the use of nonmedical vehicles to transport casualties in the event of MEDEVAC shortfalls.[273] It is important that identified nonmedical assets be tasked in the orders process to allow for "preplanning, coordination, synchronization, and rehearsals,"[274] as well as to ensure compliance from units hesitant to reduce their combat power. The example MASCAL plan in ATP 4-02.13 outlines procedures and responsibilities for MASCAL planning and response, including plans for the use of nonstandard evacuation vehicles.[275]

In addition to considering which vehicles will be used, plans should address how to ensure patients are provided at least some level of en route medical care. "Every effort should be made to staff and equip nonmedical vehicles used for CASEVAC with medical personnel, even if only to move the ROUTINE patient precedence category."[276] When possible, combat medics or combat lifesavers should accompany patients during CASEVAC to provide some level of monitoring and treatment while en route.[277] Additionally, CASEVAC platforms should be augmented with some medical materiel resources, as described in ATP 4-02.13:

> Each of these vehicles should be equipped with a Warrior aid and litter kit (NSN 6545-01-532-4962). The kit is designed to provide the user with enough medical supplies and a stable evacuation platform for two critically injured casualties. Coordinating for the release of these assets upon demand rather than waiting for a MASCAL situation to occur is also crucial to the success of the operation.[278]

b. Negotiate Contracts with Private/Commercial MEDEVAC Services Prior to the Operation on a Contingency Basis

Medical planners should ensure that any contracts for capabilities that may be required in a CBRN environment are established prior to the time of need. Further, they should simplify the process of activating contracts as much as possible to minimize delays between the request and availability of capabilities.

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[273] ATP 4-02.13, *Casualty Evacuation*, 7-3.

[274] ATP 4-02.2, *Medical Evacuation*, 1-7.

[275] ATP 4-02.13, *Casualty Evacuation*, A-3–A-4.

[276] Ibid., 7-3.

[277] Ibid., 7-2–7-3.

[278] Ibid., 7-2.

c. Consider Synergistic Effect of Using Private/Commercial MEDEVAC Platforms with Contagious Patient Isolation Capabilities

Augmenting existing evacuation capacity with commercial MEDEVAC platforms that can safely transport contagious patients in isolation can prevent many of the adverse impacts of contagious patients on medical regulating. In particular, this type of augmentation eliminates the risk of contagious patients exposing dedicated military MEDEVAC platforms, crews, or other patients during MEDEVAC. As a recent example of this concept in use, DOD guidance on air medical transport of COVID-19 patients includes using specialized contracted commercial MEDEVAC providers, such as Phoenix Air Group, to augment military MEDEVAC and "[ensure] the safety of patients and transport personnel" operating in a contagious biological environment.[279] The benefits of isolating contagious patients during evacuation are further described in a later section of this chapter.

E. Expand Patient Staging Facility Capacity

1. Benefits

a. Mitigates MEDEVAC Shortfall by Increasing the Time Patients Can Be Held Outside an MTF in the Case of Delayed MEDEVAC

If a MEDEVAC delay or shortfall would cause patients to wait at the patient staging facility longer than the maximum patient holding time, then expanding the facility capacity to allow patients to be held longer could mitigate that challenge. Increasing the maximum patient holding time would mean that MTFs could transfer patients to the staging facility sooner and that patients would not need to be returned to the MTF if a short MEDEVAC delay would cause them to exceed the original maximum holding time.

b. Mitigates MEDEVAC Shortfall due to Administrative/Legal Challenges to International AE of Contagious Patients by Decreasing the Burden on MTF of AE Delays

An expanded patient staging facility capacity helps mitigate administrative or legal challenges to contagious patient AE in much the same way that it helps mitigate a MEDEVAC delay or shortfall due to any other cause. A longer maximum patient holding time would allow leadership more time to resolve the administrative or legal challenges to AE of contagious patients while reducing the burden on MTFs to hold the patients. Moreover, a larger holding capacity would allow the patient staging facility to

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[279] Donovan, *Force Health Protection Guidance*, 1 of Attachment 1 ("Department of Defense Guidance on Air Medical Transport for COVID-19 Positive Patients and/or COVID-19 Exposed Persons.").

accommodate any backlog of patients awaiting AE due to the administrative or legal delays.

c. Mitigates MTF Bed Shortfall by Increasing Alternate Patient Holding Capacity

Expanding the capacity at the patient staging facility increases the number of stabilized patients that overburdened MTFs can transfer even if MEDEVAC is not immediately available. By providing a medically supervised capability to hold patients prior to evacuation, patient staging facilities can serve as overflow capacity for supported MTFs. Patients stable enough for evacuation no longer need their MTF beds, and removing them from the MTF frees up the beds for other patients needing treatment.

d. Removes the Patient Staging Facility as a Bottleneck in the MEDEVAC System and Increases MEDEVAC Throughput

The patient staging facility bed capacity could limit the throughput of patients that can be evacuated and thus cause a MEDEVAC shortfall, which could be mitigated by increasing the patient staging facility capacity. As an example, imagine that a MEDEVAC asset capable of evacuating more than 15 patients arrives each hour at a 10-bed patient staging facility and evacuates all waiting patients. If the MTFs supported by the patient staging facility prepared 15 patients per hour for MEDEVAC, then each hour 10 patients would be evacuated from the patient staging facility and five stabilized patients would accumulate that could have been evacuated had there been room in the patient staging facility. If the patient staging facility capacity were expanded so that it could keep pace with the 15 patients every hour being generated by the MTFs, then with the same MEDEVAC schedule and capacity limit, all 15 patients waiting at the patient staging facility could be evacuated. In this case, the patient staging facility would no longer function as a bottleneck, and patients could be evacuated at the same rate as they were stabilized for evacuation.

The idea of the patient staging facility as a bottleneck assumes that all patients must be transferred through the patient staging facility, but "patients may be taken straight from the [originating medical facility] to the airframe."[280] In this case, expanding the patient staging facility would avoid the challenge of timing the direct transfer of patients from the MTF to the airfield to coincide with the arrival of the aeromedical evacuation platform.

e. Increases Capacity for Staging Contagious Patients Separately

The patient staging facility could be expanded with one or more of the modular ERPSS extension packages being reserved for contagious patients. This would create

[280] AJMedP-2, *Allied Joint Medical Doctrine for Medical Evacuation*, 4-2.

additional space to allow contagious patients to be isolated from other patients staged for AE.

2. Costs

a. Requires Time to Deploy and Become Operational

Expanding the patient staging facility will require time for deployment, including cargo processing, equipment preparation, personnel preparation, and medical intelligence briefings.[281] Deployment timelines for the ERPSS differ for regular and reserve forces. Regular USAF personnel must be ready to deploy within 24 hours of notification, while reserve components have up to 72 hours to prepare for deployment.[282] Actual deployment of personnel, cargo, and equipment will depend on the TPFDD. Once on site, initial operational capability for the ERPSS-10 should be achieved within one hour,[283] but the time until operational capability is achieved for expansion packages is not specified.

b. Increases Sustainment Requirements

Any deployment of the patient staging facility requires "the goods and services to sustain the operations … for the duration of a deployment" to include "messing, billeting, petroleum oil lubricants (POL), real estate and other support requirements for deployed medical elements."[284] Expanding the patient staging facility capacity would increase the number of medical personnel in theater and the number of patients that could be held, which would increase the nonmedical logistics support requirements. For instance, as "[t]he ERPSS does not have the capability to provide patient meals,"[285] the collocated MTF would experience an increased demand for food. If the patient staging facility is not collocated with an MTF or if the MTF "does not have in-house food service, a support agreement is to be established with base food service for patient feeding, addressing specific therapeutic food items required for patients."[286] AFTTP 3-42.57 lists the sustainment requirements for the 10, 50, 100, and 200 bed ERPSS variants.[287]

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[281] AFTTP 3-42.57, *En Route Patient Staging System*, 17–18.

[282] Ibid., 17.

[283] Ibid., 18.

[284] Ibid., 17.

[285] ATP 4-02.2, *Medical Evacuation*, 6-8.

[286] AFTTP 3-42.57, *En Route Patient Staging System*, 13.

[287] Ibid., Table A4.1, 73–75.

3. Operational Constraints

a. Requires Space to Expand Staging Facility Footprint

Expanding the capacity of the patient staging facility requires space that is "level, unobstructed and of sufficient elevation to prevent flooding"[288] for building out the additional tents to carry out administrative duties and clinical care. Depending on the needed capacity of the expanded patient staging facility, the space requirements can be orders of magnitude larger than those of the existing facility. For instance, the ERPSS-10 (2 tents; 10 beds) requires a 5,200 square foot site, whereas the ERPSS-200 (24 tents; 200 beds) requires a site of 124,800 square feet.[289] In theory, the site selection for the initial patient staging facility should have considered the requirements of possible expansion,[290] but the capacity of an expanded patient staging facility will still be limited by the properties of the initial site location.

b. Is Limited by Maximum Expanded Patient Holding Capacity and Time

Expanding the patient staging facility can only mitigate the challenges up to a certain point and is limited by a maximum patient holding time and bed capacity. In the case of the ERPSS, this capacity limit is 200 patients (or 250 according to some documents)[291] and 72 hours per patient.[292] If the magnitude of the MEDEVAC and MTF shortfalls exceeds this limit, then expanding the patient staging facility alone will not completely mitigate these challenges.

F. Use Telemedicine

1. Benefits

a. Prevents or Mitigates MEDEVAC Shortfall by Decreasing Demand on MEDEVAC Resources (Virtual Consultation with Patients or Reach-Back)

Telemedicine can prevent or mitigate a MEDEVAC shortfall by avoiding unnecessary evacuations. In the case of a contagious biological environment, virtual at-

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[288] Ibid., 58.

[289] Ibid., 58, 73. For detailed facility and operational space requirements for each ERPSS module (ERPSS-10, 50, 100, 200), see Table 10.1, p. 58. For detailed personnel, patient, airfield resources, logistics, etc., requirements for each module, see Table A4.1, p. 73.

[290] Ibid., 58.

[291] Ibid., 12; and ATP 4-02.2, *Medical Evacuation* (p. 6-8) state the maximum capacity as 200, while ATP 4-02.55, *Army Health System Support Planning* (p. J-10) and JP 4-02, *Joint Health Services* (p. A-A-8) report a maximum capacity of 250.

[292] ATP 4-02.2, *Medical Evacuation*, 6-8.

home consultations allow medical personnel to assess whether patients are ill enough to require MEDEVAC and inpatient care or if they can be treated as outpatients without MEDEVAC.

In any environment, medical providers at lower roles of care can consult with specialists at Role 3 MTFs, which "could avoid evacuating a patient to a hospital that could have been managed at a Role 1 or 2 MTF."[293] Medical providers at any role of care, especially those deployed in austere and remote locations, can benefit from using remote consults to help inform whether patients require evacuation.[294] In 2004, when the Army established a teleconsultation service reaching back to specialists in CONUS, one of the primary goals was "to reduce the number of evacuations from the theater by using the subspecialty experts to render remote care."[295] Since then, such reach-back has been shown to "prevent avoidable medical evacuations while hastening those that are critical."[296]

b. Mitigates MEDEVAC Shortfall by Increasing Medical Capabilities Far-Forward in Case of Prolonged Field Care

In the case of MEDEVAC shortfalls, "combat medics must be prepared to provide medical care to serious casualties in the field without the support of robust medical infrastructure or resources."[297] In this prolonged field care scenario, telemedicine supports the goal to "decrease patient mortality and morbidity"[298] by allowing specialists to share their expertise with combat medics, combat lifesavers, or even nonmedical members of the unit in real time. Not all medics need to be "trained as vascular surgeons, but they do have to be able to get detailed information that'll help keep their patients alive."[299] With telemedicine, even if the patient cannot be evacuated to the surgeon, the surgeon can be brought to the patient virtually to guide the medic through the patient examination and treatment.[300] While telemedicine is an effective means of transferring medical knowledge, most telemedicine technologies cannot facilitate the transfer of physical skills to medics in the field, which could limit the procedures that could be performed.

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[293] ATP 4-02.10, *Theater Hospitalization*, 1-3.

[294] McManus et al., "Teleconsultation Program," 211.

[295] Ibid., 213.

[296] Hwang et al., "Utilization of Telemedicine," 1350.

[297] Taylor E. Schlotman et al., "Bridging the Gap between Military Prolonged Field Care Monitoring and Exploration Spaceflight: The Compensatory Reserve," *npj Microgravity* 5 (2019): 1, https://doi.org/10.1038/s41526-019-0089-9.

[298] Sean Keenan and Jamie C. Riesberg, "Prolonged Field Care: Beyond the "Golden Hour"," *Wilderness & Environmental Medicine* 28, no. 2 (June 2017): S137, https://doi.org/10.1016/j.wem.2017.02.001.

[299] Lowe, "War without MEDEVAC Helos."

[300] Keenan and Riesberg, "Prolonged Field Care," S137.

c. Prevents MTF Bed Shortfall by Decreasing Demand on MTF Beds (Virtual Consultation with Patients)

Using telemedicine to virtually manage patients at home during a contagious disease outbreak can reduce the demand for MTF beds and help prevent an MTF bed shortfall in two ways. First, some patients who might otherwise present to the medical system in-person can be effectively treated as outpatients. For a future pandemic influenza, it is expected that most persons who seek care could be managed as outpatients using a home-based approach, which would reduce the demand for inpatient care.[301] Second, the option of remotely monitoring patients during convalescence creates "the potential to release patients earlier from the hospital and to avoid new hospital visits, which potentially frees up hospital beds and equipment for those patients who most need them."[302]

d. Mitigates MTF Personnel Shortfall due to Misalignment of MTF Personnel Capabilities with Patient Needs by Supplementing Medical Personnel Capabilities with the Knowledge of Virtual Experts (Reach-Back)

By bringing a specialist to the point of care virtually, telemedicine can mitigate an MTF personnel shortfall caused by not having the right specialist at an MTF. Such reach-back options are available at any role of care. Role 3 MTFs "are designed to employ numerous medical specialists," so they are an important reach-back resource for Role 1 and 2 MTFs, which typically do not have many medical specialties represented among the physicians.[303] The network of SMEs available for reach-back support extends far beyond the medical staff at deployed MTFs and includes "the CCDR staff, supporting and other CCMD [combatant command] SMEs, Service SMEs, DHA [Defense Health Agency] SMEs, Navy Health Research Center, other USG departments and agencies, designated multinational partners, academic and industrial sources, and both technical linkages and personal relationships developed through training and habitual associations."[304]

e. Prevents MTF Personnel Shortfall due to Illness or Quarantine by Decreasing Risk of Medical Personnel Exposure to Contagious Patients (Virtual Consultation with Patients)

With a policy of virtual medical appointments during a contagious biological environment, MTF personnel are less likely to be exposed to contagious patients and therefore less likely to be unavailable due to illness or quarantine. Reducing the number of

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[301] Homeland Security Council, *Implementation Plan for the National Strategy for Pandemic Influenza* (Washington, DC: The White House, May 2006), 112.

[302] David A. Hoffman, "Increasing Access to Care: Telehealth during COVID-19," *Journal of Law and the Biosciences* 7, no. 1 (June 2020), 2, https://doi.org/10.1093/jlb/lsaa043.

[303] ATP 4-02.10, *Theater Hospitalization*, 1-2–1-3.

[304] JP 4-02, *Joint Health Services*, IV-26–IV-27.

in-person interactions, even with patients not known to be infectious, can decrease the risk of exposure to medical personnel. During the COVID-19 pandemic for example, the CDC advocated for telemedicine as a means of "minimizing the transmission risk of SARS-CoV-2, the virus that causes COVID-19, to healthcare personnel."[305]

f. Prevents CBRN Exposure to Patients by Minimizing the Number of Patients That Have Contact at MTFs (Virtual Consultation with Patients)

Just as telemedicine can help protect MTF personnel during a contagious biological environment, it can also "be a safer option for … [susceptible] patients by reducing potential infectious exposures."[306] With remote treatment options, both patients that are infectious and those that are susceptible to infection are less likely to present for in-person treatment. As a result, susceptible patients that do seek in-person treatment will be less likely to contact infectious patients, and those that do not seek in-person treatment will not face any risk of exposure at the MTF.

2. Costs

a. Requires Technology Investments

All applications of telemedicine require some investment in the enabling technology, which varies widely in complexity and ranges from landline telephones to augmented reality devices. In most applications, both hardware and software are required to make use of this technology. When COVID-19 caused DOD to swiftly transition to virtual healthcare, MTF personnel "reported shortages of IT [information technology] equipment and stated that the MTFs lacked the IT infrastructure necessary to optimize telework and conduct virtual health care appointments. [They] reported not having enough IT hardware, such as webcams and common access card readers, and stated that they could not obtain laptops from the DHA when needed."[307] MTF personnel resorted to conducting virtual appointments using personally owned electronic devices and publicly available commercial software solutions.[308] For some telemedicine applications, purchasing additional standard hardware items and using commercial software may not be sufficient, and new IT systems may be required. This represents the most costly investment, as the

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[305] Centers for Disease Control and Prevention (CDC), "Using Telehealth to Expand Access to Essential Health Services during the COVID-19 Pandemic," last updated June 10, 2020, https://www.cdc.gov/coronavirus/2019-ncov/hcp/telehealth.html.

[306] CDC, "Using Telehealth."

[307] DOD Office of Inspector General, "Medical Treatment Facility Challenges," 13.

[308] Ibid., 13.

DOD IT acquisition process has historically been "laced with inefficiencies and inadequacies that have resulted in prolonged schedules as well as increased cost."[309]

Additional technical challenges may be introduced in a combat theater. Adversaries are likely to take down commercial networks, so telemedicine strategies should not rely on cell service. Consequently, there will be significant requirements for reliable, secure, and most likely wireless network access, which can be scarce in an operational environment.

b. Increases Data Security and Privacy Challenges

Even if the technological challenges are overcome, any telemedicine solution must conform to data security and privacy requirements. One of the critical impediments to expanded use of telemedicine by the military is information security. Information about the location, condition, and health of U.S. military personnel is critical to national security, and this is heightened if service members are subjected to CBRN threats or hazards. Any telemedicine technology, including some commercial software, could be unacceptable if it lacked compliance with applicable data privacy laws or compatibility with the DOD's new electronic health record management system.[310] For instance, although video solutions have many advantages over audio-only telemedicine platforms, an inability to integrate with government software and electronic health records to ensure a secure connection has prevented widespread adoption of telemedicine video capability within the DOD.[311]

c. Requires Training

Any application of telemedicine will require training for individuals on both ends of the telemedicine system. For patients and providers seeking medical expertise, training needs include knowing whom to contact for different types of expertise and how and when to access the virtual system. Since the patient and/or provider at the point of care could be operating in a CBRN environment, training should include how to operate the telemedicine system while in IPE, which can make communication more difficult. For most applications of telemedicine, patient training on system access and use will be required before individuals become patients. A possible exception may be for hospitalized patients

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[309] Melvin D. Burch-Bynum, "DOD Information Technology Acquisition: Delivering Information Technology Capabilities Expeditiously" (Master's thesis, Naval Postgraduate School, 2013), v, https://calhoun.nps.edu/bitstream/handle/10945/37591/13Sep_Burch_Melvin.pdf?sequence=1&isAllowed=y.

[310] DOD is currently deploying in waves a new centralized electronic health record management system, MHS GENESIS, which meets DOD's cybersecurity requirements. "MHS GENESIS," Health.mil Website, accessed August 17, 2021, https://health.mil/Military-Health-Topics/MHS-Transformation/MHS-GENESIS.

[311] Elaine Sanchez, "Military Hospital Dials in Virtual Healthcare to Combat COVID-19," *Health.mil,* April 13, 2020, https://health.mil/News/Articles/2020/04/13/Military-hospital-dials-in-virtual-healthcare-to-combat-COVID-19.

transitioning from in-patient care to virtual at-home convalescent care, who can be taught the basics of telehealth while in the hospital.

Training requirements for remote medical personnel may need to be even more extensive. Experience from the DOD transition from in-person visits to virtual healthcare during the COVID-19 pandemic revealed that medical personnel experienced a learning curve using the virtual appointment technology and could benefit from additional training and standard operating procedures.[312] Training should cover challenges, workflows, strategies, and best practices, including good virtual bedside manner. Lastly, security protocols and legal/regulatory considerations, such as licensing or credentialing requirements, must not be overlooked.

3. Operational Constraints

a. Requires Sufficient and Reliable Information Technology Infrastructure

The provision of telemedicine requires a robust IT infrastructure with sufficient bandwidth and protection from cyber threats. Using telemedicine, especially video teleconferencing capabilities, will increase the required communications bandwidth of a deployed force, which J-6 staff must plan for when setting the theater.[313] The DOD transition to telemedicine during the COVID-19 pandemic demonstrates the risks of an insufficient communications infrastructure. MTF personnel "reported not being able to effectively telework or conduct virtual health care because of challenges with bandwidth and access to the virtual private network."[314] Even when the infrastructure is properly sized, an adversary cyber-attack "may impact … the use of electronic health records and telemedicine."[315] Unless an IT infrastructure is both prepared to handle the increased bandwidth requirements and hardened against cyber-attacks, telemedicine cannot be relied on to mitigate the adverse impacts on medical regulating caused by operating in a CBRN environment.

b. Is Limited by Availability of Medical Resources to Implement Recommended Interventions

The benefits of some applications of telemedicine are limited by the lack of medical countermeasures or equipment available at the point of care. Although telemedicine can help mitigate a lack of expertise, and skill to some degree, it cannot mitigate a medical materiel shortfall. For example, reach-back to a specialist would be of limited utility to a

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[312] DOD Office of Inspector General, "Medical Treatment Facility Challenges," 13–14.

[313] JP 4-02, *Joint Health Services*, IV-27; and AJMedP-1, *Allied Joint Medical Planning Doctrine*, 3-13.

[314] DOD Office of Inspector General, "Medical Treatment Facility Challenges," 13.

[315] AJMedP-1, *Allied Joint Medical Planning Doctrine*, 3-8.

medical provider treating a botulism patient at a remote location with no access to botulinum antitoxin. In order to improve patient outcomes in some scenarios, telemedicine may need to be combined with other concepts to quickly move medical resources to the point of treatment.

4. Planning Considerations

a. Pre-Establish Contact with Designated Subject Matter Experts

Prior to deployment, medical staffs should establish lists of subject matter experts specific to each type of CBRN threat anticipated who could assist in a virtual capacity during deployment. AFTTP 3-42.22 recommends that forces "deploy with a "smart book," which contains phone numbers for points of contact for consultation, reach-back, etc." and includes an example list of infectious disease reach-back contacts in the case of a biological incident.[316] ATP 3-11.36 includes an appendix on CBRN technical reach-back sources within the DOD and NATO.[317] Waiting until after deployment to identify specialists will make the task more difficult and could result in delays if the proper contact information is not available when virtual specialist expertise is required.

b. Plan for Information Technology Requirements

Medical planners should "consider and plan for [IT] factors and requirements that support timely access to reach-back capabilities"[318] and other applications of telemedicine being considered. As discussed earlier, a lack of IT infrastructure contributed to DOD challenges in transitioning to virtual healthcare in the COVID-19 pandemic.

c. Consider Synergistic Effect with Augmenting Medical Materiel

A major limitation to telemedicine applications involving consultation with patients at home or in the field may be the lack of medical materiel to implement the recommendations of the virtual subject matter experts. In these scenarios, a combination of telemedicine and rapid augmentation of medical materiel could improve patient outcomes. These concepts would complement each other by providing both the expertise to diagnose and treat a patient and the materiel solution to implement the recommended course of treatment.

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316 AFTTP 3-42.22, *Contagious Casualty Management*, 14.

317 Headquarters, Department of the Army, *Multi-service Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Planning*, Army Techniques Publication 3-11.36 (Washington, DC: Headquarters, Department of the Army, September 2018), Appendix B, https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1005625.

318 AFTTP 3-42.22, *Contagious Casualty Management*, 14.

G. Limit the Number of MEDEVAC Platforms in Contaminated Areas and Prioritize Ground Ambulances

1. Benefits

a. Prevents MEDEVAC Shortfall due to MEDEVAC Platforms Being Unavailable During Decontamination, Especially Among Higher Value Air Ambulances

Each MEDEVAC platform entering a contaminated area would require thorough decontamination prior to resuming operations in a clean environment.[319] If the mission did not allow time for thorough decontamination within an hour of contamination (or within six hours for vehicles painted with chemical agent resistant coating), vehicles should be washed down as part of operational decontamination.[320] Both the operational and thorough decontamination procedures would make the platform unavailable for some periods. Limiting the number of MEDEVAC platforms that operate in a contaminated area would reduce the number requiring decontamination and would prevent MEDEVAC shortfalls caused by their unavailability during the decontamination process.

2. Costs

a. Exacerbates MEDEVAC Shortfall due to Patients Exceeding Available MEDEVAC Capacity

The primary cost of limiting the number of MEDEVAC platforms in a contaminated area is the delayed time to MEDEVAC all patients within those areas. If the number of patients in a contaminated area requiring evacuation exceeds the capacity of the limited MEDEVAC platforms allowed in that area, then this concept exacerbates a MEDEVAC shortfall.

b. Increases Requirements for Tracking and Coordinating Medical Resources

Once the boundaries of the contaminated areas are known and MEDEVAC assets are segregated into clean and contaminated platforms, then this information must be integrated into the medical regulating decision-making process. When a MEDEVAC request is made, the medical staff must be able to determine whether MEDEVAC platforms would need to traverse contaminated routes to evacuate the patients and which evacuation asset should respond, given the contamination statuses of the available MEDEVAC platforms.

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[319] MECCD and SAAM, "Standard Medical Operations Guidelines," 81.

[320] ATP 3-11.32, *CBRN Passive Defense*, 2-68.

3. Operational Constraints

a. Requires the Ability to Distinguish Between Clean and Contaminated Areas and MEDEVAC Platforms

The main operational constraint on implementing this concept is the ability to distinguish between clean and contaminated areas and MEDEVAC platforms. This would require CBRN units to establish and mark the boundaries of contaminated areas and medical units to identify the presence of contamination on MEDEVAC platforms.

4. Planning Considerations

a. Consider Synergistic Effect with Augmenting Evacuation Capacity via CASEVAC

One way to limit the number of MEDEVAC assets committed to contaminated areas without delaying evacuation of patients from those areas is to augment evacuation capacity with nonmedical vehicles already in the contaminated areas. This idea is consistent with doctrine, which advocates using contaminated medical and nonmedical assets before employing uncontaminated resources.[321]

H. Collectively Protect MTFs

1. Benefits

a. Prevents MTF Bed Shortfall due to Contaminated Beds by Protecting MTF Beds from CBRN Hazards

COLPRO systems provide an environment free from contamination, which could prevent bed shortfalls due to contamination. Without COLPRO, chemical agents could penetrate MTF shelter materials within six hours of contamination and render MTF beds unusable.[322]

b. Prevents MTF Personnel Shortfall due to Illness, Injury, or Quarantine by Protecting MTF Personnel from CBRN Hazards

Without COLPRO, CBRN hazards inside the MTF could lead to MTF personnel illness, injury, or quarantine, which would reduce their capacity to perform their duties.[323] By protecting MTF personnel from chemical, biological, and radiological particle hazards

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[321] ATP 4-02.2, *Medical Evacuation*, 2-33.

[322] ATP 4-02.7, *Health Service Support*, 12-1.

[323] Ibid., 12-16.

in the environment, COLPRO systems could prevent MTF personnel shortfalls resulting from exposure to those hazards.

c. Prevents MTF Personnel Shortfall due to Increased Rest Periods When Wearing Protective Equipment by Protecting MTF Personnel from CBRN Hazards

COLPRO MTFs allow "medical personnel and patients to work without individual chemical and biological protective gear."[324] As a result, MTF personnel inside the MTF would not be subject to any increased rest periods imposed by wearing protective equipment. When a COLPRO MTF is operational, some medical personnel would still be required to don MOPP Level 4 to facilitate patient entry and exit procedures. Of the eight medical personnel required to operate a CBPS system in chemical-biological mode, only four provide treatment inside the clean area or in the CBPS. The remaining half of the medical personnel must don MOPP Level 4 to perform triage, oversee decontamination, and manage patients outside the MTF.[325]

d. Prevents MTF Personnel Shortfall due to Degraded Capability When Wearing Protective Equipment by Protecting MTF Personnel from CBRN Hazards

Collectively protected MTFs could provide an "environment unencumbered by the stresses of IPE,"[326] reducing both the number of MTF personnel required to wear protective equipment and the associated shortfalls due to degraded capability. As mentioned earlier, some fraction of the MTF personnel would be required to operate in MOPP Level 4 to manage patients outside the MTF, but some MTF personnel would be spared the impediment of wearing protective equipment.

e. Prevents Medical Materiel Shortfall due to Contamination by Protecting Medical Materiel in the MTF from CBRN Hazards

Without COLPRO, medical materiel inside an MTF is subject to contamination from hazards in the environment. Liquid chemical agents, for instance, can penetrate shelters without chemically protective liners within six hours and contaminate "medical supplies and equipment; especially, sterilized equipment and supplies, paper-wrapped cotton sponges, and open or lightly closed medications/solutions."[327]

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[324] Ibid., 12-10.

[325] Ibid., 3-4.

[326] Ibid., 12-9.

[327] Ibid., 12-1.

f. Prevents CBRN Exposure to Patients by Protecting Patients Inside MTF from CBRN Hazards

COLPRO systems allow for a hazard-free environment inside the MTF where treatment procedures involving open wounds or the respiratory tract can continue without risking exposure of patients to CBRN hazards.[328]

g. Protects MTF Personnel, Materiel, and Patients from Non-CBRN Environmental Factors

In addition to protecting MTF personnel, medical materiel, and patients from CBRN hazards, COLPRO MTFs could provide protection from a number of environmental hazards or nuisances. For instance, people and equipment inside COLPRO MTFs are protected from extreme heat or cold, humidity, dust and sand, and pests.

2. Operational Constraints

a. Must be Operational Prior to CBRN Hazard in the Environment

While "[a] single CBPS system can be inflated in four minutes and fully operational in less than 20 minutes,"[329] this still requires warning of an imminent attack in order to ensure patients and MTF resources are protected from exposure. Furthermore, whereas the CBRN resistant features of the CBPS systems are inherent, the agent resistant liners in COLPRO systems like CP DEPMEDS and CPEMEDS must be included during construction.[330] If the liners were not included during construction of CP DEPMEDS or CPEMEDS, no amount of warning would allow the MTF to be collectively protected without first dismantling and reconstructing the facility with the liners.

I. Designate an MTF for Contagious Patients Only

1. Benefits

a. Prevents MTF Personnel Shortfall due to Illness or Quarantine Because MTF Personnel in Non-Contagion MTFs Are Not at Risk of Exposure from Contagious Patients

The main benefit of designating one or more MTFs as contagion facilities would be to reduce the number of points within the medical system at risk of contagious disease

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[328] Ibid., 12-1.

[329] "Chemical Biological Protective Shelter Systems (2000)," Army Medicine Website, accessed May 26, 2021, https://armymedicine.health.mil/Innovations/2000ChemBioShelter.

[330] ATP 4-02.7, *Health Service Support*, 12-12.

spread. By concentrating all contagious patients at designated MTFs, the risk to MTF personnel is limited to those at the designated contagion facilities. Assuming contagious and non-contagious patients were correctly sorted at triage, the risk of exposure from contagious patients would be eliminated for all MTF personnel at the non-contagion MTFs. By reducing MTF personnel losses due to illness and quarantine, this concept could prevent an MTF personnel shortfall caused by actual or possible exposure.

b. Prevents CBRN Exposure to Patients Because Patients in Non-Contagion MTFs Are Not at Risk of Exposure from Contagious Patients

Treating all contagious patients at a designated contagion facility would reduce the risk of non-contagious patients at other MTFs being exposed to contagious patients, just as it did for MTF personnel in the non-contagion MTFs. This concept would prevent further harm to patients from exposure and reduce the chances of spreading the disease within the medical system.

2. Costs

a. Exacerbates MEDEVAC Shortfall by Increasing Demand for MEDEVAC of Non-Contagious Patients Currently in a Newly Designated Contagion MTF

While all patients at an MTF would eventually be evacuated or released back to their units, the sudden designation of the MTF as for contagious patients only could increase the urgency with which MTF personnel sought to clear patients from the MTF. By triggering MEDEVAC requests for patients that could have recovered at the MTF without further movement, this concept could increase the demand on MEDEVAC and exacerbate a MEDEVAC shortfall.

b. Exacerbates MEDEVAC Shortfall Because Average MEDEVAC Time May Increase Compared to Policy of Patients Going to Nearest MTF

Designating a contagion MTF could increase the average MEDEVAC transport time compared to a policy of evacuating patients to the closest MTF with available capabilities. If the contagion MTF would have been the destination MTF for a non-contagious patient, then the patient would likely experience a longer evacuation to the second-choice facility. Similarly, unless the contagion MTF was the closest MTF for all contagious patients, the average transport time for contagious patients would likely increase as well.

c. Exacerbates MTF Bed Shortfall by Limiting Beds Available for Balancing Patient Load Between MTFs

When designating an MTF for contagious patients, total MTF beds will ideally be allocated proportionally to the number of projected contagious and non-contagious patients, but this may be difficult to achieve in practice. If contagious patients exceed the number of beds in the contagion MTF or non-contagious patients exceed the number of beds in the non-contagion MTFs, the ability to balance the patient loads to mitigate the MTF bed shortfalls is hindered by this concept. Any excess bed capacity in MTFs cannot be shared as easily if those beds are reserved for patients of a different type. This could result in an MTF bed shortfall even if the total number of beds exceeds the total number of patients.

3. Operational Constraints

a. Requires the Ability to Distinguish Between Contagious and Non-Contagious Patients

In order to treat all contagious patients at a designated contagion MTF and all non-contagious patients at other MTFs, medical personnel must be able to distinguish between these two groups. A case definition specifying the criteria for whether a patient should be classified as a contagious patient should be established and disseminated when this concept is implemented.

4. Planning Considerations

a. Pre-Select an MTF to Designate for Contagious Patients (or Decide on Selection Criteria)

Medical planners could save time and reduce the number of decisions to be made upon recognition of an outbreak by deciding in advance which MTF is best to designate for managing contagious patients. If proximity to the unit(s) most affected is the main consideration, then specifying a particular MTF would necessarily follow an actual outbreak. If medical materiel and personnel resources were the driving factors, then planners could assess the candidate MTFs and pre-select one as the contagion facility in the event of an attack or naturally-occurring outbreak.

b. Consider Synergistic Effect with Deploying Specialized Medical Augmentation Teams, Using Telemedicine, and Using Lateral or Skip Evacuation

The effectiveness of designating a contagion MTF could be magnified by implementing one or more other concepts assessed in this chapter. To ensure contagious

patients receive treatment from the most qualified medical personnel, staff at a designated contagion MTF could be augmented by specialized medical augmentation teams or could consult with contagious disease experts via reach-back. Use of a designated contagion MTF also implies the non-linear movement of patients through the medical system, which entails using lateral or skip evacuation to transport patients to the contagion MTF as soon as practical.

J. Isolate Contagious Patients During Evacuation

1. Benefits

a. Mitigates MEDEVAC Shortfall due to Administrative/Legal Challenges to International Aeromedical Evacuation of Contagious Patients by Minimizing Risk of Disease Spread During Transport and Reducing Administrative/Legal Opposition to Overflight or Emergency Landing Rights

Isolating highly contagious patients during evacuation may help overcome the administrative/legal obstacle of securing overflight or emergency landing rights. Some nations may be hesitant to allow contagious patients to be transported through their airspace due to fears that the disease could spread within their borders in the case of an emergency landing. If these nations believed that patients, medical providers, aircraft operators, and the aircraft itself posed little exposure risk to anyone that might need to interact with the aircraft during an emergency landing, then they may consider granting overflight and emergency landing rights. Since patient isolation via a high-level containment transport system can ensure negligible transmission risk, this concept may mitigate MEDEVAC shortfalls due to these types of administrative/legal obstacles.

b. Prevents or Reduces MEDEVAC Shortfall due to Aeromedical Evacuation Platforms Unavailability During Disinfection by Minimizing Disinfection Required of Platforms After Evacuation of Contagious Patients

The use of a high-level containment transport system may decrease disinfection requirements, reducing the time evacuation platforms are unavailable due to disinfection, although there was considerable variability on this issue in the literature. The U.S. COVID-19 evacuation guidelines include recommendations to clean and disinfect the evacuation platform post-mission, even though the use of a high-level containment transport system is recommended, if available.[331] In contrast, based on the experience of the Swiss Air Rescue

[331] Donovan, *Force Health Protection Guidance*.

(Rega), "fixed-wing ambulances or helicopters do not require additional decontamination between transports"[332] when evacuating COVID-19 patients via a closed transport system.

Disinfection recommendations following evacuation of patients with viral hemorrhagic fever are similarly variable in the literature. For transporting patients with EVD, the CDC claims that using a closed transport system "minimizes the need to clean and decontaminate the aircraft after the mission."[333] Dindart reported using a chlorine solution to disinfect the aircraft "at every point of contact between the pod and the plane" after transporting patients with suspected EVD and estimated the process to take approximately 15 minutes.[334] Following the 2011 evacuation of a Lassa Fever patient with a closed transport system by a commercial MEDEVAC crew, the entire aircraft cabin was disinfected with Nocolyse spray after the mission.[335]

c. Prevents MEDEVAC Shortfall due to Crew Illness or Quarantine by Isolating Contagious Patients to Protect MEDEVAC Crews from Exposure

Isolating highly contagious patients during evacuation can reduce the risk of transmission of infection to MEDEVAC crews.[336] Isolation can be achieved using high-level containment transport systems that are "[c]apable of protecting crew, medical personnel and passengers from a contaminated and/or contagious patient"[337] via barrier protection and negative pressure filtration systems.[338] By protecting MEDEVAC crews from exposure to contagious patients, evacuation via high-level containment transport systems will prevent or reduce MEDEVAC shortfalls caused by crews becoming ill or requiring quarantine.

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[332] Albrecht et al., "Transport of COVID-19," 4.

[333] CDC, "Guidance on Air Medical Transport."

[334] Jean-Michel Dindart et al., "Aerial Medical Evacuation of Health Workers with Suspected Ebola Virus Disease in Guinea Conakry-Interest of a Negative Pressure Isolation Pod-A Case Series," *BMC Emergency Medicine* 17, no. 1 (March 2017): 2–3, https://doi.org/10.1186/s12873-017-0121-x.

[335] Eric Lotz and Hervé Raffin, "Aeromedical Evacuation Using an Aircraft Transit Isolator of a Patient with Lassa Fever," *Aviation, Space, and Environmental Medicine* 83, no. 5 (May 2012): 530, https://doi.org/10.3357/asem.3094.2012.

[336] Roberto Biselli, "Aeromedical Evacuation of Patients with Hemorrhagic Fevers: The Experience of Italian Air Force Aeromedical Isolation Team," *Journal of Human Virology & Retrovirology* 2, no. 5 (August 2015): 7, https://doi.org/10.15406/jhvrv.2015.02.00058.

[337] Bohannon et al., *Smart Defence Project 1.1045*, E-12.

[338] Gibbs et al., "Review of Literature," 363.

d. Prevents MEDEVAC Shortfall from Degraded Crew Capability due to Wearing Protective Equipment by Eliminating Requirement for Enhanced PPE During Aeromedical Evacuation with Some Systems

Depending on the type of transport system and national policy, isolating contagious patients during evacuation may provide relief from wearing PPE to some members of MEDEVAC crews. With closed transport systems, "accompanying medical personnel do not need to wear personal protective equipment (PPE) during the transport,"[339] whereas, with open transport systems, all medical providers are required to operate in PPE.[340] With either system, nonmedical personnel do not require PPE. Even with the same system, PPE procedures may differ by nation, as observed in a multinational medical training exercise with a simulated patient suffering from a notional novel Morbilivirus disease considered to be airborne-transmissible. During patient handover between a British and an Italian Trexler Air Transport Isolator (T-ATI) closed system, the British crew wore scrubs, single gloves, and fluid-resistant aprons, whereas the Italian crew wore goggles, N-95 masks, fluid-resistant coveralls, double gloves, and shoe covers.[341]

e. Prevents Contagious Spread to Susceptible Patients by Isolating Contagious Patients

In the same way that isolating contagious patients can protect MEDEVAC crews, it can also reduce the risk of transmission to other patients on the same evacuation platform. Although the recommendation for both COVID-19 (transmitted by respiratory droplets or aerosols) and EVD (transmitted by direct contact with body fluids) is to avoid transporting patients with either disease with other patients who do not have the disease,[342] there may be times when this is unavoidable. In these cases, the high-level containment transport system could prevent exposure to these other patients.

2. Costs

a. Entails Financial Cost to Purchase and Maintain

As a materiel solution, using a high-level containment transport system to isolate patients during evacuation requires a financial investment in the procurement and maintenance of the system. The estimated procurement cost for the TIS in 2014 was $2.5

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[339] Albrecht et al., "Transport of COVID-19," 4.

[340] Biselli, "Aeromedical Evacuation," 7.

[341] Personal observation of patient handover at Câmpia Turzii in Romania during Vigorous Warrior 2019 between British and Italian ATI teams.

[342] Donovan, *Force Health Protection Guidance* 3 of Attachment 1 ("Department of Defense Guidance on Air Medical Transport for COVID-19 Positive Patients and/or COVID-19 Exposed Persons."); CDC, "Guidance on Air Medical Transport."

million for 25 units.[343] The NPC, developed in response to the COVID-19 pandemic and certified for operational use in June 2020, cost about $2 million to develop and test a prototype.[344] While a closed transport system may be an order of magnitude cheaper per unit,[345] the per-unit capacity is also limited to one patient, whereas an open transport system such as the NPC can transport as many as 28 patients.[346] Moreover, as some closed transport systems are single-use items,[347] the cost per unit may equal the cost per patient.

b. Requires Individual and Unit Level Training

To ensure the safety of the patients and MEDEVAC crew, contagious patients "must be managed by highly trained teams and organizations, especially considering the uncontrolled environment of AE-HLCT [aeromedical evacuation high-level containment transport] missions and the potential for the rapid deterioration of patient condition."[348] Aeromedical evacuation crews are often tailored to meet the specific mission requirements and could be augmented by members of a Critical Care Air Transport Team and infectious disease physicians to transport contagious patients. Training for these individuals includes not only the individual and collective training required for their normal roles (when not transporting highly contagious patients), but also training on how to safely use the high-level containment transport system. For instance, training for personnel tasked for TIS missions "includes TIS familiarization, donning and doffing PPE procedures, exercising patient loading/unloading procedures, simulated in-flight patient care, and didactics in strict adherence to infection control procedures, vital to patient and crew safety."[349]

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[343] Owen C. Gadeken, "Rapid Development of the U. S. Military's Transport Isolation System: The "Ebola Carrier" (A Project Management Case Study)" (paper presented at PMI® Global Congress 2015—North America, Orlando, FL. Newtown Square, PA: Project Management Institute), https://www.pmi.org/learning/library/rapid-development-military-transport-9872.

[344] Brian W. Everstine, "USAF Testing Rapidly Developed System to Fly Infectious Patients," *Air Force Magazine*, April 22, 2020, https://www.airforcemag.com/usaf-testing-rapidly-developed-system-to-fly-infectious-patients; and Brian Brackens, "AFLCMC-led Team Delivers Isolation Container Prototype for Testing," *Air Force Life Cycle Management Center*, April 22, 2020, https://www.af.mil/News/Article-Display/Article/2161925/aflcmc-led-team-delivers-isolation-container-prototype-for-testing/.

[345] Some commercial variants are on the order of $10,000 per unit. See https://adonyss.com/product/adonyss-portable-patient-isolation-chamber; https://www.grainger.com/product/38F321; or https://www.grainger.com/product/52WU52.

[346] Everstine, "USAF Testing."

[347] Lotz and Raffin, "Aeromedical Evacuation," 530; and ProPac, "CAPSULS™ PPE Patient Isolation Unit," accessed August 17, 2021, https://propacusa.com/product/capsuls-patient-isolation-unit.

[348] Shawn G. Gibbs et al., "Need for Aeromedical Evacuation High-Level Containment Transport Guidelines," *Emerging Infectious Diseases* 25, no. 5 (May 2019): 1033, https://doi.org/10.3201/eid2505.181948.

[349] "Transportation Isolation System (TIS)," Air Mobility Command Website, April 1, 2020, https://www.amc.af.mil/About-Us/Fact-Sheets/Display/Article/2132917/transport-isolation-system-tis.

While the frequency of training will vary according to national and unit policies, high-level containment transport system teams must "regularly test, validate, and exercise their systems and procedures to ensure mission readiness."[350] Military portions of the Italian Aeromedical Isolation Team train every 15 days with their civilian counterparts.[351] The British Deployable Air Isolator Team conducts unit-level training on a monthly basis.[352] The U.S. TIS teams "receive multi-day initial TIS training" as well as refresher training prior to mission execution.[353] Regardless of the frequency, a significant investment of training time is required to maintain the highly specialized capability to transport contagious patients safely.

c. Requires Time to Become Operational

When planning to evacuate contagious patients in isolation, it is important to consider the time it may take to make the transport system available in the case of an outbreak. Ideally, the systems would be both procured and deployed to theater before they are needed. In the case that they were procured, but not prepositioned in theater prior to the operation, then they would need to be deployed to theater when needed. This could take hours or days depending on the theater, the location of the transport system, and the TPFDD.

If the systems were not already procured, then they would need to be purchased, contracted, or manufactured. There are commercial single patient capacity closed transport system options available for purchase, but it is unclear what type of turnaround time would be available, especially if there were competing demands from civilian response organizations or other nations or militaries, as in the case of a global pandemic. Some private/commercial MEDEVAC platforms are equipped with a high-level containment transport system, and this was the DOD's preferred method of transporting COVID-19 patients.[354] The backlog for the State Department's Portable Bio Containment Module was reportedly six months during the COVID-19 pandemic, which influenced the USAF decision to develop the NPC system.[355] The NPC went from conception to the delivery of

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[350] Gibbs et al., "Need for Aeromedical Evacuation," 1033.

[351] S. Schilling et al., "European Concepts for the Domestic Transport of Highly Infectious Patients," *Clinical Microbiology and Infection* 15, no. 8 (August 2009): 731, https://doi.org/10.1111/j.1469-0691.2009.02871.x.

[352] Edward D. Nicol et al., "Aeromedical Transfer of Patients with Viral Hemorrhagic Fever," *Emerging Infectious Diseases* 25, no. 1 (January 2019): 9, https://doi.org/10.3201/eid2501.180662.

[353] Air Mobility Command, "Transportation Isolation System (TIS)."

[354] Donovan, *Force Health Protection Guidance*.

[355] Brian Feeney, "CCDC Chemical Biological Center Helps Air Force Design, Test and Field Large-Scale COVID-19 Transport Capability in Record Time," September 16, 2020, https://www.army.mil/article/

an operational system in only 88 days.[356] While this seems incredibly rapid for the development and fielding of a new capability, it could still be far too late to be operationally useful.

d. Requires the Disposal of Contaminated Waste

While the use of a high-level containment transport systems protect patients and MEDEVAC crews from exposure, it may also generate a great deal of contaminated waste. Some closed transport systems are single-use items,[357] whereas some feature a reusable frame with a disposable envelope.[358] Due to the highly hazardous nature of the waste generated from patients isolated in a high-level containment transport system, it may be more difficult and costly to dispose of than conventional clinical waste. "In the United States, the terminal disposal of Category A waste (of which EVD and many other highly hazardous communicable diseases are classified) is costly and requires specific packaging and a vendor with a Department of Transportation special permit to move and process the waste."[359] In addition to generating more contaminated waste than if the patient were treated in place (due to the additional waste of the transport system itself), this concept introduces the problem of disposing of the contaminated waste in a separate location than the original outbreak location.

e. Increases Requirements for Tracking and Coordinating Medical Resources

Another cost of using a high-level containment transport system is the additional administrative burden placed on patient regulators to track, manage, and employ these specialized evacuation assets. Not only is there a requirement to carefully track any medical personnel, equipment, or transportation platforms that are used,[360] but there is also the need to prioritize which patients can utilize what may be a scarce resource and to align patient needs with available resources as efficiently as possible.

239091/ccdc_chemical_biological_center_helps_air_force_design_test_and_field_large_scale_covid_19_transport_capability_in_record_time.

[356] Air Mobility Command, "Negatively Pressurized Conexes."

[357] Lotz and Raffin, "Aeromedical Evacuation," 530; and ProPac, "CAPSULS™ PPE Patient Isolation Unit."

[358] Nicol et al., "Aeromedical Transfer," 6.

[359] Gibbs et al., "Review of Literature," 364.

[360] ATP 4-02.13, *Casualty Evacuation*, 7-2.

3. Operational Constraints

a. Is Limited in Capacity of Patients That Can Be Transported Safely

Historically, the organizations with the capability to provide patient isolation during aeromedical evacuation "often have limited capacity, personnel, or systems to conduct multiple missions, with most only able to conduct 1 or 2 AE-HLCT missions simultaneously."[361] These limitations contributed to a U.S. contagious casualty management "concept of operations with a limited capability to transport contagious casualties and "Treatment-in-Place" (TIP) as the cornerstones."[362] Reflecting an apparent change in the concept of operations in response to the COVID-19 pandemic, the USAF recently developed the NPC, "a high capacity transport system that could meet the U.S. Transportation Command goal of transporting up to 4,000 diagnosed and symptomatic COVID-19 cases a month at a reasonable cost."[363]

4. Planning Considerations

a. Consider Lead Time for Procurement of Systems

As discussed above, if the demand for high-level containment transport systems extends outside of the military, which is likely in the case of a contagious disease outbreak, then there may be a significant delay in procuring systems. Medical planners should consider the availability of any specialized assets they may require and ensure plans to evacuate contagious patients in isolation are supported by a stockpile of transport systems, contracts to rapidly deliver such systems, or service contracts to evacuate military patients on private/commercial MEDEVAC platforms.

K. Evacuate Contagious Patients Only with Other Contagious Patients

1. Benefits

a. Prevents CBRN Exposure to Patients by Avoiding Contact with Contagious Patients

Evacuating contagious patients only with other patients with the same contagious disease could prevent the spread of disease to non-contagious patients during MEDEVAC. Evacuating contagious and non-contagious patients separately would provide no chance for contact between the two groups and would reduce the risk of CBRN exposure to non-

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[361] Gibbs et al., "Need for Aeromedical Evacuation," 1034.

[362] AFTTP 3-42.22, *Contagious Casualty Management*, 5.

[363] Feeney, "Large-Scale COVID-19 Transport Capability."

contagious patients. If contagious patients were isolated during evacuation, then the risk of transmission from an isolated patient to a susceptible non-contagious patient in the same MEDEVAC platform would be very low, so the benefit of additionally segregating contagious from non-contagious patients would be reduced.

2. Costs

a. May Exacerbate MEDEVAC Shortfall due to Patients Exceeding Available MEDEVAC Capacity if MEDEVAC Platforms Are Unable to Be Utilized at Full Capacity

Evacuating contagious and non-contagious patients separately could hinder the most efficient transport of patients through the medical system. Without the restriction imposed by this concept, MEDEVAC units could fill vacant seats/litters with either contagious or non-contagious patients needing evacuation. The requirement to not mix patient types on the same MEDEVAC platform, however, could leave some spaces vacant that otherwise could have been filled by waiting patients of the other type. If this concept caused a reduction in MEDEVAC occupancy, it could lead to a MEDEVAC shortfall.

b. Increases Requirements for Tracking and Coordinating Medical Resources

Imposing additional restrictions on how patients could be moved through the medical system complicates the coordination of patient movement. Evacuating contagious patients only with other contagious patients therefore increases the information that medical staffs must track and consider when arranging MEDEVAC.

3. Planning Considerations

a. Consider Synergistic Effect with Using Lateral or Skip Evacuation and Designating an MTF for Contagious Patients Only

Combining the concepts of segregating patients by their contagious status with using lateral or skip evacuation to transport contagious patients directly to a dedicated contagion facility could have mutually beneficial effects. If contagious and non-contagious patients were bound for separate MTFs, then it would make sense to separate them prior to MEDEVAC. As discussed earlier, with a contagion MTF, non-linear movement to that facility could make the most efficient use of medical evacuation and treatment resources.

Appendix B.
Illustrations

Figures

Tables

Appendix C.
References

Air Mobility Command Website. "Transportation Isolation System (TIS)." *Air Mobility Command*, April 1, 2020. https://www.amc.af.mil/About-Us/Fact-Sheets/Display/Article/2132917/transport-isolation-system-tis.

Air Mobility Command. "Negatively Pressurized Conexes Ready to Save Lives." *U.S. Air Force*, June 29, 2020. https://www.af.mil/News/Article-Display/Article/2240539/negatively-pressurized-conexes-ready-to-save-lives/.

Albrecht, Roland, Jürgen Knapp, Lorenz Theiler, Marcus Eder, and Urs Pietsch. "Transport of COVID-19 and Other Highly Contagious Patients by Helicopter and Fixed-Wing Air Ambulance: A Narrative Review and Experience of the Swiss Air Rescue Rega." *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine* 28, no. 40 (2020). https://doi.org/10.1186/s13049-020-00734-9.

American Veterinary Medical Association Website. "Addressing the Role of Veterinary Medicine in Human Health Care following Catastrophes Involving Mass Human Casualty." Accessed January 27, 2021. https://www.avma.org/resources-tools/avma-policies/addressing-role-veterinary-medicine-human-health-care-following-catastrophes-involving.

Army Medicine Website. "Chemical Biological Protective Shelter Systems (2000)." Accessed May 26, 2021. https://armymedicine.health.mil/Innovations/2000ChemBioShelter.

Beaton, Randal, Andy Stergachis, Mark Oberle, Elizabeth Bridges, Marcus Nemuth, and Tamlyn Thomas. "The Sarin Gas Attacks on the Tokyo Subway – 10 Years Later/Lessons Learned." *Traumatology* 11, no. 2 (June 2005): 103–19. https://doi.org/10.1177/153476560501100205.

Biselli, Roberto. "Aeromedical Evacuation of Patients with Hemorrhagic Fevers: The Experience of Italian Air Force Aeromedical Isolation Team." *Journal of Human Virology & Retrovirology* 2, no. 5 (August 2015). https://doi.org/10.15406/jhvrv.2015.02.00058.

Blyth, Dana M., Heather C. Yun, David R. Tribble, and Clinton K. Murray. "Lessons of War: Combat-related Injury Infections during the Vietnam War and Operation Iraqi and Enduring Freedom." *The Journal of Trauma and Acute Care Surgery* 79, no. 4 (October 2015): S227–S235. https://doi.org/10.1097/TA.0000000000000768.

Bohannon, Mark E., Julia K. Burr, Lucas A. LaViolet, and Sean M. Oxford. *Report of the Project Team for Smart Defence Project 1.1045, Volume 1, Historical Record*. IDA Document NS D-10974. Alexandria, VA: Institute for Defense Analyses, January 2020.

Brackens, Brian. "AFLCMC-led Team Delivers Isolation Container Prototype for Testing." *Air Force Life Cycle Management Center*, April 22, 2020. https://www.af.mil/News/Article-Display/Article/2161925/aflcmc-led-team-delivers-isolation-container-prototype-for-testing.

Burch-Bynum, Melvin D. "DoD Information Technology Acquisition: Delivering Information Technology Capabilities Expeditiously." Master's thesis, Naval Postgraduate School, September 2013. https://calhoun.nps.edu/bitstream/handle/10945/37591/13Sep_Burch_Melvin.pdf?sequence=1&isAllowed=y.

Centers for Disease Control and Prevention Website. "Guidance on Air Medical Transport (AMT) for Patients with Ebola Virus Disease (EVD)." Last updated September 2, 2021. https://www.cdc.gov/vhf/ebola/clinicians/emergency-services/air-medical-transport.html.

Centers for Disease Control and Prevention Website. "Using Telehealth to Expand Access to Essential Health Services during the COVID-19 Pandemic." Last updated June 10, 2020. https://www.cdc.gov/coronavirus/2019-ncov/hcp/telehealth.html.

Chairman of the Joint Chiefs of Staff. *Deployment and Redeployment Operations*. Joint Publication 3-35. Washington, DC: Chairman of the Joint Chiefs of Staff, January 10, 2018. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_35.pdf.

Chairman of the Joint Chiefs of Staff. *Joint Health Services*. Joint Publication 4-02. Washington, DC: Chairman of the Joint Chiefs of Staff, 11 December 2017, Incorporating Change 1, 28 September 2018. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp4_02ch1.pdf.

Chairman of the Joint Chiefs of Staff. *Joint Operations*. Joint Publication 3-0. Washington, DC: Chairman of the Joint Chiefs of Staff, 11 January 2017, Incorporating Change 1, 22 October 2018. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp3_0ch1.pdf.

Cohn, Carolyn. "Medical Evacuation Services Balk at Flying Out Ebola Patients." *Reuters*, October 11, 2014. https://www.reuters.com/article/us-health-ebola-evacuation/medical-evacuation-services-balk-at-flying-out-ebola-patients-idINKCN0HZ1TZ20141011?edition-redirect=in.

De Nardo, Pasquale, Elisa Gentilotti, Fulvia Mazzaferri, Eleonora Cremonini, Paul Hansen, Herman Goossens, Evelina Tacconelli, et al. "Multi-Criteria Decision Analysis to Prioritize Hospital Admission of Patients Affected by COVID-19 in Low-resource Settings with Hospital-bed Shortage." *International Journal of Infectious Diseases* 98 (2020): 494–500. https://doi.org/10.1016/j.ijid.2020.06.082.

Delgado, Debra A., Steven L. Brimhall, and Richard E. Brewer. *Formal Test Report for the Agent Transfer Hazard to and from Vehicles (ATHV) Field Test*. DPG/JCP-98/005. Dugway, UT: U.S. Army Dugway Proving Ground West Desert Test Center, July 1998.

Dindart, Jean-Michel, Olivier Peyrouset, Romain Palich, Abdoul Bing, Richard Kojan, Solenne Barbe, Souley Harouna, and Nikki Blackwell. "Aerial Medical Evacuation of Health Workers with Suspected Ebola Virus Disease in Guinea Conakry-Interest

of a Negative Pressure Isolation Pod-A Case Series." *BMC Emergency Medicine* 17, no. 1 (March 2017). https://doi.org/10.1186/s12873-017-0121-x.

DOD Office of Inspector General. *Evaluation of Department of Defense Medical Treatment Facility Challenges During the Coronavirus Disease-2019 (COVID-19) Pandemic*. DODIG-2020-133. Alexandria, VA: DOD Office of Inspector General, September 2020. https://www.oversight.gov/sites/default/files/oig-reports/DODIG-2020-133_Redacted.pdf.

Donovan, Matthew P. *Force Health Protection Guidance (Supplement 5) – Department of Defense Guidance for Movement and Medical Treatment of COVID-19 Patients, Symptomatic Persons Under Investigation, or Potentially Exposed COVID-19 Persons*. Washington, DC: Office of the Under Secretary of Defense for Personnel and Readiness, April 7, 2020.

Edgewood Chemical Biological Center. *CBRN Handbook: An Industrial Base Product Guide for Chemical, Biological, Radiological, and Nuclear Items for the U.S. Army*. Rock Island, IL: Edgewood Chemical Biological Center, June 2009.

Everstine, Brian W. "USAF Testing Rapidly Developed System to Fly Infectious Patients." *Air Force Magazine*, April 22, 2020. https://www.airforcemag.com/usaf-testing-rapidly-developed-system-to-fly-infectious-patients/.

Feeney, Brian. "CCDC Chemical Biological Center Helps Air Force Design, Test and Field Large-Scale COVID-19 Transport Capability in Record Time." September 16, 2020. https://www.army.mil/article/239091/ccdc_chemical_biological_center_helps_air_force_design_test_and_field_large_scale_covid_19_transport_capability_in_record_time.

Gadeken, Owen C. "Rapid Development of the U. S. Military's Transport Isolation System: The "Ebola Carrier" (A Project Management Case Study)." Paper presented at PMI® Global Congress 2015—North America, Orlando, FL. Newtown Square, PA: Project Management Institute. https://www.pmi.org/learning/library/rapid-development-military-transport-9872.

Gibbs, Shawn G., Jocelyn J. Herstein, Aurora B. Le, Elizabeth L. Beam, Theodore J. Cieslak, James V. Lawler, Joshua L. Santarpia, et al. "Need for Aeromedical Evacuation High-Level Containment Transport Guidelines." *Emerging Infectious Diseases* 25, no. 5 (May 2019): 1033–34. https://doi.org/10.3201/eid2505.181948.

Gibbs, Shawn G., Jocelyn J. Herstein, Aurora B. Le, Elizabeth L. Beam, Theodore J. Cieslak, James V. Lawler, Joshua L. Santarpia, et al. "Review of Literature for Air Medical Evacuation High-Level Containment Transport." *Air Medical Journal* 38, no. 5 (October 2019): 359–365. https://doi.org/10.1016%2Fj.amj.2019.06.006.

Hadef, Hysham, Jean-Claude Bartier, Herve Delplancq, and Jean-Pierre Dupeyron. "Using Baseline Data to Address the Lack of Hospital Beds during Mass-casualty Incidents." *Prehospital and Disaster Medicine* 23, no. 4 (August 2008): 377–379. https://doi.org/10.1017/s1049023x0000604x.

Headquarters, Air Combat Command. *Contagious Casualty Management*. Air Force Tactics, Techniques, and Procedures 3-42.22. Hampton, VA: Headquarters, Air Combat Command, May 2007.

Headquarters, Air Combat Command. *Expeditionary Medical Support (EMEDS) and Air Force Theater Hospital (AFTH)*. Air Force Tactics, Techniques, and Procedures 3-42.71. Hampton, VA: Headquarters, Air Combat Command, August 2014. https://static.e-publishing.af.mil/production/1/af_sg/publication/afttp3-42.71/afttp3-42.71.pdf.

Headquarters, Air Force A4 (Logistics, Engineering and Force Protection). *Operations in a Chemical, Biological, Radiological, and Nuclear (CBRN) Environment*. Air Force Manual 10-2503. Arlington, VA: Headquarters, Air Force A4, May 2019. https://irp.fas.org/doddir/usaf/afman10-2503.pdf.

Headquarters, Air Mobility Command. *En Route Patient Staging System*. Air Force Tactics, Techniques, and Procedures 3-42.57. Scott Air Force Base: Headquarters, Air Mobility Command, August 2016. https://static.e-publishing.af.mil/production/1/af_sg/publication/afttp3-42.57/afttp3-42_57.pdf.

Headquarters, Department of the Army. *Army Health System Support Planning*. Army Techniques Publication 4-02.55. Washington, DC: Headquarters, Department of the Army, March 2020. https://irp.fas.org/doddir/army/atp4-02-55.pdf.

Headquarters, Department of the Army. *Army Health System Support to Maneuver Forces*. Army Techniques Publication 4-02.3. Washington, DC: Headquarters, Department of the Army, June 2014. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=104308.

Headquarters, Department of the Army. *Army Health System*. Field Manual 4-02. Washington, DC: Headquarters, Department of the Army, November 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1021296.

Headquarters, Department of the Army. *Army Medical Logistics*. Army Techniques Publication 4-02.1. Washington, DC: Headquarters, Department of the Army, October 2015. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=105716.

Headquarters, Department of the Army. *Aviation Tactical Employment*. Army Techniques Publication 3-04.1. Washington, DC: Headquarters, Department of the Army, May 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1009144.

Headquarters, Department of the Army. *Casualty Care*. Army Techniques Publication 4-02.5. Washington, DC: Headquarters, Department of the Army, May 2013. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=103276.

Headquarters, Department of the Army. *Casualty Evacuation*. Army Techniques Publication 4-02.13. Washington, DC: Headquarters, Department of the Army, June 2021. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1022529.

Headquarters, Department of the Army. *Clinical Quality Management*. Army Regulation 40-68. Washington, DC: Headquarters, Department of the Army, February 2004. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=66994.

Headquarters, Department of the Army. *Dental Services*. Army Techniques Publication 4-02.19. Washington, DC: Headquarters, Department of the Army, August 2020. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1020499.

Headquarters, Department of the Army. *Medical Evacuation*. Army Techniques Publication 4-02.2. Washington, DC: Headquarters, Department of the Army, July 2019. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007289.

Headquarters, Department of the Army. *Medical Logistics Policies*. Army Regulation 40-61. Washington, DC: Headquarters, Department of the Army, January 2005. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=520.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Passive Defense*. Army Techniques Publication 3-11.32. Washington, DC: Headquarters, Department of the Army, May 2016. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1000453.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Planning*. Army Techniques Publication 3-11.36. Washington, DC: Headquarters, Department of the Army, September 2018. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1005625.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Health Service Support in a Chemical, Biological, Radiological, and Nuclear Environment*. Army Techniques Publication 4-02.7. Washington, DC: Headquarters, Department of the Army, March 2016. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=106112.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Treatment of Biological Warfare Agent Casualties*. Army Techniques Publication 4-02.84. Washington, DC: Headquarters, Department of the Army, November 2019. https://irp.fas.org/doddir/army/atp4-02-84.pdf.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Treatment of Chemical Warfare Agent Casualties and Conventional Military Chemical Injuries*. Army Techniques Publication 4-02.85. Washington, DC: Headquarters, Department of the Army, August 2016. https://www.hsdl.org/?abstract&did=796395.

Headquarters, Department of the Army. *Multi-service Tactics, Techniques, and Procedures for Treatment of Nuclear and Radiological Casualties*. Army Techniques Publication 4-02.83. Washington, DC: Headquarters, Department of the Army, May 2014. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=104161.

Headquarters, Department of the Army. *Sustainment*. Army Doctrine Publication 4-0. Washington, DC: Headquarters, Department of the Army, July 2019. https://armypubs.army.mil/ProductMaps/PubForm/Details.aspx?PUB_ID=1007565.

Headquarters, Department of the Army. *Theater Hospitalization*. Army Techniques Publication 4-02.10. Washington, DC: Headquarters, Department of the Army, August 2020. https://armypubs.army.mil/epubs/DR_pubs/DR_a/ARN30125-ATP_4-02.10-000-WEB-1.pdf.

Health.mil Website. "MHS GENESIS." Accessed August 17, 2021. https://health.mil/Military-Health-Topics/MHS-Transformation/MHS-GENESIS.

Hoffman, David A. "Increasing Access to Care: Telehealth during COVID-19." *Journal of Law and the Biosciences* 7, no. 1 (June 2020). https://doi.org/10.1093/jlb/lsaa043.

Homeland Security Council. *Implementation Plan for the National Strategy for Pandemic Influenza*. Washington, DC: The White House, May 2006. https://www.cdc.gov/flu/pandemic-resources/pdf/pandemic-influenza-implementation.pdf.

Hugelius, Karin, Julia Becker, and Annsofie Adolfsson. "Five Challenges When Managing Mass Casualty or Disaster Situations: A Review Study." *International Journal of Environmental Research and Public Health* 17, no. 9 (2020): 3068. https://doi.org/10.3390%2Fijerph17093068.

Hwang, Jane S., Charles M. Lappan, Leonard C. Sperling, and Jon H. Meyerle. "Utilization of Telemedicine in the US Military in a Deployed Setting." *Military Medicine* 179, no. 11 (November 2014): 1347–53. https://doi.org/10.7205/milmed-d-14-00115.

Janke, Alexander T., Hao Mei, Craig Rothenberg, Robert D. Becher, Zhenqiu Lin, and Arjun K. Venkatesh. "Analysis of Hospital Resource Availability and COVID-19 Mortality Across the United States." *Journal of Hospital Medicine* 16, no. 4 (April 2021): 211–214. https://doi.org/10.12788/jhm.3539.

Keenan, Sean, and Jamie C. Riesberg. "Prolonged Field Care: Beyond the "Golden Hour"." *Wilderness & Environmental Medicine* 28, no. 2 (June 2017): S135–S139. https://doi.org/10.1016/j.wem.2017.02.001.

Koenig, Kristi L., Ronald E. Goans, Richard J. Hatchett, Fred A. Mettler Jr, Thomas A. Schumacher, Eric K. Noji, and David G. Jarrett. "Medical Treatment of Radiological Casualties: Current Concepts." *Annals of Emergency Medicine* 45, no. 6 (June 2005): 643–652. https://doi.org/10.1016/j.annemergmed.2005.01.020.

Kotwal, Russ S., Jeffrey T. Howard, Jean A. Orman, Bruce W. Tarpey, Jeffrey A. Bailey, Howard R. Champion, Robert L. Mabry, John B. Holcomb, and Kirby R. Gross. "The Effect of a Golden Hour Policy on the Morbidity and Mortality of Combat Casualties." *JAMA Surgery* 151, no. 1 (2016): 15–24. https://doi.org/10.1001/jamasurg.2015.3104.

Lloyd, Don A. *Chemical Challenges for Contamination Survivability Analyses*. IDA Paper P-4348. Alexandria, VA: Institute for Defense Analyses, May 2009. FOUO.

Lotz, Eric, and Hervé Raffin. “Aeromedical Evacuation Using an Aircraft Transit Isolator of a Patient with Lassa Fever.” *Aviation, Space, and Environmental Medicine* 83, no. 5 (May 2012): 527–530, https://doi.org/10.3357/asem.3094.2012.

Lowe, Christian. “The Army is Preparing its Medics for a War without MEDEVAC Helos.” *We Are The Mighty*, May 28, 2018. https://www.wearethemighty.com/articles/the-army-is-preparing-its-medics-for-a-war-without-medevac-helos/.

Macintyre, Anthony G., George W. Christopher, Edward Eitzen, Jr, Robert Gum, Scott Weir, Craig DeAtley, Kevin Tonat, and Joseph A. Barbera. “Weapons of Mass Destruction Events with Contaminated Casualties: Effective Planning for Healthcare Facilities.” *JAMA* 283, no. 2 (January 2000): 242–249. https://doi.org/10.1001/jama.283.2.242.

McManus, John, Jose Salinas, Melinda Morton, Charles Lappan, and Ron Poropatich. “Teleconsultation Program for Deployed Soldiers and Healthcare Professionals in Remote and Austere Environments.” *Prehospital and Disaster Medicine* 23, no. 3 (June 2008): 210–216. https://doi.org/10.1017/s1049023x0006489x.

McWhirter, Cameron, and Betsy McKay. “Special Planes Are Lifeline for Ebola Patients.” *The Wall Street Journal*, last updated March 13, 2015. https://www.wsj.com/articles/special-planes-are-lifeline-for-ebola-patients-1426276096.

Medical Evacuation Concepts & Capabilities Division and School of Army Aviation Medicine. “U.S. Army MEDEVAC Critical Care Flight Paramedic Standard Medical Operations Guidelines, CY20 Version.” Ft. Rucker, AL: Medical Evacuation Concepts & Capabilities Division, January 2020. https://www.milsuite.mil/book/groups/army-air-medevac-operations.

Mehuron, Tamar A. “The Current and Future State of CRAF.” *Air Force Magazine*, February 2003. https://www.airforcemag.com/article/the-current-and-future-state-of-craf/.

Nguyen, Long H., David A. Drew, Mark S. Graham, Amit D. Joshi, Chuan-Guo Guo, Wenjie Ma, Raaj S. Mehta, et al. “Risk of COVID-19 among Front-line Health-care Workers and the General Community: A Prospective Cohort Study.” *The Lancet Public Health* 5, no. 9 (September 2020): e475-e483. https://doi.org/10.1016/S2468-2667(20)30164-X.

Nicol, Edward D., Stephen Mepham, Jonathan Naylor, Ian Mollan, Matthew Adam, Joanna d’Arcy, Philip Gillen, et al. “Aeromedical Transfer of Patients with Viral Hemorrhagic Fever.” *Emerging Infectious Diseases* 25, no. 1 (January 2019): 5–14. https://doi.org/10.3201/eid2501.180662.

North Atlantic Treaty Organization. “NATOTerm: The Official NATO Terminology Database.” Acessed December 14, 2020. https://nso.nato.int/natoterm.

North Atlantic Treaty Organization. *Allied Joint Chemical, Biological, Radiological, and Nuclear (CBRN) Medical Support Doctrine*. Allied Joint Medical Publication 7, Edition B, Version 1. Brussels, Belgium: NATO Standardization Office, January 2021. DRAFT.

North Atlantic Treaty Organization. *Allied Joint Doctrine for Medical Support*. Allied Joint Publication 4.10, Edition C, Version 1. NATO STANAG 2228. Brussels, Belgium: NATO Standardization Office, September 2019. https://www.coemed.org/files/stanags/01_AJP/AJP-4.10_EDC_V1_E_2228.pdf.

North Atlantic Treaty Organization. *Allied Joint Medical Doctrine for Medical Evacuation*. Allied Joint Medical Publication 2, Edition A, Version 1. NATO STANAG 2546. Brussels, Belgium: NATO Standardization Office, August 2018. https://www.coemed.org/files/stanags/02_AJMEDP/AJMedP-2_EDA_V1_E_2546.pdf.

North Atlantic Treaty Organization. *Allied Joint Medical Planning Doctrine*. Allied Joint Medical Publication 1, Edition A, Version 1. NATO STANAG 2542. Brussels, Belgium: NATO Standardization Office, September 2018. https://www.coemed.org/files/stanags/02_AJMEDP/AJMedP-1_EDA_V1_E_2542.pdf.

North Atlantic Treaty Organization. *Collective Protection in a Chemical, Biological, Radiological and Nuclear Environment (CBRN - COLPRO)*. Allied Tactical Publication 70, Edition A, Version 1. NATO STANAG 2515. Brussels, Belgium: NATO Standardization Office, April 2014. https://nso.nato.int/nso/nsdd/main/list-promulg.

North Atlantic Treaty Organization. *Commander's Guide on Medical Support to Chemical, Biological, Radiological, and Nuclear (CBRN) Defensive Operations*. Allied Medical Publication 7.6, Edition A, Version 1. NATO STANAG 2873. Brussels, Belgium: NATO Standardization Office, February 2018. https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.6_EDA_V1_E_2873.pdf.

North Atlantic Treaty Organization. *Medical Aspects in the Management of a Major Incident/Mass Casualty Situation*. Allied Medical Publication 1.10, Edition A, Version 1. NATO STANAG 2879. Brussels, Belgium: NATO Standardization Office, December 2015. https://www.coemed.org/files/stanags/03_AMEDP/AMedP-1.10_EDA_V1_E_2879.pdf.

North Atlantic Treaty Organization. *Medical Management of CBRN Casualties*. Allied Medical Publication 7.1, Edition A, Version 1. NATO STANAG 2461. Brussels, Belgium: NATO Standardization Office, June 2018. https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.1_EDA_V1_E_2461.pdf.

North Atlantic Treaty Organization. *NATO Planning Guide for the Estimation of CBRN Casualties*. Allied Medical Publication 7.5, Edition A, Version 1. NATO STANAG 2553. Brussels, Belgium: NATO Standardization Office, October 2017. https://www.coemed.org/files/stanags/03_AMEDP/AMedP-7.5_EDA_V1_2553.pdf.

North Atlantic Treaty Organization. *Patient Evacuation and Flow Management*. Allied Medical Publication 2.3, Edition A, Version 1. Brussels, Belgium: NATO Standardization Office, February 2020. DRAFT.

Office of the Chairman of the Joint Chiefs of Staff, *DOD Dictionary of Military and Associated Terms*. Washington, DC: The Joint Staff, August 2021. http://www.jcs.mil/Doctrine/DOD-Terminology.

Operations Group, National Training Center. *Preparing for Large Scale Combat Operations*. Fort Leavenworth, KS: Center for Army Lessons Learned, January 29, 2021. https://usacac.army.mil/sites/default/files/publications/18100.pdf.

Pisano, Antonio, Andrey Yavorovskiy, Luigi Verniero, and Giovanni Landoni. "Indications for Tracheal Intubation in Patients with Coronavirus Disease 2019 (COVID-19)." *Journal of Cardiothoracic and Vascular Anesthesia* 35, no. 5 (May 2021): 1276–1280. https://doi.org/10.1053%2Fj.jvca.2020.11.062.

ProPac. "CAPSULS™ PPE Patient Isolation Unit." Accessed August 17, 2021. https://propacusa.com/product/capsuls-patient-isolation-unit.

Robb, Douglas J. "Medical Support to the Warfighter: from Battlefield to Tertiary Care & Beyond." *The American Osteopathic Academy of Addiction Medicine*, October 5, 2018. https://www.aoaam.org/resources/Documents/2018%20Convention%20Slides/Friday%20-%2010-5-2018%20-%2011am%20-%20Excellence%20in%20Trauma%20Recovery%20-%20Lt%20General%20Robb.pdf.

Rojas-Muñoz, Edgar, Chengyuan Lin, Natalia Sanchez-Tamayo, Maria Eugenia Cabrera, Daniel Andersen, Voicu Popescu, Juan Antonio Barragan, et al. "Evaluation of an Augmented Reality Platform for Austere Surgical Telementoring: A Randomized Controlled Crossover Study in Cricothyroidotomies." *npj Digital Medicine* 3, no. 1 (May 2020): 1–9. https://doi.org/10.1038/s41746-020-0284-9.

Sanchez, Elaine. "Military Hospital Dials in Virtual Healthcare to Combat COVID-19." *Health.mil,* April 13, 2020. https://health.mil/News/Articles/2020/04/13/Military-hospital-dials-in-virtual-healthcare-to-combat-COVID-19.

Schilling, S., P. Follin, B. Jarhall, A. Tegnell, M. Lastilla, B. Bannister, F. Maria Fusco, et al. "European Concepts for the Domestic Transport of Highly Infectious Patients." *Clinical Microbiology and Infection* 15, no. 8 (August 2009): 727–33. https://doi.org/10.1111/j.1469-0691.2009.02871.x.

Schlotman, Taylor E., Kris R. Lehnhardt, Andrew F. Abercromby, Benjamin D. Easter, Meghan E. Downs, Kevin S. Akers, and Victor A. Convertino. "Bridging the Gap between Military Prolonged Field Care Monitoring and Exploration Spaceflight: The Compensatory Reserve." *npj Microgravity* 5 (2019). https://doi.org/10.1038/s41526-019-0089-9.

Sen-Crowe, Brendon, Mason Sutherland, Mark McKenney, and Adel Elkbuli. "A Closer Look into Global Hospital Beds Capacity and Resource Shortages during the COVID-19 Pandemic." *Journal of Surgical Research* 260 (April 2021): 56–63. https://doi.org/10.1016/j.jss.2020.11.062.

Thaggard, Andy. "Kuwait Land Forces Director of Military Medical Health Authority Visits U.S. Military Hospital – Kuw." *Army.mil*, May 8, 2019.

https://www.army.mil/article/221555/kuwait_land_forces_director_of_military_medical_health_authority_visits_u_s_military_hospital_kuw.

U.S. Air Force. *Counter-Weapons of Mass Destruction Operations*. Air Force Doctrine Publication 3-40. Maxwell Air Force Base, AL: LeMay Center for Doctrine, April 2016. https://www.doctrine.af.mil/Portals/61/documents/AFDP_3-40/3-40-AFDP-CCBRN.pdf.

U.S. Army Garrison Humphreys. "USAG-Humphreys (South Korea) COVID-19 Response Playbook." U.S. Army Garrison Humphreys, March 17, 2020. https://www.redcea.com/covid19/Shared%20Documents/U.S.%20DoD%20(Departamento%20de%20Defensa%20EE.UU.)/8th%20Army%20(Korea)/USAG%20Humphreys%20COVID%2019%20Playbook%20UNCLASS.PDF.

U.S. Army Medical Research Institute of Chemical Defense. *Medical Management of Chemical Casualties Handbook, Fourth Edition*. Aberdeen Proving Ground, MD: Chemical Casualty Care Division, USAMRICD, February 2007. https://www.globalsecurity.org/wmd/library/policy/army/other/mmcc-hbk_4th-ed.pdf.

U.S. Army Medical Research Institute of Infectious Disease. "Biodefense Solutions to Protect Our Nation." Accessed 12 July 2021. https://www.usamriid.army.mil/images/USAMRIIDBrochure.pdf .

U.S. Army Medical Research Institute of Infectious Disease. *USAMRIID's Medical Management of Biological Casualties Handbook, 9th Edition*. Frederick, MD: USAMRIID, 2020. https://www.usamriid.army.mil/education/bluebookpdf/USAMRIID's%20Blue%20Book%209th%20edition%20-%20PDF%20format.pdf.

U.S. Department of Health & Human Services, Radiation Emergency Medical Management (REMM). "Radiological Dispersal Devices (RDDs)." Accessed October 5, 2021. https://remm.hhs.gov/rdd.htm.

U.S. Department of Homeland Security. "Radiological Dispersal Device Incident Response Planning: Incident Site Medical Management." Accessed May 15, 2021. https://www.hsdl.org/?view&did=765540.

U.S. Transportation Command. *Patient Movement of Contaminated, Contagious or Potentially Exposed Casualties*. USTRANSCOM Instruction 41-02. Belleville, IL: U.S. Transportation Command Surgeon General, July 11, 2019.

Williams, Nahjier. "The Value of Military and Civilian Medical Partnerships in Kuwait." *U.S. Army Central*. April 24, 2019. https://www.usarcent.army.mil/News/Article/1825407/the-value-of-military-and-civilian-medical-partnerships-in-kuwait/.

Withers, Mark R., and George W. Christopher. "Aeromedical Evacuation of Biological Warfare Casualties: A Treatise on Infectious Diseases on Aircraft." *Military Medicine* 165, no. 11 Suppl 3 (November 2000): 1–21. https://pubmed.ncbi.nlm.nih.gov/11143422/

Appendix D.
Abbreviations

AE	Aeromedical Evacuation
AE-HLCT	Aeromedical Evacuation High-Level Containment Transport
AFDP	Air Force Doctrine Publication
AFTTP	Air Force Tactics, Techniques, and Procedures
AMedP	Allied Medical Publication
AOR	Area of Responsibility
ATP	Army Techniques Publication
AVMA	American Veterinary Medical Association
CASEVAC	Casualty Evacuation
CBPS	Chemical and Biological Protective Shelter
CBRN	Chemical, Biological, Radiological, and Nuclear
CCATT	Critical Care Air Transport Team
CCDR	Combatant Commander
CCMD	Combatant Command
CDC	Centers for Disease Control and Prevention
COLPRO	Collective Protection
CONUS	Continental United States
COVID-19	Coronavirus Disease 2019
CP DEPMEDS	Chemically Protected Deployable Medical Systems
CPEMEDS	Collectively Protected Expeditionary Medical Support
CRAF	Civil Reserve Air Fleet
CSU	Casualty Staging Unit
DHA	Defense Health Agency
DOD	Department of Defense
DOW	Died of Wounds
ERPSS	En Route Patient Staging System
EVD	Ebola Virus Disease
FFEPS	UTC for ERPSS Initial 10-Bed Capability
FRSD	Forward Resuscitative Surgical Detachment
HHCD	Highly Hazardous Communicable Diseases

HL	Mustard-Lewisite Agent
ICU	Intensive Care Unit
ID	Infectious Disease
IPE	Individual Protective Equipment
IT	Information Technology
JMPT	Joint Medical Planning Tool
JP	Joint Publication
KIA	Killed in Action
MASCAL	Mass Casualty
MEDEVAC	Medical Evacuation
MOPP	Mission-Oriented Protective Posture
MTF	Medical Treatment Facility
NATO	North Atlantic Treaty Organization
NPC	Negatively Pressurized Conex
PAPR	Powered Air-Purifying Respirator
PM	Patient Movement
POL	Petroleum Oil Lubricants
PPE	Personal Protective Equipment
RDD	Radiological Dispersal Device
RSL	Radiation Safety Level
RTD	Return to Duty
SME	Subject Matter Expert
SMRC	Specialized Medical Response Capabilities
SOP	Standard Operating Procedure
T-ATI	Trexler Air Transport Isolator
TIC	Toxic Industrial Chemical
TIP	Treatment in Place
TIS	Transport Isolation System
TPFDD	Time Phased Force Deployment Data
TPFDL	Time Phased Force Deployment List
USAF	United States Air Force
USAMRICD	United States Army Medical Research Institute of Chemical Defense
USAMRIID	United States Army Medical Research Institute of Infectious Diseases
USG	United States Government

USTRANSCOM	United States Transportation Command
UTC	Unit Type Code
VX	Persistent Nerve Agent VX

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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. REPORT DATE (DD-MM-YY)	2. REPORT TYPE	3. DATES COVERED (From – To)
xx-11-2021	Final	

4. TITLE AND SUBTITLE

Medical Regulating in a CBRN Environment

5a. CONTRACT NO.

HQ0034-14-D-0001

5b. GRANT NO.

5c. PROGRAM ELEMENT NO(S).

6. AUTHOR(S)

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5d. PROJECT NO.

5e. TASK NO.

CA-6-4777

5f. WORK UNIT NO.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

8. PERFORMING ORGANIZATION REPORT NO.

IDA Paper P-22724
Log: H 21-000242

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Office of the Surgeon General
DHHQ 7700 Arlington Blvd.
Falls Church, VA 22042-5143

10. SPONSOR'S / MONITOR'S ACRONYM(S)

OTSG

11. SPONSOR'S / MONITOR'S REPORT NO(S).

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Major combat operations in an environment with chemical, biological, radiological or nuclear (CBRN) threats and hazards will present unique challenges to medical operations. These medical challenges of the CBRN environment could complicate the process of moving patients through the military medical system to match them with available and appropriate medical capabilities, known as medical regulating. This Institute for Defense Analyses paper provides a qualitative overview of the adverse impacts on medical regulating in a CBRN environment and discusses the benefits, costs, operational constraints, and planning considerations for potential response options.

15. SUBJECT TERMS

Medical regulating, patient regulating, medical evacuation, evacuation, MEDEVAC, CBRN environment, CBRN hazard

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NO. OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			MAJ Mark T. Williams
U	U	U	U	138	19b. TELEPHONE NUMBER (Include Area Code) 703-681-8188

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