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Responding to Future Pandemics: Biosecurity Implications and Defense Considerations

Diane DiEuliis and James Giordano
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ABSTRACT: In an evolving and expanding biothreat landscape caused by emerging biotechnologies, increases in global infectious disease outbreaks, and geopolitical instability, the Department of Defense now faces challenges that alter its traditional approach to biothreats and prompt the need for modernized, improved preparedness for—and response to—potential biothreat scenarios. These challenges further complicate specific weaknesses revealed by the COVID-19 pandemic, including the Department’s inability to sustain the military mission while meeting intragovernmental expectations to assist with civilian public health resources and services.

Keywords: biosecurity, biodefense, biological threats, preparedness and response

Over the past decade, three primary interactive factors have complicated the current widely evolving landscape of biodefense threats. First, emerging biotechnologies are radically leveling and expanding the pool of agents and techniques that bad actors could leverage as weapons. New techniques and technologies (such as gene editing and synthetic biology) could be used to modify extant pathogens or create others capable of incurring greater morbidity or mortality.¹ These technologies might initially be obscured by altered patterns of disease progression and thereby avoid early detection and response.²

Second, the frequency and unpredictability of emerging infectious diseases may increase given population expansion, climate change, and human encroachment into natural habitats where zoonotic jumps of disease can be more frequent. Third, such developments are occurring against a backdrop of an increasingly uncertain geopolitical landscape. For the past several years, the US government’s biosecurity policy and governance efforts have exemplified the interactive nature of these factors by failing to keep pace with scientific advancements capable of generating novel risks and threats.

1. Joseph DeFranco et al., “Emerging Technologies for Disruptive Effects in Non-Kinetic Engagements,” *HDIAC Journal* 6, no. 2 (Summer 2019): 48–55, <https://hdiac.org/articles/emerging-technologies-for-disruptive-effects-in-non-kinetic-engagements/>.

2. Diane DiEuliis and James Giordano, “Gene Editing Using CRISPR/Cas9: Implications for Dual-Use and Biosecurity,” *Protein and Cell* 15 (2017): 1–2.

In addition, global population growth and environmental and geopolitical changes, including human migration, may render broader segments of the world's populace vulnerable to infectious disease outbreaks that could easily and rapidly escalate to major epidemic or pandemic proportions.

The conditions described above affect national security directly and indirectly, influencing the mission capability of the US Department of Defense (DoD) across all areas of responsibility domestically and abroad. These challenges alter the traditional DoD approach to biothreats and prompt the need for modernized, improved preparedness for and response to potential bio-incidents or biothreat scenarios. Although experts and officials knew about these issues before COVID-19, the pandemic revealed specific weaknesses in preparedness and response, including challenges posed by governmental requirements to sustain the DoD military response while assisting with civilian public health resources and services. In this article, we first examine the current biosecurity landscape and the weaknesses and challenges the pandemic revealed. This examination provides both a context and criteria for our recommendations on how to identify threats more effectively and efficiently and close vulnerability gaps in the future.

Changing Landscape of Biothreats

The advances made in emerging biotechnologies could “lower the bar” for the development of biothreats. The ability to create viruses *de novo* (from scratch) by accessing their genetic sequence information or to modify a variety of microbes (including viruses, bacteria, and fungi) to render them pathogenic (that is, having increased morbidity or lethality) are notable risks capable of enabling direct harms. The tools required for these manipulations have become more readily accessible to a wider range of actors, thereby diversifying the current and near-future potential operational environment. We contend that kinetic power to incur mass casualties and lethality and non-kinetic effects with the aim of focal or mass disruption (rather than overt destruction) may define this environment.³ The aftermath of the COVID-19 pandemic has brought into stark relief the downstream, indirect repercussions of biothreat-induced disruptions, including economic and societal instabilities and distrust of public institutions. A competitor or adversary could seek to induce and exploit these repercussions through the threat or use of biological agents. Given current US governance models have not been coterminous with advancing biotechnologies, there are evident weaknesses, flaws, and vulnerabilities in domestic biosecurity that adversaries could target and (kinetically or non-kinetically) leverage in the near term.

As the global human population grows and infringes on natural environments, the potential for zoonotic transfer of infectious diseases also increases. Many disparate factors converge in this regard. Unprecedented human density in megacities puts pressure on infrastructures, sanitation, and hygiene, which are further exacerbated by ecological change and natural disasters. Indeed, the changing climate and human migration establish disease vectors (for example, zoonotic and insect-transmitted pathologies) capable of thriving and expanding their host ranges.

As disease vectors continue to increase, the military must devote more time and energy to considering how to address them in operations. In the last decade, the US military responded to five different infectious disease outbreaks, all while sustaining mission effectiveness during challenging conflict operations.³ The threat of infectious disease varies considerably between combatant commands, depending on geographical epidemiological risk and the geopolitical environment. The latter is instrumental to the Department of Defense's understanding of an operational theater's health and security capabilities. This knowledge is vital, given that several countries either predict or have already experienced increased disease outbreaks. Although some countries have invested in high-containment research labs to prepare for and counter disease outbreaks, these laboratories can pose risks for accidental dissemination and the spread of novel pathogens.⁴

We must note that the same emerging technologies altering the bioterror landscape can mitigate the challenge of increases in the occurrence of infectious diseases. Indeed, bioscientific and technological advances are driving a growing bioeconomy—wherein a potential shift from petroleum-based manufacturing platforms to biotechnology-based platforms is underway.⁵ The ability to produce high-value chemicals and materials offers a significant benefit to the industrial base that supports DoD requirements.⁶ In the near future, the Department of Defense may be able to create various materials, devices, and tools for warfighters

3. Thomas Cullison and J. Stephen Morrison, "Commentary: Bring DOD Fully into the Mix of Pandemic Preparedness and Response," Center for Strategic and International Studies (CSIS) (website), June 30, 2022, <https://www.csis.org/analysis/bring-dod-fully-mix-pandemic-preparedness-and-response>.

4. Diane DiEuliis and James Giordano, "The Need for Modernization of Biosecurity in the Post-COVID World," *mSphere* 7, no. 2 (April 2022): 8–14.

5. Peter Emanuel, Brian Feeney, and Diane DiEuliis, "Want to Grow the Economy? Try Fermenting It Instead," Institute for National Strategic Studies/National Defense University (website), March 11, 2021, <https://inss.ndu.edu/Media/News/Article/2524839/want-to-grow-the-economy-try-fermenting-it-instead/>.

6. Diane DiEuliis, Patrick Terrell, and Peter Emanuel, "Breaching the Department of Defense's Biotech Bottleneck," *Health Security* 18, no. 2 (April 2020): 139–44, <http://doi.org/10.1089/hs.2019.0150>.

that are based upon and affect their biology.⁷ This biotechnological revolution could foster the creation of tools and methods of preparedness and response to future outbreaks. Developing medical countermeasures (such as RNA vaccines and better diagnostics) in the nonmedical milieu may also produce raw materials for supplies vital to the socioeconomic stability of a population. For example, during the pandemic, the need for active pharmaceutical ingredients was critical to the development of medicines. These ingredients, however, are only available through foreign and often single-source suppliers. The bioeconomy could be used to afford a novel means of production for these critical ingredients and enable their distributed manufacturing, providing for more rapid logistical use across the Department of Defense's broad areas of operation.

COVID-19 brought this fact into focus. One of our first observations at the beginning of the pandemic was that platforms for biotechnology, particularly those essential to medical and economic preparedness and response, must be "modernized."⁸ Care for the sick and prevention of the spread of disease require treatments and vaccines. The capability to produce and manufacture these treatments and vaccines at scale quickly is critical, and the biosecurity sector must iteratively review, address, sustain, revise, or fortify these domains—and newly emerging ones—as needed to meet twenty-first-century biothreats. The need to develop and sustain advanced biotechnological abilities to test people rapidly and reliably and track the spread of the disease-causing agents is also crucial. Given the reliance on advanced and dual-use technologies to accomplish modernization, we argue the United States must improve traditional measures and methods of biosecurity (to address the expanding novel risk space effectively) and its preparedness and response platforms to provide protection effectively and efficiently from both natural and man-made threats.

Maintaining Readiness across DoD Response Capabilities

The COVID-19 pandemic clearly demonstrated that public health vulnerabilities can impact military readiness. The Department of Defense can and has assisted during domestic disaster events in accordance with the Defense Support of Civil Authorities. By sheer logistics, the Department of Defense is unmatched in its ability to support the nation during crises.

7. Joseph DeFranco, Maureen Rhemann, and James Giordano, "The Emerging Neurobioeconomy: Implications for National Security," *Health Security* 18, no. 4 (2020): 66–80.

8. Diane DiEuliis et al., "Beyond 1918: Bringing Pandemic Response into the Present, and Future," Institute for National Strategic Studies/National Defense University (website), April 27, 2020, <https://inss.ndu.edu/Media/News/Article/2165914/beyond-1918-bringing-pandemic-response-into-the-present-and-future/>.

As shown during the pandemic, however, the Department of Defense must also ensure protection of the total force (active and civilian) domestically and abroad; the pandemic revealed force sustainment stressors and suggested potential vulnerabilities in DoD capabilities for force readiness. Fortunately, unlike the influenza pandemic of 1918–19, COVID-19 posed less of a threat to the younger, more physically fit population vital to the DoD mission. Yet, the COVID-19 crisis should provide a lesson for future threats that may affect the military population.⁹

Beyond examining and rectifying the appropriate balance between the needs of the force and the Defense Support of Civil Authorities' responsibilities, military leadership needs to examine the overlap of chemical and biological defense requirements of the force versus those focal to force health protection. Many of the public health provisions available and administered to warfighters are based on accepted and approved civilian health and therapeutic standards. It is also commendable that the Department of Defense is in the process of adopting ever-broadening definitions of *health* and *wellness*, to improve the health, wellness, and occupational protection of warfighter personnel.¹⁰

These definitions may not suffice for all scenarios worldwide where active-duty personnel can be exposed to exotic or rare diseases, and these same personnel face additional health risks stemming from chemical, biological, radiation, or nuclear (CBRN) exposures. The health challenges of novel diseases and current and emerging CBRN threats require updated and evolving medical and nonmedical assessments and interventions not necessarily identical (in type or extent) to those required for the general civilian population—these must be available to warfighters specifically. The unique needs of DoD personnel are not likely to be addressed or accommodated by Big Pharma or Big Tech, since they would be regarded as possible therapeutics for small likelihood (potential) events.

We assert that herein lies the paradox. This intersection of the health, medical, and counter-weapons of mass destruction most significantly impacted the military response to COVID-19. The Department of Defense had few internally crafted countermeasures or diagnostics, given that COVID-19 was a non-CBRN threat and not a biological weapon. Instead, it relied upon the quotidian aspects of force health diagnostics

9. Vikram Venkatram, Diane DiEuliis, and James Giordano, "The COVID Crisis: Implications and Lessons for United States'—and Global—Biosecurity," in *COVID-19: Analysing the Threat*, ed. Ajey Lele and Kritika Roy (New Delhi: Pentagon Press, 2020), 397–405.

10. Patrick Smith and Erin Sone, "Holistic Health and Fitness (H2F): Developing and Maintaining the Whole Soldier," Company Leader (website), October 3, 2020, <http://companyleader.themilitaryleader.com/2020/10/03/holistic-health-and-fitness-h2f/>.

and protections provided by civilian preparedness and response resources.¹¹ The delays and, in some cases, failures of diagnostic capabilities had the potential to compromise DoD missions (for example, the USS *Theodore Roosevelt* incident).¹² In light of this overlap between defense health protection and CBRN, requirements should be further examined to establish policy guidelines for how the overlap of biothreats should be best mitigated, given force health protection and chemical and biological defense are functionally and financially distinct silos.

Fortifying DoD preparedness and response capabilities could also serve civilian public health readiness and engagement needs. By fortifying warfighter capabilities to respond to a biological attack, the Department of Defense would also be creating valuable resources for a public health emergency that could compromise national safety and social stability, thus undermining national security. Taken together, these factors highlight the need to develop considerations that more precisely define DoD roles in biothreat scenarios. There is a need for better public health testing; such assessments would have facilitated more accurate predictions of COVID-19's spread within the military and afforded more salient insights into mission-specific group vulnerabilities across the Department of Defense. Gathering these insights could have better enabled the identification and allocation of human resources and services necessary to stabilize and sustain the DoD mission.¹³ To delimit extant gaps in DoD readiness, the Department of Defense should focus on medical and other capabilities and tools to identify and treat bioweapon threats and naturally occurring diseases and ecological variables.

Operational International Landscape

As the multinational and multi-locale incidence and future threats of outbreaks increase and the international public health community pursues global health security standards, a number of countries have devoted greater investment in public health capabilities. Such investments include the establishment of biological research laboratories to study high-consequence

11. Cheryl Pellerin, "DoD Chemical-Biological Program Has a Global Mission," US Department of Defense (DoD) (website), February 3, 2016, <https://www.defense.gov/News/News-Stories/Article/Article/649239/dod-chemical-biological-program-has-a-global-mission/>.

12. Diane DiEuliis and Laura Junor, "Ready or Not: Regaining Military Readiness during COVID19," Institute for National Strategic Studies/National Defense University (website), April 10, 2020, <https://inss.ndu.edu/Media/News/Article/2145282/ready-or-not-regaining-military-readiness-during-covid19/>.

13. Diane DiEuliis, N. B. Kohls, and James Giordano, "Of Nemesis and Narcissus: Lessons COVID May Provide for Enterprises—and Ethics—of Global Health Promotions and Biosecurity," in *Medicine and Ethics in Times of Corona*, ed. Martin Woesler and Hans-Martin Sass (Zürich: LIT Verlag, 2020), 323–29.

pathogens. While these enterprises are crucial, monitoring these laboratories' Biosafety Level 3 and 4 standards and their enforcement has been inconsistent and inadequate. Biological incidents arising in and emerging from these laboratories' activities can pose threats to US (and allied) force readiness. Department of Defense operational communities uniquely positioned around the globe can offer advantages in building partnerships to assist in creating and maintaining stronger biosecurity programs.¹⁴ The Department of Defense's long-standing support of its Cooperative Threat Reduction Program, established after the fall of the Soviet Union to secure and destroy Soviet weapons of mass destruction, exemplifies such engagement. Historically, the program worked with partner nations to improve biological safety and security.¹⁵ American efforts could benefit from current, and perhaps renewed, cooperative threat reduction relationships to focus on lessons learned from the COVID-19 pandemic.

Global Cooperation and Competition (“Coopetition”)

While collaboration is vital, it is equally important to recognize and acknowledge the reality and domains of competition and conflict. As biotechnology becomes a strategic, disruptive endeavor for leveraging hegemony in various domains, countries that invest in dedicated biotechnology programs and industries will be more globally competitive in socioeconomic contexts and applications that could affect national stability and security.

Notably, China's government (through its direct engagement of research and commercial enterprises) has recognized this reality and its present and future implications for power balances and has established broadly funded tactical and strategic efforts toward becoming a global leader in biotechnology.¹⁶ Indeed, China's political system enables the facile enjoining of government and private sectors to generate biomedical

14. Diane DiEuliis and James Giordano, “Balancing Act: Precision Medicine and National Security,” *Military Medicine* 187, no. S1 (January-February 2022): 32–35, https://academic.oup.com/milmed/article-pdf/187/Supplement_1/32/42002338/usab017.pdf.

15. US Mission Geneva, “Fact Sheet on DoD Cooperative Threat Reduction (CTR) Program,” US Mission to International Organizations in Geneva (website), April 4, 2022, <https://geneva.usmission.gov/2022/04/04/fact-sheet-on-dod-cooperative-threat-reduction-ctr-program-biological-threat-reduction-with-partner-countries/>.

16. Celeste Chen, Jacob Andriola, and James Giordano, “Biotechnology, Commercial Veiling, and Implications for Strategic Latency: The Exemplar of Neuroscience and Neurotechnology Research and Development in China,” in *Strategic Latency: Red, White, and Blue – Managing the National and International Security Consequences of Disruptive Technology*, ed. Zachary S. Davis and Michael Nacht (Livermore, CA: Center for Global Security Research/Lawrence Livermore Press, 2018), 12–32.

instruments and technologies used to supply various countries with medical supplies, thus creating bioeconomic dependencies.¹⁷

The United States, and the Department of Defense in particular, will need to contend with this competition in the near and long term. Critical to this endeavor is the recognition that previously held constructs of a single global superpower may no longer be realistic or viable. Instead, it will be important to acknowledge the probability of multiple superpower nations, each of which establishes and exerts capability in particular domains. In this light, one possible tactical approach toward strategic stability may be to develop spaces and dimensions of cooperative competition. Within this paradigm, key aspects of national superpowers' capabilities to manifest dimensional hegemony are reliant, at least in part, upon (1) the explicit definition and demarcation of the parameters and extent of these power spaces, (2) other nations' cooperative sharing and contributions to these established interactive aspects of spaces and domains of power, and (3) the reciprocal exchange of goods, resources, and services necessary to sustain these spheres of interactive power to facilitate and fortify multinational interaction.

To do so effectively, however, will require a whole-of-government collaboration and whole-of-nation(s) involvement of the United States (with respect to harnessing intranational resources of the governmental, research, and commercial or economic sectors) and its allies. This cooperation would create an omnibus of bioeconomic capability that could then exert competitive influence in multi-superpower negotiations and global relations.¹⁸

Conclusion

Advances in biotechnology have broadened the scope of applications—hence, their use could lead to beneficial and harmful effects on public health and, by extension, national stability and security. These purposes, ends, and manifest effects must be addressed explicitly and realistically.

17. Vikram Venkatram and James Giordano, *Strategic Multilayer Assessment Special Topics Paper – The COVID Crisis: Implications for United States—and Global—Biosecurity* (Washington, DC: DoD Strategic Multilayer Assessment Group – Joint Staff/J-3/Pentagon Strategic Studies Group, April 22, 2020); and Vikram Venkatram and James Giordano, *Contagion: COVID-19's Impact on the Operational Environment* (Washington, DC: DoD Strategic Multilayer Assessment Group – Joint Staff/J-3/Pentagon Strategic Studies Group, April 2020).

18. James Giordano, Joseph DeFranco, and L. R. Bremseth, *Radical Leveling and Emerging Technologies as Tools of Non-Kinetic Disruption* (white paper), Invited Perspective Series: Strategic Multilayer Assessment (SMA) – Future of Global Competition & Conflict Effort, ed. Sarah Canna (Boston: NSI Inc., February 2020), 5–11; and John Wallbank and James Giordano, “Heeding Breaches in Biosecurity: Navigating the New Normality of the Post-COVID Future,” *Mad Scientist Laboratory* (blog), September 24, 2020, <https://madsciblog.tradoc.army.mil/271-heeding-breaches-in-biosecurity-navigating-the-new-normality-of-the-post-covid-future/>.

Recently, statements on behalf of the United States at the Biological Weapons Convention have provided hope these issues will be raised to the international level for discussion.¹⁹ Additionally, the COVID-19 pandemic has afforded a sentinel call for the Department of Defense to recognize how the biotechnology preparedness of the United States, its allies, and perhaps competitors is viable and effective and those aspects of organization and activity that need to be improved and secured. The pandemic has revealed potential vulnerability gaps between DoD preparedness for bioweapon threats and the general force—and public—health protection needs that should be further explored to protect readiness in and across all operations of the Department of Defense, governmental, and private-sector biosecurity communities. Ongoing efforts to update and further implement the *National Biodefense Strategy* and the creation of a “Biodefense Posture Review” could likely serve as appropriate opportunities to improve upon biodefense and biosecurity in light of these lessons learned.²⁰ Toward such ends, the United States and the Department of Defense must modernize biotechnology and health, medicine, and biosecurity to prepare for future potential outbreaks or pandemics in light of the pressing multinational competition emerging on the twenty-first-century global stage.

19. Bonnie Denise Jenkins, undersecretary for arms control and international security, “Remarks to the 2021 Biological Weapons Convention Meeting of States Parties, Geneva, Switzerland,” US Department of State (website), November 22, 2021, <https://www.state.gov/remarks-to-the-2021-biological-weapons-convention-meeting-of-states-parties/>.

20. Lloyd J. Austin III, secretary of defense, to senior Pentagon leadership, commanders of the combatant commands, defense agency and DoD field activity directors, memorandum, “Biodefense Vision,” November 1, 2021, <https://media.defense.gov/2021/Dec/03/2002903201/-1/-1/0/BIODEFENSE-VISION-FINAL.PDF>.

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