

25 YEARS OF PANDEMIC WARNINGS:
Health Security Net, A Global Health Security Library

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INTRODUCTION

The COVID-19 pandemic has, as of the middle of December 2020, claimed more than 1.4 million lives with over 76 million cases causing widespread global impacts. While unprecedented, this event was not unexpected; experts in public health and global health security have been warning of this risk, developing pandemic preparedness plans, and creating global response frameworks for biological risk over the course of the last quarter century. These efforts have drawn on what was learned from the 1918 pandemic influenza, which lasted several years and is widely thought to have killed over 50 million people globally,¹ the smallpox eradication efforts in the middle of the century, the deliberate use of anthrax in 2001, and from responses to a series of novel infectious disease threats, including HIV, Zika, novel strains of influenza, and recurring threats such as Ebola. Each of these diseases has threatened populations and stimulated discussion – study, preparedness efforts, and upticks in investment – within the global governance community. Interest and resources, however, were seldom sustained at the scale and scope suggested by many.

Health Security Net is an online, publicly available library of over 1,200 global health security resources including warnings, evaluations, oversight efforts, strategies, and other documents published between 1995 and 2019 that relate to pandemics. The library is designed to capture publicly available documents and to be used as a resource for cross-disciplinary analysis. Health Security Net is an expert-curated source of what was reported and communicated in the quarter century leading up to the COVID-19 pandemic, as well as the plans that were developed to fight biological threats.

This historical collection of reports, testimony, and expert advice at the national and international level is a critical resource to scholars studying what was known, unknown, acted upon and not acted upon, in the years before COVID.

Throughout the COVID-19 pandemic, there has also been a desperate need for rapid access to evidence to guide response and mitigation efforts. Decision mak-

ers have been grappling with the pandemic without an easily accessible repository of lessons, templates and best practices from past experiences. Health Security Net provides access to this evidence base, providing a reference to inform present-day decision making and help guide future actions for preparedness and response. The library is intended to serve as a repository of key resources for historical analysis of pandemic preparedness and to inform future planning and response efforts. It offers a platform for rigorous analysis that can build an evidence base and provide optimal options for the domestic and global governance of disease in the future.

HEALTH SECURITY NET: A LIBRARY OF PANDEMIC ANALYSIS IN THE LAST 25 YEARS

Health Security Net is an expansive library featuring a wide range of record types, all of which share a topical connection to pandemic risk awareness and preparedness. It comprises items that address key topics such as influenza preparedness and response, coronavirus risk awareness, specific outbreaks from the years of analysis, and messaging from central decision-making bodies about the importance of addressing the rising threats of emerging infectious disease. The library is the result of our effort to collect, organize, and make written and verbal reports of pandemic threat and risk information readily available to the public. We included materials that were provided by and to international bodies, as well as the Executive and Legislative branches of the United States Government. Our methodology to develop the library is available online (**healthsecuritynet.org**), including a glossary of terms that helps explain how records were categorized. The library remains a work in progress and will continue to expand as new materials are identified and coded, and the scope expanded to include additional events and sources.

Health Security Net² currently consists of 1,263 records, including:

- **873 Reports:** Items presented as a reporting of findings; may include written documentation of studies, meetings, investigations, etc. This also includes guidance and technical guidelines.
- **263 Government Actions:** Items that reflect an oversight, strategic, or other action taken on

1 Centers for Disease Control and Prevention. (2019, March 20). Influenza (Flu): 1918 Pandemic. Centers for Disease Control and Prevention. <https://www.cdc.gov/flu/pandemic-resources/1918-pandemic-h1n1.html>.
2 As of January 4, 2021.

the part of a national government or an intergovernmental body. This may also include hearings, strategies, plans, resolutions, and decisions; not all are legally binding.

- **118 Journal Papers:** Articles published in a professional journal; may reflect original research, literature reviews, commentaries, editorials, letters, and news items; and may or may not be peer-reviewed.

- **9 Simulations and Exercises:** Reports on simulations or exercises held, both table-top and operationalized training activities.

The majority of documents included in the library focus on medical preparedness and emergency response with further emphasis on the relative importance of international aid and collaboration on surveillance and detection (Figure 1). For the purpose of this analysis, medical preparedness and emergency response include the development, availability, and distribution of medical countermeasures; clinical management of cases; healthcare worker protection; and quarantine and social distancing as a response measure.

We also examined the kind and category of organization that published each document, focusing on organizations with differing roles in governance. Notably, while “medical preparedness and emergency response” was the most common topic for global intergovernmental organizations, the US federal government, and non-governmental organizations (largely US-based), academic journal articles, and non-governmental organizations were the most likely to publish documents associated with threat and risk awareness.

Not surprisingly, perhaps, the focus of the work in the repository was heavily aligned with current events, demonstrating a strong temporality to the issuing of reports and testimony on pandemic preparedness that ebbs and flows. As outbreaks unfolded globally, these events rapidly became the focus of topic both domestically and for intergovernmental organizations, though this focus was not often sustained.

Figure 2 shows the number of records annually, with

the color-coding representing those records that reported on specific outbreaks. (The black records reflect non-outbreak specific records, such as preparedness plans, strategies, technical guidance for certain pathogens, etc.) Across time, records reflect recent and ongoing outbreaks. The 2003 Severe Acute Respiratory Syndrome (SARS) coronavirus outbreak, for instance, was the focus of many documents both immediately and following that outbreak, and was followed by a transition to a predominant focus on influenza (both H5N1 and H1N1) from 2005 through 2012. Ebola was the primary focus of discussion with a large percentage of the analysis and intellectual capital investment in 2014 and into 2015 and 2016. Notably, Middle East Respiratory Syndrome (MERS), another coronavirus, began to appear in outbreak-related reports in late 2012 and continued through 2019 as sporadic outbreaks occurred.

Of these outbreak-specific records, Figure 3 illustrates which outbreaks garnered the most attention and what the focus of the documents was. The West Africa Ebola outbreak was the focus of the greatest total number of outbreak reports, with an emphasis on surveillance, detection, medical preparedness and emergency response. Most notably, the 2014 Ebola outbreak was one of the first of the endemic Ebola outbreaks to jump continents, triggering a number of reports on international aid and collaboration – a significant increase in the level of international concern as compared to prior Ebola outbreaks.³

The reports around influenza outbreaks and the SARS and MERS coronavirus outbreaks between 2003 and 2009 spurred significant discussion, albeit at levels half of that of the West Africa Ebola outbreak. The SARS records primarily focused on medical preparedness and emergency response, and a shift is seen with MERS to threat and risk awareness and surveillance and detection.

Not shown in this graph are records that address certain pathogens outside the context of a given outbreak. A review of the library reveals that records related to pandemic influenza largely dominate the international documents, with 200 of the 419 international reports (those published by intergovernmental organizations) focused on the topic, including both those focused on the specific events and more general frame-

3 Given the methods used to curate the library, many Ebola reports at the regional and national level were excluded from the dataset; further analysis of these documents in the future may perhaps demonstrate different themes in topics covered.

Figure 1: Key topics of reports in Health Security Net show an emphasis on medical preparedness and emergency response

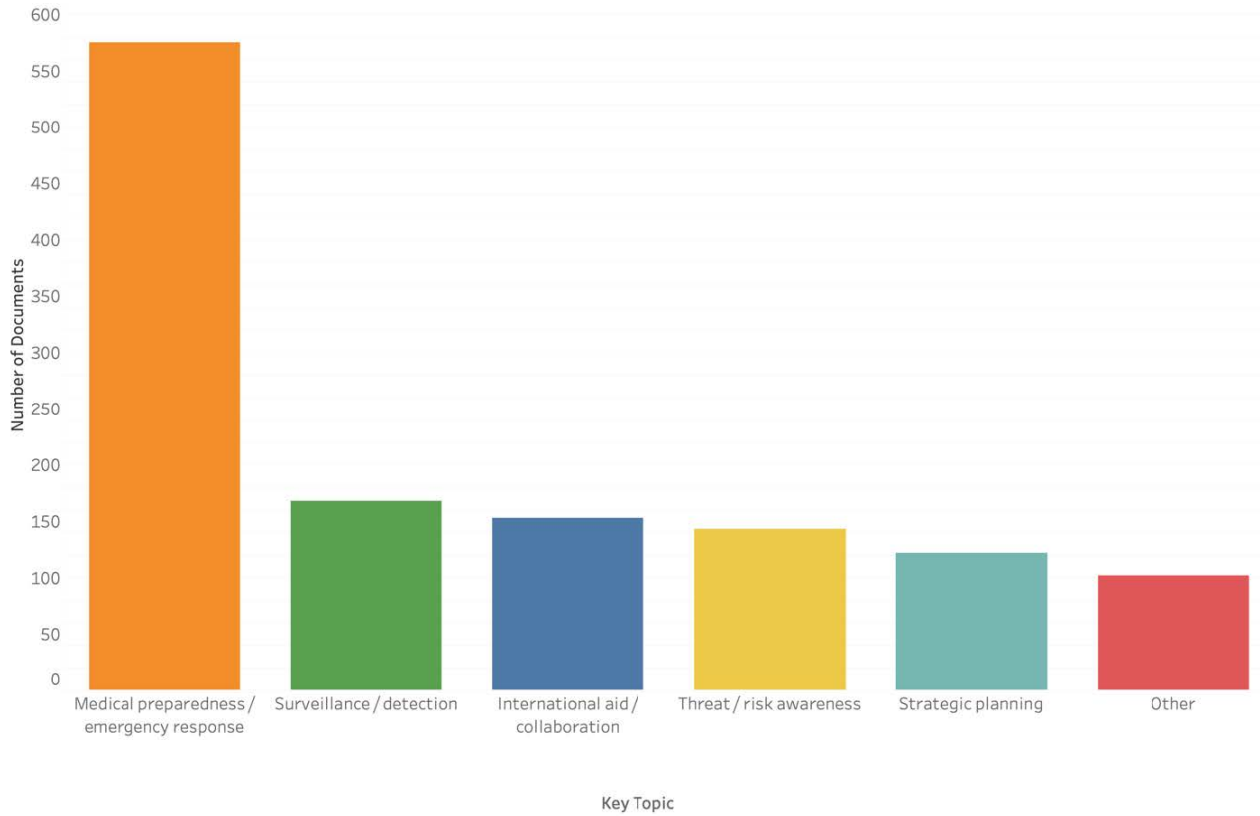
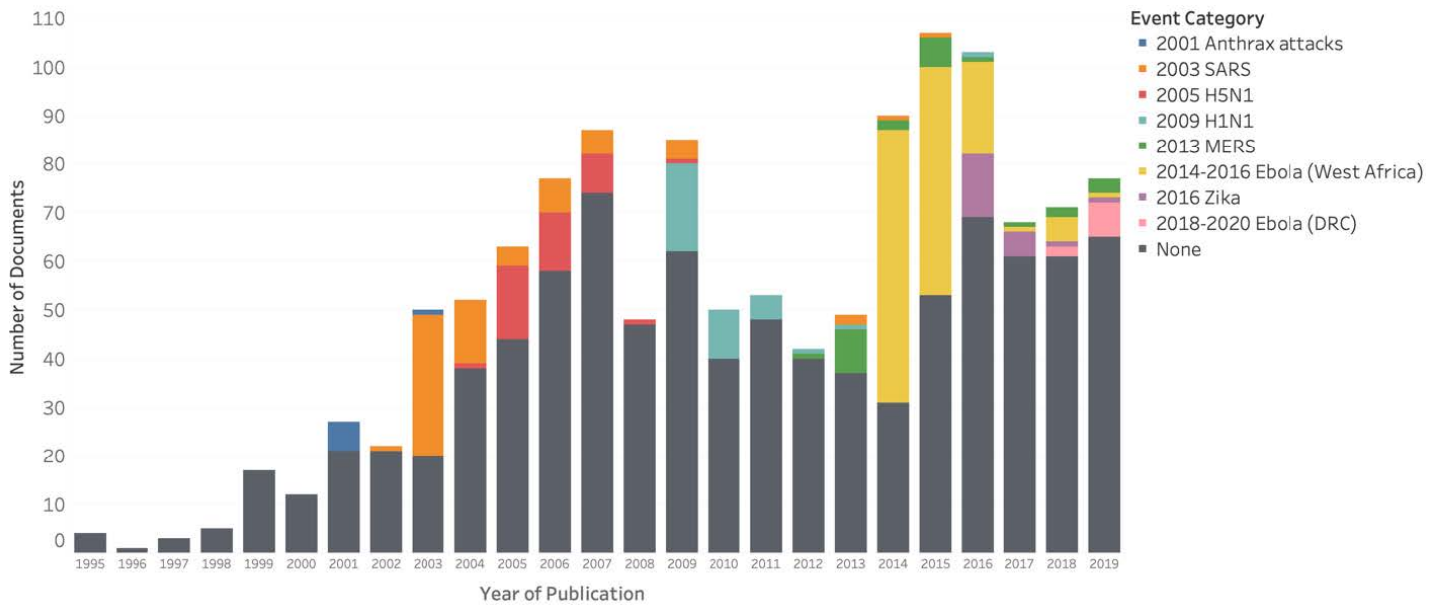


Figure 2: Records in Health Security Net reveal a global interest in the latest global outbreak of international concern



works. Similarly, non-outbreak specific reports reveal an awareness amongst experts of the pandemic potential of coronaviruses, especially from journals and researchers in the Middle East, following MERS and the discovery of virus transfer in dromedary camels. Though the primary focus of these reports was the recent MERS outbreak, there were also larger discussions around the need for widespread surveillance of these kinds of emerging coronavirus viruses.

A FOCUS ON HIGHLY-CONTAGIOUS RESPIRATORY DISEASES

Both influenza and coronaviruses are highly contagious respiratory diseases that may harbor in animal hosts. Novel strains have surfaced in the human population repeatedly in the last century. Both viral families have generated significant attention by inter-governmental and national governments since 1997, primarily driven by outbreaks in the intervening years. Many of the library's documents were organized around influenza, although MERS appears to have spurred renewed and perennial interest in coronaviruses since its emergence in 2012.

Influenza has long been recognized as a threat to nations and the entire global community. From the 1918 pandemic influenza to the 2009 H1N1 pandemic, and numerous intervening outbreaks in between, pandemic influenza is a risk clearly identified in the library's contents. The World Health Organization (WHO) influenza documentation includes materials related to the 2006 Global Action Plan for Influenza Vaccines on Influenza; the 2011 Pandemic Influenza Preparedness (PIP) Framework; the Global Influenza Surveillance Network; the Global Influenza Programme, and many other influenza-oriented activities. The PIP Framework is a central locus of activity within the WHO, and reflects numerous WHO and World Health Assembly (WHA) publications. It was established at the

64th WHA in 2011 via Resolution WHA 64.5, with the stated goal of ensuring the sharing influenza viruses with pandemic potential in order to increase vaccine development and access. It is accompanied by publications on many other influenza topics, including outbreak reports, surveillance efforts, vaccine studies, and strategies.

Laboratory studies published in 2011 (not in the database) described the generation of a new H5N1 variant, modified to increase its virulence; in the midst of the efforts to address the naturally occurring disease, the publication of a "gain-of-function" H5N1 study expanded the global debate about the threat of new strains of highly virulent influenzas and the ethics of gain-of-function experiments.⁴ Influenza was recognized anew as having significant pandemic threat potential that drove widespread preparedness activities both globally and within the United States.^{5,6}

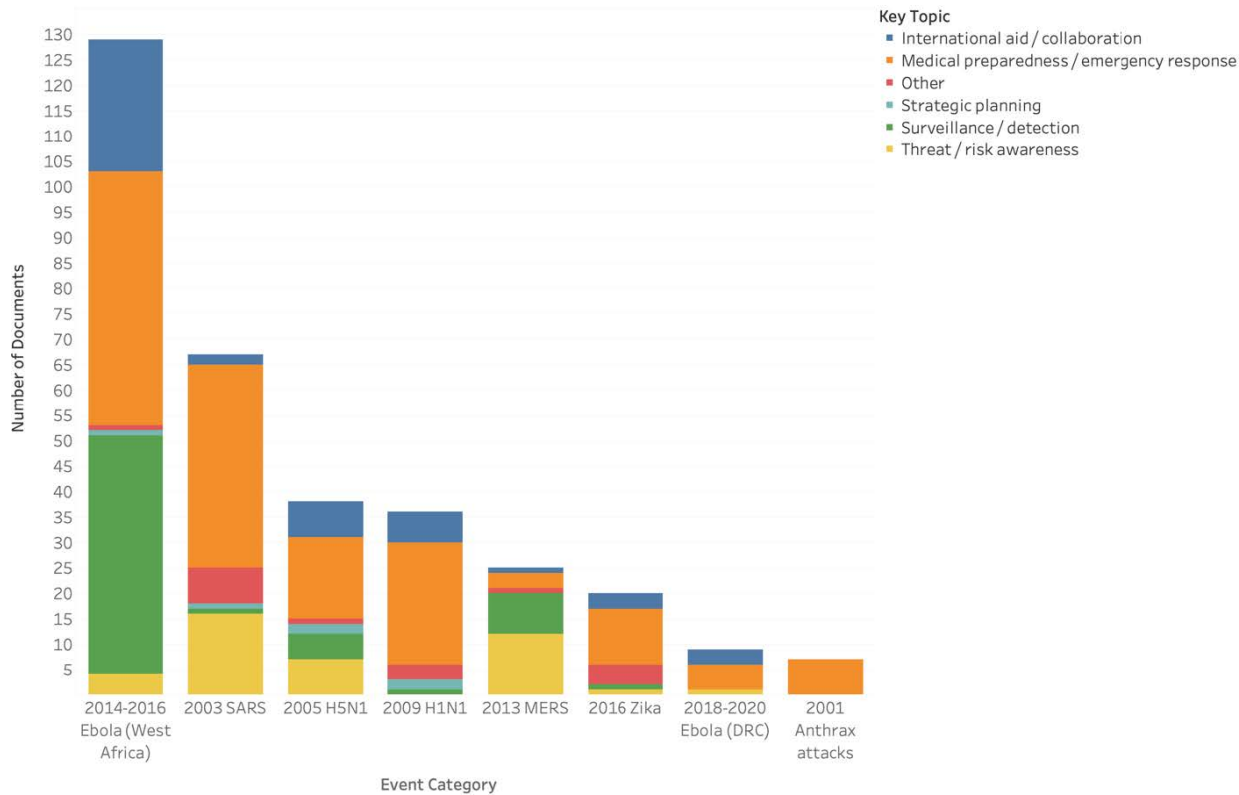
Documents published by the United Nations Food and Agriculture Organization (FAO) and World Organisation for Animal Health (OIE) helped focus attention on the zoonotic disease transmission that drove emergence of many of the emerging infectious disease threats identified in the last 25 years. In addition to three OIE resolutions, six OIE topical reports were also captured from the WHO search, reflecting co-authored publications, and were added to the library. These records covered topics including H5N1 avian influenza preparedness and response, zoonotic disease transmission among species, and multisectoral approaches to zoonoses. These documents reflect a global shift to a focus on "One Health," an approach to the health landscape that demands a recognition of the interconnectedness of people, animals, and the environment. The OIE and FAO documents jointly published with the WHO emphasize the importance of integrating this concept into surveillance and global health security efforts.

4 Herfst, S., Schrauwen, E.J., Linster, M., Chutinimitkul, S., de Wit, E., Munster, V.J., Sorrell, E.M., Bestebroer, T.M., Burke, D.F., Smith, D.J., Rimmelzwaan, G.F., Osterhaus, A.D., & Fouchier, R.A. (2012, June 22). Airborne transmission of influenza A/H5N1 virus between ferrets. *Science*, 336(6088):1534-41. doi: 10.1126/science.1213362.

5 Koonin, L.M., Sliger, K., Kerr, J., Bullen-Austin, L., Graeden, E., Farris, K., Ionta, C., Krause, D., & Patel, A. (2020, October 12). CDC's Flu on Call Simulation: Testing a National Helpline for Use During an Influenza Pandemic. *Health Security*, Vol. 18, No. 5. <https://doi.org/10.1089/hs.2019.0152>.

6 Reed, C., Biggerstaff, M., Finelli, L., Koonin, L.M., Beauvais, D., Uzicanin, A., Plummer, A., Bresee, J., Redd, S.C., & Jernigan, D.B. (2013, January). Novel Framework for Assessing Epidemiologic Effects of Influenza Epidemics and Pandemics. *Emerging Infectious Diseases*, Vol. 19, No. 1. 10.3201/eid1901.120124.

Figure 3: Outbreak-specific records focused most heavily on Ebola, with influenza and coronavirus present but at much lower levels



The 2003 SARS outbreak signified one of the first large-scale global outbreaks of an emerging infectious disease caused by a coronavirus that confirmed and fueled significant efforts in the subsequent decade on emerging infectious diseases both in the United States and globally. The database includes 21 national (US) documents, 18 international documents, and 98 journal articles focused on SARS and other coronaviruses. Discussions of the SARS pandemic and MERS outbreaks include areas of focus such as risk assessment, predictive modeling, and vaccine development. Many of the academic journal articles called for better coronavirus monitoring and started addressing response requirements, as in one paper published in 2015 that tested lifespan of coronaviruses on personal protection equipment.⁷ The earliest coronavirus document in the database is a WHO record from 2003, which covered key epidemiologic information related to SARS, with an eye toward equipping international governments

With the data needed to develop vaccines and treatments.⁸ The need for surveillance and threat awareness of emerging coronaviruses was a clear focus of the work.

Records from the United States, both from the federal government and non-governmental organizations, reveal a long-standing interest in pandemics and emerging infectious disease driven by an awareness of the threat caused by increases in human mobility, globalization, wildlife trade, and climate change. Importantly, although these reports initially focused on the immediate threat of the most recent outbreak, this work prompted more expansive and future-focused efforts. For example, H5N1 prompted focus on pandemic influenza, but also attention to needs in medical surge and animal (bird) disease surveillance; the Ebola outbreak in West Africa in 2014-2016 prompted broader discussion of WHO reform. Third-party groups (e.g. CSIS Commission on Strengthening America's Health Secu-

7 Casanova, L., Rutala, W., Weber, D., & Sobsey, M. (2010). Coronavirus survival on healthcare personal protective equipment. *Infection Control & Hospital Epidemiology*, 31(5), 560-561. <https://doi.org/10.1086/652452>.

8 World Health Organization. (2003). Consensus document on the epidemiology of severe acute respiratory syndrome (SARS). World Health Organization. <https://apps.who.int/iris/handle/10665/70863>.

9 rity,⁹ Bipartisan Commission on Biodefense¹⁰) focused attention on issues related to political leadership and the value of assigning overall responsibility for biodefense to a more centralized entity within the fragmented US government. Over 25 years a strong emphasis on medical countermeasure readiness emerged, including calls for transitioning toward platforms, broad-spectrum treatments, and early research to support rapid development of MCMs for a novel pathogen.

Critically, these efforts focused on highly contagious and deadly respiratory diseases, typically assumed to emerge as a newly identified zoonotic strain, for which there were no known medical countermeasures.

This focus on a relatively generic threat supported and informed a body of work emphasizing international surveillance, social distancing, and travel restrictions as a potential mechanism for managing a pandemic;^{11,12,13} the development of a broad-spectrum or universal influenza vaccine;^{14,15,16} and stockpiling of both existing influenza vaccine and the personal protective equipment needed for medical personnel during such an event.^{17,18}

PANDEMIC THREAT AWARENESS IN THE UNITED STATES

As the COVID-19 pandemic has unfolded, a key question in global governance and particularly in the United States has focused on whether there had been sufficient warning. To build the evidence base for a detailed analysis on what constitutes sufficient warning and how those warnings were or were not applied effectively within the United States, we captured a series of domestic documents, including 160 congressional hearings. Select warnings from witness testimony are captured in Table 1. Even when discussing particular diseases events, witnesses often provided warnings relevant to long-term preparedness efforts. In many cases, witnesses forewarned gaps in preparedness that have become apparent during the national response to COVID-19 (Table 1).

The library also contains reports from advisory and oversight bodies to the U.S. federal government. These bodies issued 484 unclassified reports relevant to pandemics and emerging infectious disease risk. Like the witness testimonies, many of these reports recognized vulnerabilities that became apparent during COVID-19

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- 9 The CSIS Commission on Strengthening America's Health Security. (November 2019). Final report: ending the cycle of crisis and complacency in U.S. Global Health Security. Washington, DC: Center for Strategic and International Studies. <https://www.csis.org/analysis/ending-cycle-crisis-and-complacency-us-global-health-security>.
- 10 Blue Ribbon Study Panel on Biodefense. (October 2015). A national blueprint for biodefense: leadership and major reform needed to optimize efforts. Washington, DC: Blue Ribbon Study Panel on Biodefense. Hudson Institute. <https://biodefensecommission.org/reports/a-national-blueprint-for-biodefense/>.
- 11 USAID. (2020). PREDICT: Pandemic Preparedness for Global Health Security. United States Agency for International Development. <https://p2.predict.global/>.
- 12 World Health Organization. (2020). Global Influenza Surveillance and Response System (GISRS). World Health Organization. https://www.who.int/influenza/gisrs_laboratory/en/.
- 13 Qualls, N., Levitt, A., Kanade, N., Wright-Jegede, N., Dopson, S., Biggerstaff, M., Reed, C., & Uzicanin, A. (2017, April 21). Community Mitigation Guidelines to Prevent Pandemic Influenza—United States, 2017. Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report. <https://www.cdc.gov/mmwr/volumes/66/rr/rr6601a1.html>.
- 14 NIAID. (2019, September 5). Universal Influenza Vaccine Research. National Institutes of Health NIAID. <https://www.niaid.nih.gov/diseases-conditions/universal-influenza-vaccine-research>.
- 15 World Health Organization. Pandemic influenza preparedness framework for the sharing of influenza viruses and access to vaccines and other benefits. (2011). World Health Organization. https://www.who.int/influenza/resources/pip_framework/en/.
- 16 Chitale, Rohit. (2020). PREventing Emerging Pathogenic Threats (PREEMPT). Defense Advanced Research Projects Agency. <https://www.darpa.mil/program/preventing-emerging-pathogenic-threats>.
- 17 Yen, C., Hyde, T.B., Costa, A.J., Fernandez, K., Tam, J.S., Hugonnet, S., Huvos, A.M., Duclos, P., Dietz, V.J., & Burkholder, B.T. (2015, March). The development of global vaccine stockpiles. *Lancet Infectious Diseases*, 15(3): 340-347. doi: 10.1016/S1473-3099(14)70999-5.
- 18 Patel, A., & Gorman, S.E. (2009, September). Stockpiling antiviral drugs for the next influenza pandemic. *Clinical Pharmacology & Therapeutics*, 86(3):241-3. doi: 10.1038/clpt.2009.142.

(Table 2). They addressed concerns such as the ever-increasing risk of emerging infectious disease emergence, particularly zoonotic emergence; the economic disruption that would result from a pandemic; insufficient attention to the Strategic National Stockpile; and the inadequacy of international resources to deal with the transnational spread of a high-consequence disease and the U.S. vulnerability to such an occurrence.

Health Security Net also documents a series of US-based simulations and exercises focused on pandemics and other high-consequence outbreaks. These nine records span nearly two decades. The first such event was held in June 2001, just a few months before the US anthrax attacks, and exercised response to a hypothetical attack with smallpox (Dark Winter).¹⁹ In 2005, another terrorism exercise was held (Atlantic Storm).²⁰ Over the years, the emphasis shifted to naturally occurring outbreaks, covering influenza, unknown novel pathogens, and coronaviruses. Three of these exercises were funded by the federal government and in-

cluded participants from around the globe. Similar exercises and simulations were hosted by a large number of non-governmental organizations with participants from the global health security community with the findings presented at the United Nations in the last 20 years.^{21,22,23,24,25,26}

FINANCING AND FUNDING FOR PANDEMIC PREPAREDNESS AND RESPONSE

As with any area of policy and governance, success is dependent on implementation, and implementation requires funding, both domestically and globally.²⁷ Based on analysis completed outside this effort, close to 80,000 projects have been funded since 2014 to support health security endeavors through global initiatives.²⁸ This analysis was based on large-scale data collection effort focused on global funding of health security, available at **ghscosting.org**. For most low and middle-income countries, global aid is a major source of funding for health security systems, and developing

- 19 Johns Hopkins Center for Civilian Biodefense, Center for Strategic and International Studies, ANSER, & Memorial Institute for the Prevention of Terrorism. Dark Winter: Bioterrorism Exercise, Andrews Airforce Base, June 22-23, 2001.
- 20 Smith BT, Inglesby TV, Brimmer E, Borio L, Franco C, Gronvall GK, Kramer B, Maldin B, Nuzzo JB, Schuler A, Stern S. (2005, September). Navigating the storm: report and recommendations from the Atlantic Storm exercise. *Biosecurity and Bioterrorism*, 3(3):256-67. <https://doi.org/10.1089/bsp.2005.3.256>.
- 21 Nuclear Threat Initiative. (2020). Preventing global catastrophic biological risks: A tabletop exercise at the 2020 Munich Security Conference. NTI, Munich Security Conference, Feb. 14-16 2020. <https://www.nti.org/about/projects/global-catastrophic-biological-risks/preventing-global-catastrophicbiological-risks-tabletop-exercise-2020-munich-securityconference/#:~:text=In%20February%202020%2C%20during%20the,a%20high%2D-consequence%20biological%20event>.
- 22 Permanent Representation of France to the Conference on Disarmament. (2020, March 31). BWC: Final report of the tabletop exercise on article VII (8-9 November 2016). Ministry of Europe and Foreign Affairs. <https://cd-geneve.delegfrance.org/BWC-Final-report-of-the-tabletop-exercise-on-article-VII>.
- 23 Zanders, J.P., Trapp, R., & Nexon, E. (2019, August). Tabletop Exercise on the Implementation of Article VII of the Biological and Toxin Weapons Convention (BTWC). Foundation for Strategic Research (FRS). <https://www.the-trench.org/wp-content/uploads/2018/07/English-20190804-BTWC-Article-VII-TTX-Lome%CC%81-report-Final-EN.pdf>.
- 24 Attal-Juncqua, A. (2017, November). Responding to deliberate biological release: the requirements for effective, coordinated international action. Wilton Park. <https://www.wiltonpark.org.uk/wpcontent/uploads/2020/09/WP1556-Report.pdf>.
- 25 Center for Health Security. (2019). Event 201: A Global Pandemic Exercise. Johns Hopkins Center for Health Security. <https://www.centerforhealthsecurity.org/event201/about>.
- 26 Tak, S., Jareb, A., Choi, S., Sikes, M., Choi, Y.H., & Boo, H. (2018, February). Enhancing 'Whole-of-Government' Response to Biological Events in Korea: Able Response to 2014. *Osong Public Health and Research Perspectives*, 9(1): 32-35. doi: 10.24171/j.phrp.2018.9.1.06.
- 27 Abdellatid, Yasser Omar, & Graeden, Ellie. (2020, December 22). A funding gap is hurting developing countries' efforts to contain COVID-19. World Economic Forum. <https://www.weforum.org/discom?bobulate=altHYm%2FnuhNCAMBOX0Sa8qmS%2FjrCrxxhUrcT09KpmMjOscFUPsE0BCBpgOuE%0A-oDh139uwQe5QIYbF08rFysfKsA%3D%3D%0A>.
- 28 Georgetown Global Health Security Tracking (2020). GIDA. <https://tracking.ghscosting.org/data>.

Table 1: Warnings from select witness testimonies at U.S. congressional hearings

Source	Warning from witness testimony
Twenty-First Century Biological Threats Subcommittee on Bioterrorism and Public Health Preparedness, Senate Committee on Health, Education, Labor and Pensions May 11, 2005	EIDs are not anomalous; they are a near certainty The public health system is under-resourced, which will become quickly apparent during a biological event Broad-spectrum antivirals/antibiotics play a crucial role in fighting EID; however, pharmaceutical companies lack an incentive to develop them and are currently ending research programs in this area
The Threat of and Planning for Pandemic Flu Subcommittee on Health, House Committee on Energy & Commerce May 26, 2005	Current disease surveillance capabilities are insufficient A severe pandemic will exact heavy economic costs Interventions to slow the spread of disease will create privacy and procedural challenges There is a healthcare worker shortage, which will be exacerbated during a pandemic as healthcare workers fall ill or care for ill relatives
Beyond Readiness: An Examination of the Current Status and Future Outlook of the National Response to Pandemic Influenza House Committee on Homeland Security July 29, 2009	It remains unclear who in the federal government will lead a pandemic response In a pandemic, the roles of federal and state governments are not clearly delineated
Outbreaks, Attacks, and Accidents: Combating Biological Threats Subcommittee on Oversight & Investigations, House Committee on Energy & Commerce February 12, 2016	Interagency coordination to address biological events soaks up valuable response time; centralized leadership and planning is needed Hospitals are unprepared for a surge in cases State and local health departments are under-resourced

Summaries of warnings from witness testimonies delivered at selected hearings about or relevant to emerging infectious disease, 1995-2019. EID: emerging infectious disease.

Table 2: Pandemic warnings from select U.S. reports

Source	Selected Warnings
<p>Implementation Plan for the National Strategy for Pandemic Influenza Homeland Security Council 2006</p>	<p>Immense economic and social disruption can arise from a pandemic and the public health measures used to address it Pandemic planning is needed at all levels of government</p>
<p>Annual Threat Assessment of the Intelligence Community Director of National Intelligence 2009</p>	<p>Novel, virulent infectious diseases remain the most direct health-related threat to the United States Current international regulations/resources are inadequate to contain the transnational spread of disease A pandemic would have high economic costs</p>
<p>Anticipated Responsibilities of the SNS in the Year 2020: Examination with Recommendations Natl. Biodefense Science Board & OPHEP Board of Scientific Counselors 2013</p>	<p>America is increasingly reliant on the Strategic National Stockpile (SNS) to ensure preparedness for an ever-growing list of kinds of hazards Funding for the SNS is not keeping pace, leaving it unable to perform these expanded duties</p>
<p>The Neglected Dimension of Global Security: A Framework to Counter Infectious Disease Crises Commission on a Global Health Risk Framework for the Future/National Academy of Medicine 2016</p>	<p>EIDs are among the greatest threats to human life, and they appear to be emerging more frequently Spending to counter pandemics is low compared to other high-profile threats, such as terrorism, war, and financial crises Proactive investment in PPE, vaccines, diagnostics, and therapeutics is needed</p>
<p>Worldwide Threat Assessment of the U.S. Intelligence Community Director of National Intelligence 2019</p>	<p>The U.S. and world remain vulnerable to the next large-scale outbreak Global improvements to health security have been tenuous Increased human proximity to animals, expansion of travel, and other factors have increased risk from EIDs</p>

Warnings from selected reports about or relevant to emerging infectious disease, 1995-2019. EID: emerging infectious disease; OPHEP: Office of Public Health Emergency Preparedness; PPE: personal protective equipment.

countries are largely dependent on external support for these efforts. Indeed, according to the United Nations, around 70 countries worldwide have been identified as aid dependent.²⁹ For example, in countries like South Sudan, Tuvalu, and Liberia, external financing accounts for more than 50% of GDP.³⁰ As of September 2020, 456 projects were recorded engaged in efforts to counter COVID-19 globally. The amount of funds committed to COVID-19 related projects by donors in 2020 topped \$22.5 billion; this amounts to nearly 30% of total committed funds earmarked for health security. Critically, this funding for COVID-19 appears to have supplanted or been pulled from general funds for global health security.

Within the United States, the government does not catalog biodefense activity and spending in a unified fashion, creating a considerable challenge for determining what the whole of federal biodefense activity is, and how much it costs.³¹ However, some estimates are available. One annual evaluation has estimated, depending on how programs are counted, that biodefense and related spending has ranged from \$4.9 billion to more than \$11 billion annually since 2001.^{32,33,34} Spending on the sub-category of “civilian pandemic influenza and emerging infectious disease” shows \$1.3 billion in expenditures in FY2010 (the first year for which that particular analysis is available), dipping to a nadir of \$0.96-\$0.97 billion for the next three fiscal years, and up to \$1.5 billion by FY2018. Both categories “civilian pandemic influenza and emerging infectious disease” and “multiple-hazard and general preparedness” veer upward after the Ebola emergency prompted Congress to infuse cash into the system during FY2015.³⁵

Though much funding is supported through state and local funding, these data are not broadly available. Funding for global health security as a unique category, calculated separately but with some overlap to the noted biodefense expenditures, has also waxed and waned over time; this spending has generally been in the area of \$400-500 million annually over the last decade.³⁶

DISCUSSION

Over the course of the last few decades, global awareness of the threat of emerging infectious diseases, the potential impact of a pandemic, the importance of identifying and preventing those threats before they arise and then responding and recovering to those threats effectively has become a major topic in governance both at the state and global scales. Health Security Net provides a library of global health security documents, reports, hearings, and studies, that provides rapid access and the ability to find the results of 25 years of work on pandemic preparedness activities. While the existence of a document or evidence of hearings alone do not provide evidence of action in government, Health Security Net and the compilation of these materials is intended to support this type of detailed analysis, helping drive future efforts to those that were most closely linked to clear and successful action.

We hope that Health Security Net will provide a resource to study a series of questions to better prepare the world for future biological threats. Subsequent cross-disciplinary analysis will be required to better understand how these warnings and reports were applied, where, when, to what end, and in what context. Several

29 UNCTAD. (2019). The Least Developed Countries Report 2019. United Nations Conference on Trade and Development. https://unctad.org/system/files/official-document/ldcr2019_en.pdf.

30 UNCTAD. (2019). The Least Developed Countries Report 2019. United Nations Conference on Trade and Development. https://unctad.org/system/files/official-document/ldcr2019_en.pdf.

31 Blue Ribbon Study Panel on Biodefense. (2015, October). A national blueprint for biodefense: leadership and major reform needed to optimize efforts. Washington, DC: Blue Ribbon Study Panel on Biodefense. Hudson Institute.

32 Franco, C., & Sell, T.K. (2012). Federal agency biodefense funding, FY2012-FY2013. *Biosecurity and Bioterrorism*, 10(2):162-81. doi: 10.1089/bsp.2012.0025.

33 Boddie, C., Sell, T.K., & Watson, M. (2014). Federal funding for health security in FY2015. *Biosecurity and Bioterrorism*, 12(4):163-77. doi: 10.1089/bsp.2014.0050.

34 Watson, C., Watson, M., Gastfriend, D., & Sell, T.K. (2018). Federal Funding for Health Security in FY2019. *Health Security*, 16(5):281-303. doi: 10.1089/hs.2018.0077.

35 Boddie, C., Sell, T.K., & Watson, M. (2014). Federal funding for health security in FY2015. *Biosecurity and Bioterrorism*, 12(4):163-77. doi: 10.1089/bsp.2014.0050.

36 Michaud J, Moss K, Kates J. (2020, December 19). The U.S. Government and global health security. Kaiser Family Foundation.

key questions we believe are critical to explore include:

1. Health Security Net contains nearly 1,200 documents pertaining to pandemic threat awareness, preparedness, and response. **To what degree was this information known to and applied by experts and technical organizations and to what extent were recommendations acted upon – or not, either for reasons of competing priorities or other judgements made by decision-makers, and how did these decisions materially affect US and global preparedness for COVID-19?**

2. While the likelihood of a zoonotic event and its possible catastrophic effects on lives and livelihoods are well catalogued in the library, some of the most stressing aspects of the COVID-19 response have been unexpected. Moreover, complex indices developed by the public health community to assess preparedness capacity, including the Joint External Evaluations and Global Health Security Index, have turned out not to be correlated with the effectiveness of national responses to COVID-19, suggesting significant failures of foresight and disciplinary expertise that are deserving of further inquiry and accountability. **Drawing from Health Security Net, how can historians, policy scholars, and public health experts learn from what was anticipated or articulated and what was not, to help us understand the key historical question of whether or not we could have been better prepared for the challenge of COVID-19 in the United States and globally?**

3. **How can this body of knowledge be applied to successful implementation of future preparedness and response activities?** Successful implementation is driven not by guessing the specific threat correctly but developing translational preparedness and response plans, medical countermeasures, and other operational requirements to be flexible, dynamic, and broadly applicable. Are there examples of key successes or failures of implementation and can these be linked to what was known in the field? How does resourcing or funding impact this success? What is the relationship between the input of expert advice and the actual building of capacity to effectively respond to a novel pathogen?

4. **To what degree did the literature on pandemic preparedness in its totality translate to success or**

failure in effective response? Applying what has been learned about the gaps highlighted in the successes and failures of the COVID-19 outbreak can serve as the basis for the next round of efforts. By reviewing what was already known, the next round of study can be tailored to those areas where more focus is needed.

The real work of rigorous, cross-disciplinary analysis based on the library can now begin. We designed Health Security Net to be fully integrated with a suite of tools built on a shared data architecture that will support and inform more comprehensive analyses over time (gida.ghscosting.org). Taken together, further analyses can demonstrate how the work captured in the library drove or were driven by changes in funding for global health security, including funding for specific events; the policy environment both globally and domestically; and the intersection between funding, policy, and governance that drive success in global health security.

As a dynamic tool to which further data can be added, the library supports the study of research questions across disciplines and provides a resource from which to ask questions about national and global priorities: How much effort went into understanding and preparing for particular pathogens? What was the balance of investment across prevention, detection, response, and recovery? Have national and global governance bodies generally been proactive or reactive? How many of the barriers to early outbreak detection are political versus technical or logistical? This work is a keystone for ensuring that there is a better prepared, coordinated, and informed response for the next threat.



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