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Industry Study

Final Report
Pandemic Industrial Response

The Dwight D. Eisenhower School for National Security and Resource Strategy
National Defense University
Fort McNair, Washington, D.C. 20319-5062

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PANDEMIC INDUSTRIAL RESPONSE (2021)

EXECUTIVE SUMMARY

In December 2019, a few pneumonia-like cases, later identified as a novel Coronavirus, were identified in Wuhan, China. On January 31, 2020, the World Health Organization (WHO) declared a global health emergency.[1] As the health crisis worsened and the WHO declared a global pandemic on March 11, 2020, the United States faced a nationwide emergency for which it was not prepared.

The crisis combined the supply chain and manufacturing challenges of World War II with the health catastrophe of the Spanish Flu. A whole of nation approach would be required to address the pandemic, repair the economy, and ensure national security. The crisis would require the public and private sectors to exercise new response models that could combine resources with expertise and transcend the organization-specific silos of knowledge and excellence that had developed over the last several decades. The models would focus on three means: communication, collaboration and transparency.

After a rocky start at the beginning of the Coronavirus (COVID-19) crisis, over time the public and private sectors developed a more effective approach to fighting the pandemic, realizing that partnerships based on transparency, clear communication and collaboration across organizations were critical to dealing with the overwhelming challenges posed by COVID-19. The newly emerging crisis models can be categorized as: Public-Public (internal government); Public-Private (a hybrid combination of government and industry working together; and Private-Private (industry to industry).

At the start of the pandemic, the U.S. government (USG) did not have a logical nexus for interagency coordination of a comprehensive coast-to-coast response. The USG, led by the White House, would somehow need to pull multiple USG agencies together. In particular, the Department of Health and Human Services, the Federal Emergency Management Agency, and the Department of Defense played crucial roles in the nation's federal support. The public-public model presents a discussion and analysis of how the government formed task forces and adjusted internal resources to align with expertise.

As U.S. domestic demand for PPE increased and global supply chains broke down, manufacturers could not produce the PPE that consumers needed to protect themselves. With the Strategic National Stockpile quickly depleting, the U.S. government partnered with Corporate America and took extraordinary steps to bolster the nation's industrial manufacturing base, implementing the Defense Production Act (DPA) for the first time since the Korean War. The public-private model focuses on the use of the DPA and the creation of a common operating picture to be shared between industry and the federal government to better align supplies.

At the same time, in a show of exceptional cooperation, many private firms formed partnerships among themselves to create and distribute PPE as well as medical and diagnostic products. The private-private model is the story of American business stepping up voluntarily to meet the nation's needs.

While studying the models, the authors identified many organizational, operational, and procedural gaps. The authors developed multiple observations that may inform a United States whole-of-government and society mobilization in future crisis.

Observation 1: The White House was unprepared to manage a national health emergency. The National Security Council (NSC) was not adequately organized to provide the White House with early warning and recommendations on appropriately responding to the emerging pandemic.

Observation 2: The United States' heavy reliance on offshore-produced medical material and supplies reduced its momentum to meet the increased demand for PPE. Dispersed supply chains abroad, distant sources of raw materials, and offshore manufacturing plants exposed domestic production capability gaps. The USG's lack of sufficient industry knowledge and market intelligence affected its ability to collaborate with Industry. Industry can utilize its existing facilities, established relationships with manufacturers, ordering systems, and efficient shipping networks to deliver critical products.

Observation 3: The U.S. government created synergies with Industry that should not be lost. The USG, with Industry, created tremendous national crisis management momentum. Government DPA Title III contracts drove the expansion of domestic production to mitigate the impact of crippled international supply chains as well as maintain critical defense industrial base capabilities. The USG de-risked the vaccine development process for Industry by leaning forward with the purchase of thousands of doses of vaccine in advance of the normal approval threshold.

Observation 4: The U.S. government was inconsistent in messaging. Although the USG's pandemic industrial response was as successful as it was due to collaboration, communication, and transparency, the Seminar observed several weaknesses. To varying degrees, the pandemic messaging between USG and Industry was inconsistent or ineffective. For example, the lack of clear instructions from the federal government at the pandemic onset created confusion. It slowed the national response, including everything from the initial messaging (requirement for and availability of PPE) to vaccine distribution. The lack of clarity and agreement on the federal government's role versus the roles of states, tribes and territories hampered the consistency of response. Additionally, Industry was frustrated by the USG's communication to the public. For instance, the USG communicated to the American people that it had ordered Industry to implement specific actions to increase domestic production capacity whereas Industry had already begun to work on those actions before the USG's announcements.

SCOPE OF THE PANDEMIC INDUSTRIAL RESPONSE INDUSTRY STUDY

The purpose of the Pandemic Industrial Response Industry Study, conducted from January-May 2021, was to analyze the United States' industrial response to the Coronavirus (COVID-19) pandemic that started in early 2020. The Industry Study was not intended to be a health-related study of the Coronavirus virus, its pathology, or treatments. **The Pandemic**

Industrial Response Seminar team ("the Seminar") focused on the intersection of United States government (USG) and private sector actions, including use of the Defense Production Act (DPA), that may offer lessons for United States whole-of-government and society mobilization in future crises. (Refer to Appendix A for a list of Pandemic Response Industry Study participants.) The knowledge gained through the team's investigation on the pandemic response may also offer useful lessons for future Department of Defense military surges. The IS focused on a small number of specific categories that have potential relevance to DoD surges or USG mobilization:

- The use of the Defense Production Act (DPA) Title III and CARES Act funding to increase domestic production capacity of health and medical related equipment/supplies.
- The use of DPA Title III, CARES Act, and other funding to support the Defense Industrial Base and Defense-Critical Workforce.
- The use of DPA Title I authorities to prioritize and accept government contracts and to allocate the distribution of goods, services, and facilities.
- The use of DPA Title VII authorities, e.g., voluntary agreements with private industry and volunteer pool of industry executives.
- Private sector initiatives.

RESEARCH METHODOLOGY

Primary study included a review of relevant literature, including news articles, U.S. government reports, U.S. government laws, and U.S. government rules. Subsequent investigation included meetings with 22 U.S. federal government organizations, eight private American companies that played active roles in the U.S. pandemic response and mobilization, and three foreign government organizations.

In the literature review, the Seminar also studied surge and mobilization in the People's Republic of China, Russia, Germany, and Sweden. Additionally, the Seminar met online with the Swedish Armed Forces as well as with the Swedish Civil Contingencies Agency to discuss the country's Total Defense concept. Lastly, the team heard from the Canadian Armed Forces regarding its response to the pandemic.

The ongoing COVID-19 pandemic has changed the way people work. Due to the pandemic-related restrictions on travel and the need for social distancing and other preventative measures, this academic year was conducted online rather than in person. Thus, all classes, meetings, and interviews, with the exceptions of two domestic site visits, were conducted online via Microsoft Teams. This offered some benefit in that many of the companies were willing to meet with the team for a series of sessions, and some companies provided people from different parts of the company at each session. The Seminar met online with the following organizations:

United States Government

Government Accountability Office (GAO)

United States Congress

Department of Commerce
- International Trade Administration

Department of Defense
- Joint Acquisition Task Force (JATF)
- Ft. Detrick Military Infectious Diseases Research Program (MIDRP) Director
- Defense Logistics Agency (DLA)
- Defense Logistics Agency Warstopper Program
- Deputy Assistant Secretary of Defense (DASD) Industrial Policy
- Walter Reed Army Institute of Research (WRAIR)
- U.S. Army Medical Materiel Development Activities (USAMMDA)
- Supply Chain Task Force
- Defense Support to Civilian Authorities (DASD)
- Joint Program Executive Office Chemical Biological Defense (JPEO-CBD)

Department of Health and Human Services
- Office of the Assistant Secretary for Preparedness and Response (ASPR)
- Biomedical Advanced Research and Development Authority (BARDA)
- Federal COVID Response Vaccine Team
- The Innovation Ecosystem (WRAIR)
- Federal COVID-19 Response Vaccine Team Moderna
- Emerging Infectious Diseases Branch (WRAIR)

Department of Homeland Security
- Federal Emergency Management Agency (FEMA)

Department of the Treasury
- Committee of Foreign Investment in the United States (CFIUS)

Private Sector
- 3M
- Ford
- Hollingsworth & Vose
- Lockheed Martin
- McKesson
- Merck
- Spirit Aerosystems

Hybrid Government-Private Sector

- Operation Warp Speed (OWS)

International

- Swedish Armed Forces
- Swedish Civil Contingencies Agency
- Canadian Armed Forces

The Seminar also conducted two site visits. However, due to the National Defense University's policy on social distancing during the pandemic, the Seminar was divided into two teams. One team visited GM facilities in Indiana, while the second team visited Puritan Medical Products in Maine.

In-person Site Visits:

- General Motors
- Puritan Medical Products

The organizational leaders that participated in the study described the impact of the pandemic on their organizations and operations and recounted their roles in the nationwide effort to increase production of pandemic-related supplies such as personal protective equipment, ventilators, and the development of vaccines. Major foci of discussions with private firms included the U.S. government's use of the Defense Production Act, the role and use of U.S. fiscal stimulus funding, and public and private sector operational speed and agility. During extensive question and answer sessions, the students sought to understand organizational roles as well as to develop a comprehensive understanding of the interlocking efforts of the public and private sectors.

The team analyzed qualitative data through ongoing documentation, a review of speaker sessions, multiple collaborative online processing sessions, and a comprehensive design thinking exercise to identify the major lessons that emerged.

LIMITATIONS TO THE STUDY

- Although the Seminar met with several U.S. federal executive and legislative representatives, it did not have the opportunity to speak with several more that may have been involved in the pandemic response.

- The Seminar did not meet with state, local, territorial, or tribal representatives.

- Although the Seminar met with at least one company in each of the specific categories listed above, the coverage was not uniform.

- The Seminar was not able to meet with all the relevant players in the specific supply chains.

- The Seminar did not meet with any vaccine manufacturers.

- In non-pandemic years, the Seminar would have attended more site visits, which are invaluable to the students' learning experience. This year, each student only had one opportunity to experience life on the shop floor, have side-bar conversations with the workforce, and gain a more rounded and nuanced understanding of modern American factories and the role of organized labor in specific American industries.

- In non-pandemic years, the Seminar would have likely met with a broader base of domestic companies, as well as possibly with more associations, labor organizations, and investors, although for shorter periods and geographically focused.

- Due to the pandemic, the Seminar was not able to travel internationally to conduct site visits to meet with representatives from ally or partner nations. However, as noted above, the team met online with the Swedish Armed Forces and the Swedish Civil Contingencies Agency to discuss the country's Total Defense concept, as well as with the Canadian Armed Forces to discuss Canada's response to the pandemic.

- While the team documented the amount of DPA and other funding obligated to various firms, it did not perform an analysis of any quantitative data (i.e. statistical, trend, correlation, et cetera.)

- The Seminar collected data through interviews rather than through a series of structured research questions or empirical observation. Although the team met with a wide range of interlocutors to study many different viewpoints, bias is inherent as the information shared was filtered through the interlocutors' own narratives.

INTRODUCTION

In December 2019, a few pneumonia-like cases were identified in Wuhan, China. By January 2020, the World Health Organization (WHO) took notice, cases had spread to countries neighboring China, and the United States (U.S.). Centers for Disease Control and Prevention (CDC) recommended additional screenings at airports in the United States. By January 21, 2020, the first case was identified in the U.S., in Washington state. By January 23, 2020, Chinese scientists confirmed human-to-human transmission and Wuhan was under quarantine. On January 30, 2020, the WHO declared a global health emergency.[2]

While the nation was starting to feel the effects of the health crisis, the U.S. economy, which had been strong until February 2020, began to falter and a period of 128 months of national economic expansion came to an end.[3] Mandated social distancing and the use of personal protective equipment imposed deleterious secondary effects on the economy as it influenced consumers to stay home. Aggregate demand decreased, multiple businesses closed, the unemployment level skyrocketed (especially among low-income workers), and GDP fell 31.4% on annualized basis in Q2 2020.[4]

Over the last several decades American manufacturers and distributors, as well as raw material suppliers critical to the U.S. industrial base, had moved much of their production to other countries, including China, where the cost of operating was lower. With COVID-19 raging in Asia, the U.S. quickly realized that global supply chains for critical materials were more fragile than they had previously realized. Offshore manufacturers had trouble producing and shipping products worldwide. As PPE became scarce in manufacturing countries, like China, foreign government authorities implemented export controls to keep products in-country.

The United States government was facing a crisis unlike any it had encountered before. This crisis combined the supply chain and manufacturing challenges of World War II with the health catastrophe of the Spanish Flu. A whole of nation approach would be required to address the pandemic, repair the economy, and ensure national security. The nation was faced with questions such as determining the appropriate balance of USG interaction in an economy that is built around free enterprise and commerce and a societal culture that is used to minimal government restrictions. The USG was forced to contemplate whether it should count on commercial industry and civilian supply and health systems to produce and deliver the needed materials and services, or whether it should take a more active role.

The pandemic would require the USG to exercise new response models that could combine resources with expertise and transcend organization-specific silos of knowledge and excellence that had been created over the last several decades. The models would focus on three means: communication, collaboration and transparency. The models would capitalize on the skillsets of myriad agencies and combine data for decision making in a way that had never been done before.

After a rocky start at the beginning of the Coronavirus (COVID-19) crisis, over time the public and private sectors developed a more effective approach to fighting the pandemic, realizing that partnerships based on transparency, clear communication and collaboration across organizations were critical to dealing with the overwhelming challenges posed by COVID-19. The newly emerging crisis models can be categorized as: Public-Public (internal government); Public-Private (a hybrid combination of government and industry working together; and Private-Private (industry to industry).

This paper presents the story of the U.S. industrial response to the Coronavirus pandemic through the framework of these three models. While the U.S. response was strong, the Seminar nonetheless identified some gaps. The Seminar will provide observations and recommend questions the USG should consider as it reflects on the COVID-19 crisis and how it can prepare for future crises.

THE STRATEGIC NATIONAL STOCKPILE AND SUPPLY CHAIN CRISIS

The Government's safety net to supply chain crisis for public health emergencies is the Strategic National Stockpile. In 1999, Congress tasked the Department of Health and Human Services (HHS) and the Center for Disease Control and Prevention (CDC) with creating a National Pharmaceutical Stockpile (NPS) of pharmaceuticals and vaccines to respond to potential chemical, biological, and disease threats. The initial role of the NPS was to support

state and local responders with lifesaving supplies for use during public health emergencies; however, the purpose was only to assist if a locality ran out of stock. In 2003, the NPS became the Strategic National Stockpile (SNS). After the 2009 flu pandemic, the Obama Administration decided not to replenish the large N95 face mask inventory in favor of stockpiling other equipment and drugs. Likewise, the Trump Administration, particularly between 2017-2019, chose not to restock masks and other supplies that were consumed during previous disasters. In October 2018, responsibility, oversight, and operational control of the SNS transferred from CDC to HHS's Office of the Assistant Secretary for Preparedness and Response (ASPR).[5] While the SNS exists to augment local shortages, it was never designed to handle a national crisis. As the global demand for PPE increased precipitously with the advent of the COVID-19 crisis, the government's SNS was quickly depleted.

American companies struggled with how to ramp up procurement, production and distribution of PPE. Raw materials became scarce as foreign governments locked down their borders, transportation methods became restricted, and sources of supply became overtaxed. To fulfill the nation's supply chain needs, U.S. companies began looking for domestic sources. This too was challenging, as upstream suppliers of raw materials were also constrained. Across the globe, producers were vying for essential components of critical goods such as polypropylene, foam, and cotton, making it virtually impossible for U.S. companies to be transparent about schedules. This lack of transparency meant downstream distributors could not forecast and supply their customers and consumers with masks, shields, and gowns. The imperfect nature of information caused substantial inequities between market players. Government and corporate leaders realized this was not sustainable and began exploring methods to increase capabilities and expertise while maximizing limited resources.

USG COLLABORATION – PUBLIC-PUBLIC MODEL

Roles and Authorities

Prior to the pandemic, the National Response Framework (NRF) was the model used by the federal government for how the nation responds to all types of disasters and incidents. The NRF, and its related National Incident Management System (NIMS), is scalable, adaptable, and envisions a wide range of actors and organizations that may be required to play a role in response to various types of incidents.[6] The NRF was designed to improve coordination and response structures among the complex array of federal, state, tribal, and local authorities as well as non-profit, community, and private sector entities that could be involved in preparing for and responding to emergencies. Federal agencies are also guided by legislation and various policy documents that provide strategic direction and delegation of authority for emergency preparedness and response. Among these are the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), the National Biodefense Strategy, and Presidential Policy Directive 44 (PPD-44), which outlines the approach for managing domestic incidents. PPD-44 allows for the designation of a lead federal agency, when there is neither a presidential major disaster declaration nor an emergency declaration under the Stafford Act, as was the case initially with COVID-19. Finally, Executive Order (EO) 12656, created in 1988 and updated in 2003, reflects the transfer of functions to the Secretary of Homeland Security, and assigns specific emergency preparedness responsibilities to each federal government agency. Of the

many agencies with responsibilities for emergency response, three were central to the USG pandemic response – HHS, the Federal Emergency Management Agency (FEMA), which is part of the Department of Homeland Security (DHS), and the Department of Defense (DoD).

HHS is charged as the lead agency (Emergency Support Function Coordinator) to coordinate assistance mechanisms in a public health emergency, such as a pandemic, under the NRF. Moreover, it is a delegated authority under EO 12656 to "develop national plans and programs to mobilize the health industry and health resources for the provision of health, mental health, and medical services in national security emergencies."[7] As it turned out, the ability to mobilize health resources would become pivotal in the fight against COVID-19. Within DHS, FEMA was assigned as a lead or co-lead on several Emergency Support Functions in the NRF. FEMA's functions include mass care, emergency assistance, temporary housing and human services (coordinator), logistics (co-coordinator along with General Services Administration), and search and rescue. A broad array of executive orders, delegations of authority, and directives established FEMA as the lead agency for natural disaster response and a primary authority on emergency preparedness. Its organizational culture, staffing and processes are all suited to the rapid expeditionary type of emergency response they support all over the country.

Finally, the DoD maintains a range of critical capabilities to support civil authorities in the case of national emergencies and has primarily been the trusted source for surge acquisition, logistics, and contracting capabilities in support of national emergencies and mobilizations. In 2018, the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) split into two entities: the Under Secretaries of Defense for Research and Engineering (R&E) and Acquisition and Sustainment (A&S).[8] Both DoD entities played critical support roles in the pandemic response.

A final critical authority the government has available to use in times of national emergency is the Defense Production Act (DPA). The Defense Production Act of 1950 authorizes the President to influence domestic industry in the interest of national defense. [9] While the Department of Commerce is the lead federal government agency on the use of DPA, authority may also be subdelegated to other governmental agencies such as the Departments of Defense, Energy, Homeland Security, and the U.S. General Services Administration to shape the domestic industrial base for the purpose of providing the products needed to support national defense.[10] As detailed later in the paper, the DPA ultimately became an essential tool in the pandemic response.

USG Response Coordination

Despite the existence of the NRF and the various emergency response policy documents and delegations of authority noted above, when the COVID-19 pandemic struck, the U.S. government did not have a logical nexus for interagency coordination of the response. There were many agencies that needed to be involved and the White House needed a way to corral the efforts of each. The Directorate for Global Health Security and Biodefense at the National Security Council would likely have been the initial focal point. However, it had been disbanded as part of a broader NSC streamlining effort around May 2018, when some of its staff moved into other offices.[11] Once HHS Secretary Alex Azar declared a Public Health Emergency on January 31, 2020 (retroactive to January 27, 2020), the federal government needed a central

point of coordination, establishing the White House Coronavirus Task Force on January 29, 2020, with Secretary Azar as chair (later replaced by Vice President Pence on February 26, 2020).[12]

While HHS was initially designated as the lead federal agency in coordinating the whole-of-government response, it was challenged in that role. The national scale of the pandemic overwhelmed HHS capabilities, which were centered on coordinating responses to localized epidemics or chemical, biological, radiological, or nuclear incidents. In terms of authorities, HHS was able to prioritize the resourcing and allocation of health resources (defined as resources that are regulated, approved, controlled by the Food and Drug Administration (FDA) in accordance with EO 13603.) However, the health resources required for the pandemic expanded beyond the FDA's approval authority and overwhelmed HHS's existing framework. HHS may also have been challenged by the constitution of its workforce – the clinical/medical-oriented culture of HHS was not suited to address the mounting number of logistics and supply chain management issues. HHS is also comprised of many sub-organizations that played a role in pandemic response, some of whom had high visibility roles (CDC, FDA) without an office to harmonize their actions in time of crisis. (See Appendix B for a high-level organizational chart of HHS.) Most importantly, HHS could leverage the Economies Act to seek assistance from other federal departments and agencies. However, there were no provisions for delivering a national level response.

Roughly two months later, on March 13, 2020, at the same time it declared a national emergency, the Trump Administration shifted the lead coordinating responsibility from HHS to FEMA.[13] Although FEMA was better enabled with authorities than HHS, it faced similar challenges in managing the national scale of the pandemic. The FEMA all-response framework is based on an operational posture that extends down to state, local, territorial, and tribal levels. This network is focused on localized responses, surging support from one region to another; it is not designed for national-scale response. Although the FEMA network had been more frequently exercised than the HHS equivalent, it faced similar challenges in contending with the surging demand in medical supplies and equipment. Fortunately, FEMA had one card to play that HHS did not – the ability to fully leverage the capabilities within DoD through the Stafford Act. FEMA played that card by seeking DoD assistance with supply chain management and product distribution.

Supply Chain Stabilization Task Force

On March 17, 2020, FEMA and DoD established the Supply Chain Stabilization Task Force (SCTF). The Task Force was a partnership of the DoD, HHS (including the CDC), DHS, and representatives from the private sector. It applied a four-pronged approach of preservation, acceleration, expansion, and allocation to rapidly increase immediate supply, expand domestic production, and facilitate rapid distribution of critical resources to locations where they were needed most. [14]The SCTF mission embodied a whole-of-government approach to coordinating response and supporting the country's safety and medical supply chain infrastructure.

To immediately supplement low levels of U.S. domestic supply, the SCTF partnered with six of the largest American medical distributors to expeditiously import PPE and other critical

items via air rather than by the typical, slower, ocean freight method. In less than 10 days, the SCTF organized, and FEMA provided funding for, Project Air Bridge to accelerate the movement of critical PPE and medical supplies from the global market to distributors throughout the United States.[15] Project Air Bridge was terminated once U.S. domestic production and other international supply chains ramped up, with the final flight taking place at the end of June 2020.[16] Concurrently, the SCTF recommended partnerships between American manufacturers that had available raw materials, workforce, or factory production capacities with those that needed additional resources to provide their support to the national response effort.

By mid-June 2020, FEMA's primary disaster response mission required its full attention as the annual hurricane and wildfire season kicked into high gear. This drove FEMA to transition the interagency coordination lead for COVID-19 back to HHS. The DoD, as part of its support to FEMA through the SCTF, established a Joint Coordination Team that ensured a smooth FEMA to HHS transition.

Department of Defense Assistance with Acquisition

In March and April 2020, Congress enacted four fiscal relief laws that together appropriated $2.68 trillion to help mitigate the economic hardships, including the Coronavirus Preparedness and Response Supplemental Appropriations Act, the Families First Coronavirus Response Act, the Coronavirus Aid Relief and Economic Security Act, and the Paycheck Protection Program and Health Care Enhancement Act.[17] With trillions of dollars appropriated by Congress, some of the key enabling conditions were set to allow industrial expansion for PPE and other lifesaving materials.[18]

To effectively execute the funding Congress had made available to support industrial expansion, HHS and FEMA required acquisition expertise fast. Neither agency had enough personnel nor the right skillsets to program the funds quickly at a national level. Over time, the DoD aided both HHS and FEMA by providing project managers and contracting support partnered with defense health experts. This represented a unique capability within the federal government, as no other federal agency maintained a contingency-focused acquisition skillset and had as much recent experience with solving complex immediate acquisition problems as the DoD.

Over the last several decades of conflict the DoD has benefited from learning innovative acquisition methods to support rapid procurements. Most recently the DoD has focused on finding and codifying new procurement processes for weapon systems, software, and tapping into the American innovation community. The Under Secretary of Defense for Acquisition and Sustainment established the Joint Acquisition Task Force (JATF) to support HHS and FEMA. The JATF assisted HHS and FEMA with forecasting gaps and pairing opportunities for domestic industrial base expansion with rapid contracting mechanisms. As an example, the JATF assisted HHS in increasing the domestic production of ventilators by a factor of 10 through the management of $3 billion worth of contracts to meet both the domestic and international demand. In addition, the JATF used established federal acquisition processes and tools.[19] These acquisition processes laid the foundations for partnerships with industry and the framework for the Public-Private Partnership model.

Throughout the response, flexibility and adaptability were key to interagency collaboration. The willingness of agencies to step up to leadership roles (FEMA, DOD/DASD/A&S) when needed and then to recede to supporting roles when needed (FEMA, JATF) was an important factor that enabled effective collaboration.

USG PARTNERSHIP WITH INDUSTRY – PUBLIC-PRIVATE MODEL

Defense Production Act

The DPA is historically based on the War Powers Acts of World War II but passed in the beginning of the Korean War. Congress has gradually stretched the term national defense, as currently defined in the DPA. The scope of DPA authorities extends well beyond military preparedness and capabilities, as the authorities may also be used to enhance and support domestic preparedness, response, and recovery from natural hazards, terrorist attacks, and other national emergencies. [20]Appendix C provides more details about the DPA.

The three main DPA authorities implemented as a result of the pandemic include Title I, Title III, and Title VII. Title I provides the President the authority to direct businesses and corporations to prioritize and accept contracts for materials and services in support of national defense. Title III authorizes the President to expand domestic production through compensation to private businesses, by issuing loan guarantees and direct loans in exchange for the creation, maintenance, expansion, protection or restoration capacity, development of technological processes, or the production of essential materials; direct purchases and purchase commitments; and procurement and installation of equipment in private industrial facilities in support of national defense. Finally, Title VII authorizes the President to establish voluntary agreements with private industry, allowing companies to share information and collaborate with each other without concern running afoul of antitrust laws; the authority to block proposed or pending foreign corporate mergers, acquisitions, or takeovers that threaten national security; and the authority to employ persons of outstanding experience and ability and to establish a volunteer pool of industry executives who could be called to government service in the interest of national defense.[21]

Several executive orders and DPA actions were issued in response to COVID-19. In March 2020, Executive Orders 13909 and 13911 were issued in response to the shortage of medical supplies and equipment due to the pandemic. Executive Order 13909 delegated the Secretary of HHS, under Title I, prioritization authority and the ability to introduce hoarding restrictions for PPE and critical medical equipment. Management and coordination of all DPA programs were delegated to a White House trade advisor. Finally, Executive Order 13911 delegated Title III authority to the Secretaries of HHS and DHS to respond to the COVID-19 crisis and granted the DHS Secretary Title I and anti-hoarding authority, which previously belonged to HHS in prior executive orders. Refer to Appendix D for a complete list of pandemic-related executive orders.

On March 25, 2020, the Secretary of HHS identified 15 medical products to be categorized as "scarce materials or materials the supply of which would be threatened by" improper accumulation. The identification allowed the federal government, under the DPA, to

direct companies give priority in the production and distribution of these products to the government or to recipients designated by the government. A list of the products, included in the President's memo, "The Memorandum on Allocating Certain Scarce or Threatened Health and under the Medical Resources to Domestic Use" include: N-95 masks, other specified masks and airway protective devices, air-purifying respirators, powered air-purifying respirators, portable ventilators, drug products with the active ingredients, chloroquine phosphate or hydroxychloroquine HCl, sterilization services for medical devices and specified sterilizers, medical disinfecting devices and products, medical gowns, ventilators, and ventilator accessories. The supplies that specifically fall under the category of PPE are coveralls, face masks, surgical masks, face shields, and gloves or surgical gloves.[22]

Industry Impacts of DPA

The acceptance of a rated contract under Title I of the Defense Production Act has a significant impact on the way private companies conduct business. Private businesses are required to accept rated contracts unless they are unable to fill the request due to a conflict with another rated contract of equal or higher prioritization. This prioritization created several issues for private businesses, such as the breach of commercial and unrated contracts with existing customers, the potential loss of profits, and the allocation and consumption of resources such as supplies and equipment for rated over non-rated contracts.[23]

Distributors struggled to balance supplying their valued customers and government agencies. Initially, companies diverted PPE to acute care facilities and hospitals instead of their intended customer locations. Communication among suppliers, distributors, and customers was not always transparent. Communication was much easier for larger companies because they typically had government contracting experience and in-house legal departments, while smaller companies did not. Some smaller companies had to hire legal counsel to assist with understanding government contracting and legal issues. Overall, manufacturers and distributors were frustrated with the inability to see the entire supply chain. Distributors struggled to access information to forecast PPE supply numbers, which precluded distributors from clearly communicating to their customers when they could complete their next PPE shipment. Not only were supplies and finished products hard to come by, but logistically moving finished products became a challenge. When suppliers sent PPE to the government, they had no visibility into where it went from there. Some companies complained that they could not see the utilization rates of their products. They argued that end-user behavior could have affected their distribution strategies and helped them to modify product type and quantity.

Title III had an impact on human capital and competitiveness. Companies had to hire new staff and train all employees who would be using new equipment and producing new supplies. Many company executives are optimistic that post-pandemic demand will not drop, but at this point the future is unknown. Unless demand stays at its current levels, several companies will eventually have excess plant, machine, or human capacity. Some companies have already mothballed the operations they put in place for COVID-19. The lack of communication from the USG (in particular, DPA Title III office) to companies about the initial scale and scope of capacity expansion may have inadvertently distorted markets in the short term and industries in the medium-long term. The new capacity expansion could overburden smaller domestic companies, who then go out of business in 3-5 years, which may affect future mobilizations.

Title VII, a potentially useful tool for fostering information sharing and cooperation amongst industry, was not readily utilized. While FEMA created a Title VII effort and shared opportunities on the Federal Register, very few companies the Seminar interviewed had even heard of DPA Title VII. Unfortunately, the initial FEMA effort took so long to establish through the federal rule-making process that it was not active until December 2020, long after the most critical information needs about demand and supply of PPE had been met through other means. However, in the absence of a formal DPA Title VII arrangement, the Department of Justice issued a letter to medical supply distributors participating in Project Airbridge allowing them to collaborate with each other without fear of legal jeopardy under Anti-Trust laws.[24]

Prior to COVID-19, Title VII had only been used once. The Biden administration has already created initiatives to increase the use of Title VII in threats to national defense, such as the pandemic. In August 2020, FEMA issued a new voluntary agreement, under Title VII, with private industry to increase "information sharing and coordination" in response to public health emergencies.[25] The Biden administration also created EO 13994 for the purpose of soliciting industry data to assess supply chain issues. Title VII could be used in coordinating vaccine production to assist with production bottlenecks and future vulnerabilities, such as PPE and medical equipment shortages.[26]

Creating a Common Operating Picture for Supply Chain Support

A major benefit to the use of the DPA is the forced communication between industry and the federal government. Nonetheless, in such a chaotic scenario, communication and the exchange of information between the government and industry was not always thorough or timely. The government and industry communication inefficiency resulted in health care service providers and distributors not having the information they needed to make decisions. The USG was speaking with private firms, and firms were speaking among themselves, but with so many parallel conversations information could not be centralized for optimal decision making. The USG realized that the public-private partnership would need a holistic data dashboard, a Common Operating Picture (COP), to make informed decisions, track supply, and obtain and direct the right products to the right organizations. The government's response to the need for a COP was to create the Supply Chain Control Tower. Through the Tower, manufacturers, distributors, health care providers and the government shared information and had end-to-end supply chain visibility for informed, collective, decision making. Building a technology application that would connect so many different users in a short period of time was challenging. The USG also had to convince organizations to trust the government with their data, the lifeblood of their existence. In the face of crisis, Corporate America and the U.S. Government learned to work together and trust each other.

PRIVATE SECTOR PARTNERSHIPS – PRIVATE-PRIVATE MODEL

In the early days of the pandemic, while the USG was studying supply chains and reaching out to producers of critical goods, it was not yet thinking laterally about how to engage other industrial base entities in the effort. American companies were motivated to respond to the national crisis, some due to the supply chain and operational challenges they faced, some out of a

sense of social responsibility. One private sector firm, Corporate America stepped up to fill a gap because the federal government was not taking enough action. Thus, the third model, Private-Private partnerships, was formed.

Many manufacturers of non-PPE goods such as vehicles found themselves with slowed or halted production due to the economic slowdown and the need to protect factory workers from the pandemic. Several large companies proactively reached out, not only among themselves, but also to small producers of critical items that may need assistance in scaling their operations, rather than wait for the USG to contact them with requests for assistance. Examples of private-private partnerships included:

- Ford and 3M partnered to produce Power Air-Purifying Respirators (PAPRs). PAPRs are a waist-mounted, battery-powered blower which sends filtered air into a hood and provides respiratory protection for healthcare workers.[27]
- Ford teamed with General Electric (GE) to improve production of GE's existing large, highly electronic ventilator, the R860.[28]
- 3M and Cummins worked together on high-efficiency particulate filters.[29]
- 3M and Nissha Medical Technologies jointly developed anti-fogging films for face shields.[30]
- GM collaborated with VENTEC, a maker of ventilators on "Project V" to produce and deliver 30,000 ventilators.[31] While VENTEC provided the technical drawings, GM found ways to improve the designs for scale manufacturing as well as access to new suppliers.
- Tesla attempted to design a new ventilator by itself, using automotive parts but concluded that the FDA certification and approval process would take months and contribute little to crisis response. For this reason, it created a partnership with Medtronics to provide supply chain and component assistance.[32]

The automotive industry brought unique advantages to these partnerships through its broad supply chains, sophisticated engineering competencies and high-volume, high-speed manufacturing capabilities. Companies rose to the challenge and although the pandemic atmosphere was frightening, participants enjoyed solving new problems together in the unexpected alliances. Despite the successes, though, communication such as Presidential tweets regarding 3M's lack of progress and General Motors' lack of ventilator support were harmful to morale.

A major concern for companies participating in these collaborations was the need to protect intellectual property (IP). The companies fell into two groups. The first group contained companies that manufactured goods as well as production tools. These companies protected the originality and authenticity of their product and production tools through the ownership of all components. Companies in this group had economic concerns about collaboration, as their long-term survival depends on the original production processes and machines that make their products unique throughout the world. The second group consisted of companies that transferred their technology to companies that are not original equipment manufacturers in order to achieve higher production volumes. These companies transferred technology due to scaling and

resourcing needs, which exposed them to the possible risk of unauthorized IP transfer as well as resourcing misalignments.

Looking forward, companies report that the USG has not consulted with Corporate America to forecast future demand for PPE, nor has it requested assistance in restocking the SNS.

CASE STUDY – OPERATION WARP SPEED AND VACCINE DISTRIBUTION

Operation Warp Speed is an excellent example of a successful public-private partnership for mobilization and could serve as a model going forward. The subsequent efforts to move vaccines "the last mile" from the manufacturers to those who would administer them to patients provide insight not only into public-private partnerships but also into private-private partnerships.

In 2012, prior to COVID-19, the Defense Advanced Research Projects Agency, through a project known as ADEPT (Autonomous Diagnostics to Enable Prevention and Therapeutics), initiated several partnerships with vaccine researchers.[33] The research focused on the use of messenger ribonucleic acid (mRNA) as a means for delivery of antibody making instructions to the human body. By 2019, the research had progressed to human testing against the mosquito-borne Chikungunya virus.

As COVID-19 took hold of the world, to protect the health security of the nation, the USG needed to expedite Coronavirus vaccine production. At the same time, members of the ADEPT project saw the opportunity to use their prior research to build the first mRNA vaccine for general production.[34] The government took a whole of nation approach, as it did with PPE, and coordinated government entities, commercial industry, and academia to form "Operation Warp Speed" (OWS). HHS personnel from the FDA, the CDC, the National Institutes of Health, and the Biomedical Advanced Research and Development Authority provided technical expertise. DoD provided contracting and logistical support. The initial mission of OWS was to take what is normally a 73-month vaccine development process and reduce it to 14 months.[35]

In this partnership model, the USG could offset many industry risks that would otherwise slow development and production of such a highly regulated product. The accelerated vaccine process did not eliminate any of the traditional development milestones but instead focused on performing steps in parallel. For example, vaccine testing is generally performed as a three-phase process. The partnership model authorized the combination of Phase II and Phase III testing into a single event. This alone reduced testing times by 38 months.[36] Additionally, producers of vaccines cannot normally sell vaccines prior to completion of all testing, obligating industry to carry the cost of research and testing without clear forecasts on future sales. However, as a part of the OWS model, the USG procured large quantities of vaccines after the completion of Phase I testing. This up-front funding allowed firms to invest more resources towards development and production of the vaccine. At the completion of testing, the approval process can take over a year, but the FDA focused on expediting the inspection and approval processes, determining that it could grant Emergency Use Authorization (EUA) after successful Phase III testing.

The next step was to move the approved vaccines to point-of-care sites across the nation. The term "the last mile" refers to the steps between when a medical product is made, through transport, storage, handling, and administration to individual people, as well as all associated record keeping. Moving products the last mile requires collaboration among manufacturers, distributors, shippers, and frontline healthcare workers.[37] To move the COVID-19 vaccines that received EUA, distributors would need specialized cold-chain equipment and established networks.

The CDC had a pre-existing contract with McKesson to distribute flu vaccine nationwide that included an option for distribution of vaccines in the event of a pandemic. Based on this option, the CDC was able to name McKesson as a centralized distributor of COVID-19 vaccines.[38] Since December 2020, McKesson has been working with industry partners FedEx and UPS to deliver vaccines and related vaccine administration kit supplies to locations across the country.[39] FedEx and UPS, under their own accord, divided their domestic delivery zones based where they had the strongest and most dependable delivery service.[40]

The CDC partnered with CVS, Walgreens, and Managed Health Care Associates, Inc. (MHA) to offer on-site COVID-19 vaccination services for residents of nursing homes and assisted living facilities across 54 U.S. jurisdictions.[41] In addition, the federal government collaborated with states, territories, and 21 national pharmacy partners and independent pharmacy networks in the Federal Retail Pharmacy Program to increase vaccination access for other consumers.[42] In addition, major corporations worked with distributors and state governments to create vaccination sites for their personnel. This partnership allowed corporations to leverage the trust they built over the years with their employees. For example, Ford Motor Company and the United Auto Workers union worked with Rite Aid pharmacy, Liberty Memorial Health System, and Lima Memorial Health System to administer on-site vaccinations to its employees.[43]

The foundations to successful partnerships begin prior to crisis. They start with common interests and goals. The story of Operation Warp Speed and the subsequent distribution of vaccines are strong examples of the power of proactive research, relationship building, collaboration under trying circumstances, and design thinking. Appendix E provides a visual timeline of the OWS vaccine development process.

CONCLUSION

The Coronavirus crisis is a good example of a crisis requiring a whole-of-nation approach. The major lessons learned for the future are that collaboration, communication, and transparency are the primary success means for addressing emergencies and that partnerships are the ways by which the nation can leverage diverse capabilities, resources and expertise. It is through the three-partnership model that the United States was able to transition from individual safety, to supply chain integrity, to research, to production and distribution as part of a whole of nation approach. The partnership model will work for a future national-level crisis because it is diverse and allows for new approaches and resources that neither the federal government nor the private sector alone possess. One question the USG and Industry should be asking themselves now is what partnerships they can build today so they are prepared for the unknowns of

tomorrow. While DPA Title VII is a tool the government could use to strengthen communication, transparency, and collaboration to forecast and prepare for future crises, the lack of use of this instrument during COVID-19 is cause for further reflection. If the public and private sectors find Title VII too cumbersome to use, the USG should develop another option to bring government and the industrial base together to predict and respond to future crises. Finally, true partnerships are part of a culture built on relationships and trust. The public and private sectors must exercise communication, transparency, and collaboration on a day-to-day basis to build trust and strengthen relationships before the next crisis comes.

This paper is not meant to be the final discussion or recommendation on crisis management. The nation is still fighting COVID-19 and partnerships are being formed to tackle new challenges. The whole of nation approach to COVID-19 and its challenges will be studied for decades to come. It is the authors' belief that our research supports the need for a three-model partnership approach to future national crises and that corporate and government leaders should create strategies that take these models into account. Below are the Seminar's final observations and recommendations for future study.

OBSERVATIONS

The Pandemic Industrial Response study team made four holistic observations and corresponding recommendations for future study in areas that can inform whole-of-nation collaboration to address future national emergencies.

Observation 1: The White House was unprepared to manage a national health emergency. The National Security Council (NSC) was not adequately organized to provide the White House with early warning and recommendations on appropriately responding to the emerging pandemic.

Recommendations for Future Study:

- The White House should analyze how it can assign the 'right' government agency to lead a crisis response. The White House should utilize the existing Principal's Committee policy recommendation forum to determine what government agency is best equipped to lead a whole-of-government response. The designated agency should: (1) have proper resources; (2) have clear outlined authorities; and (3) regularly consult with contributing agencies.
- The White House should ensure that the NSC leads the effort to develop a whole-of-USG Playbook for future pandemic response. The Playbook/plan should:
    - Outline the federal government's roles versus those of states, territories, and municipalities; establish categories - issues/areas of guidance - where each should lead; and where they should partner.
    - Consider military operational tempo and how that may preclude full commitment from the DoD acquisition apparatus or logistics support.

Observation 2: The United States' heavy reliance on offshore-produced medical material and supplies reduced its momentum to meet the increased demand for PPE. Dispersed supply chains abroad, distant sources of raw materials, and offshore manufacturing plants exposed domestic production capability gaps. The USG's lack of sufficient industry knowledge and market intelligence affected its ability to collaborate with Industry. Industry can utilize its existing facilities, established relationships with manufacturers, ordering systems, and efficient shipping networks to deliver critical products.

Recommendations for Future Study:

- Congress should consider writing legislation to bolster the national supply of products considered critical to national security and health by utilizing policies to incentivize producers to onshore domestic manufacturing capabilities.
- The USG should consider utilizing industry's existing pharmaceutical distribution infrastructure to expedite and streamline efforts by leveraging distributors' logistics expertise during public health emergencies.
- The White House should examine the delegation of SNS administration responsibilities to determine which government agency should manage the storage, replenishment, and rotation schedules. Concurrently, the White House should also examine whether Industry could manage a more robust replenishment and product rotation system.

Observation 3: The U.S. government created synergies with Industry that should not be lost. The USG, with Industry, created tremendous national crisis management momentum. Government DPA Title III contracts drove the expansion of domestic production to mitigate the impact of crippled international supply chains as well as maintain critical defense industrial base capabilities. The USG de-risked the vaccine development process for Industry by leaning forward with the purchase of thousands of doses of vaccine in advance of the normal approval threshold.

Recommendations for Future Study:

- The Department of Commerce should lead discussions with industry leaders to consider approaches for building on the collaborative momentum that has been established during the COVID-19 response.
- The Department of Commerce should review the current DPA Title III process to ensure it is accessible to companies new to contracting with the USG.
- The DoD should analyze how the USG can de-risk corporate investments in other sectors relevant to national security.

Observation 4: The U.S. government was inconsistent in messaging. Although the USG's pandemic industrial response was as successful as it was due to collaboration, communication, and transparency, the Seminar observed several weaknesses. To varying degrees, the pandemic messaging between USG and Industry was inconsistent or ineffective. For example, the lack of clear instructions from the federal government at the pandemic onset created confusion. It slowed the national response, including everything from the initial messaging (requirement for and availability of PPE) to vaccine distribution. The lack of clarity and agreement on the federal government's role versus the roles of states, tribes and territories hampered the consistency of response. Additionally, Industry was frustrated by the USG's communication to the public. For instance, the USG communicated to the American people that it had ordered Industry to implement specific actions to increase domestic production capacity whereas Industry had already begun to work on those actions before the USG's announcements.

Recommendations for Future Study:

- The USG should study the communications successes and failures of the pandemic response. Areas that merit further probing include: 1) inconsistencies in guidance from the federal government to states, territories and tribal organizations (masking and social distancing in particular); and 2) effectiveness of behavior change communication campaigns (masking and vaccine promotion in particular).
- A particularly successful example of effective communication across organizations is Operation Warp Speed. The USG should study OWS to identify success factors and how to replicate them in the future.
- The USG could examine the Swedish Total Defense concept for examples of how the government communicates with its population for civil defense preparedness and response for potential applicability within the U.S.

In Appendix F, the Seminar provides a list of questions to assist the reader in analysis of the observations and future study areas.

APPENDICES

Notes

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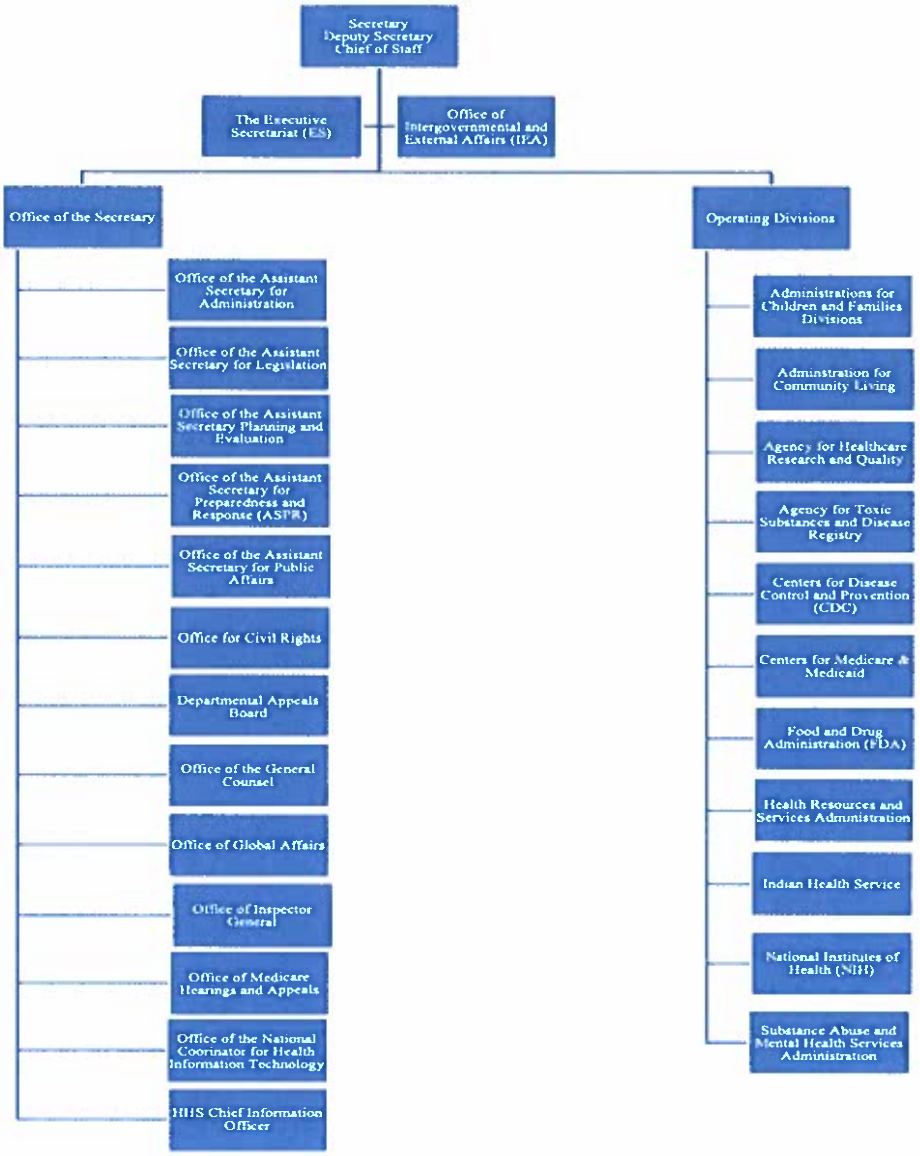
APPENDIX A
MEMBERS OF THE PANDEMIC INDUSTRIAL RESPONSE STUDY TEAM

Brigadier General Raja Imran Asghar	Pakistan Air Force
Mr. Lawrence Casselle	United States Department of State
Colonel Stacey Amos (Freeman)	United States Army
Colonel Scott Helmore	United States Army
Lt. Colonel Nikola Istuk	Armed Forces of Bosnia and Herzegovina
Colonel Kevin Kelly	United States Army
Lt Colonel Dorinda Mazza	United States Air Force
Colonel Jen McDonough	United States Army
Lt. Colonel Velimir Obradovic	Armed Forces of Montenegro
Colonel Philbert Palmore	United States Army
Ms. Morgan Parnell	United States Department of State
Ms. Melissa Patsalides	United States Agency for International Development
Ms. Kristin Rockwood	United States Department of State
Colonel John Scott	Canadian Armed Forces
Colonel Marvin Villatoro Molina	Guatemala Air Force

Brian Collins, PhD	Faculty Lead
Colonel Jeffrey Thomas, PhD	Faculty

APPENDIX B
DEPARTMENT OF HEALTH AND HUMAN SERVICES ORGANIZATIONAL CHART



Roles during pandemic

ASPR= collaborates with hospitals, healthcare coalitions, biotech firms, community members, state, local, tribal, and territorial governments, and other partners across the country to improve readiness and response capabilities. Manages SNS.

CDC= conducts critical science and provides health information

FDA= ensures safety, efficacy, and security of products. Regulates manufacturing and distribution and responsible for advancing innovations to maintain and improve health.

NIH= develop necessary tools to better diagnose, prevent and treat a disease.

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APPENDIX C
THE DEFENSE PRODUCTION ACT[1]

The Defense Production Act (DPA) of 1950 (P.L. 81-774, 50 U.S.C. §§4501 et seq.), as amended, confers upon the President a broad set of authorities to influence domestic industry in the interest of national defense. The authorities can be used across the federal government to shape the domestic industrial base so that, when called upon, it is capable of providing essential materials and goods needed for the national defense. Though initially passed in response to the Korean War, the DPA is historically based on the War Powers Acts of World War II. Gradually, Congress has expanded the term national defense, as defined in the DPA. Based on this definition, the scope of DPA authorities now extends beyond shaping U.S. military preparedness and capabilities, as the authorities may also be used to enhance and support domestic preparedness, response, and recovery from natural hazards, terrorist attacks, and other national emergencies.

Some current DPA authorities include, but are not limited to

- Title I: Priorities and Allocations, which allows the President to require persons (including businesses and corporations) to prioritize and accept contracts for materials and services as necessary to promote the national defense.

- Title III: Expansion of Productive Capacity and Supply, which allows the President to incentivize the domestic industrial base to expand the production and supply of critical materials and goods. Authorized incentives include loans, loan guarantees, direct purchases and purchase commitments, and the authority to procure and install equipment in private industrial facilities.

- Title VII: General Provisions, which includes key definitions for the DPA and several distinct authorities, including the authority to establish voluntary agreements with private industry; the authority to block proposed or pending foreign corporate mergers, acquisitions, or takeovers that threaten national security; and the authority to employ persons of outstanding experience and ability and to establish a volunteer pool of industry executives who could be called to government service in the interest of the national defense.

These are not the exclusive authorities of the DPA, but rather some of the most pertinent because of their historical or current use.

End Notes

[1] "The Defense Production Act of 1950: History, Authorities, and Considerations for Congress," Congressional Research Service (website), March 2, 2020, https://fas.org/sgp/crs/natsec/R43767.pdf.

APPENDIX D
COVID-19 EXECUTIVE ORDERS (EO)

EO 13909 Prioritizing and Allocating Health and Medical Resources to Respond to the Spread of COVID-19, 18 Mar 2020, *Federal Register* Vol 85, No 56, Monday 23 Mar 2020.

EO 13910 Preventing Hoarding of Health and Medical Resources to Respond to the Spread of COVID-19, 23 Mar 2020, *Federal Register* Nov 85, No 59, Thursday, 26 Mar 2020.

EO 13911 Delegating Additional Authority Under the Defense Production Act With Respect to Health and Medical Resources To Respond to the Spread of COVID-19, 27 Mar 2020, *Federal Register* Vol 85, No 63, Wednesday, 1 Apr 2020.

EO 13912 National Emergency Authority To Order the Selected Reserve and Certain Members of the Individual Ready Reserve of the Armed Forces to Active Duty, 27 Mar 2020, *Federal Register* Vol 85, no 63, Wednesday 1 Apr 2020.

EO 13916 National Emergency Authority To Temporarily Extend Deadlines for Certain Estimated Payments, 18 Apr 2020, *Federal Register* Vol 85, No 79, Thursday 23 Apr 2020.

EO 13917 Delegating Authority Under the Defense Production Act With Respect to Food Supply Chain Resources During the National Emergency Caused by the Outbreak of COVID-19, 28 Apr 2020, *Federal Register* Vol 85 No 85, Friday, 1 May 2020.

EO 13922 Delegating Authority Under the Defense Production Act to the Chief Executive Officer of the United States International Development Corporation To Respond to the COVID-19 Outbreak, 14 May 2020, *Federal Register* Vol 85 No 97, Tuesday, 19 May 2020.

EO 13924 Regulatory Relief To Support Economic Recovery, 19 May 2020, *Federal Register* Vol 85 No 100, Friday, 22 May 2020.

EO 13927 Accelerating the Nation's Economic Recovery From the COVID-19 Emergency by Expediting Infrastructure Investments and Other Activities, 4 Jun 2020, *Federal Register* Vol 85, No 111, Tuesday, 9 Jun 2020.

EO 13944 Combating Public Health Emergencies and Strengthening National Security by Ensuring Essential Medicines, Medical Countermeasures, and Critical Inputs Are Made in the United States, 6 Aug 2020, *Federal Register* Vol 85 No 158, Friday, 14 Aug 2020.

EO 13945 Fighting the Spread of COVID-19 by Providing Assistance to Renters and Homeowners, 8 Aug 2020. https://www.federalregister.gov/documents/2020/08/14/2020-18015/fighting-the-spread-of-covid-19-by-providing-assistance-to-renters-and-homeowners

EO 13961 Governance and Integration of Federal Mission Resilience, 7 Dec 2020. https://www.federalregister.gov/documents/2020/12/10/2020-27353/governance-and-integration-of-federal-mission-resilience

EO 13962 Ensuring Access to United States Government COVID-19 Vaccines, 8 Dec 2020. https://www.federalregister.gov/documents/2020/12/11/2020-27455/ensuring-access-to-united-states-government-covid-19-vaccines

EO 13987 Organizing and Mobilizing the United States Government to Provide a Unified and Effective Response To Combat COVID-19 and To Provide United States Leadership on Global Health and Security, 20 Jan 2021. https://www.federalregister.gov/documents/2021/01/25/2021-01759/organizing-and-mobilizing-the-united-states-government-to-provide-a-unified-and-effective-response

EO 13991 Protecting the Federal Workforce and Requiring Mask-Wearing, 20 Jan 2021. https://www.federalregister.gov/documents/2021/01/25/2021-01766/protecting-the-federal-workforce-and-requiring-mask-wearing

EO 13994 Ensuring a Data-Driven Response to COVID-19 and Future High-Consequence Public Health Threats, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01849/ensuring-a-data-driven-response-to-covid-19-and-future-high-consequence-public-health-threats

EO 13995 Ensuring an Equitable Pandemic Response and Recovery, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01852/ensuring-an-equitable-pandemic-response-and-recovery

EO 13996 Establishing the COVID-19 Pandemic Testing Board and Ensuring a Sustainable Public Health Workforce for COVID-19 and Other Biological Threats, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01854/establishing-the-covid-19-pandemic-testing-board-and-ensuring-a-sustainable-public-health-workforce

EO13997 Improving and Expanding Access to Care and Treatments for COVID-19, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01858/improving-and-expanding-access-to-care-and-treatments-for-covid-19

EO 13998 Promoting COVID-19 Safety in Domestic and International Travel, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01859/promoting-covid-19-safety-in-domestic-and-international-travel

EO 13999 Protecting Worker Health and Safety, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01863/protecting-worker-health-and-safety

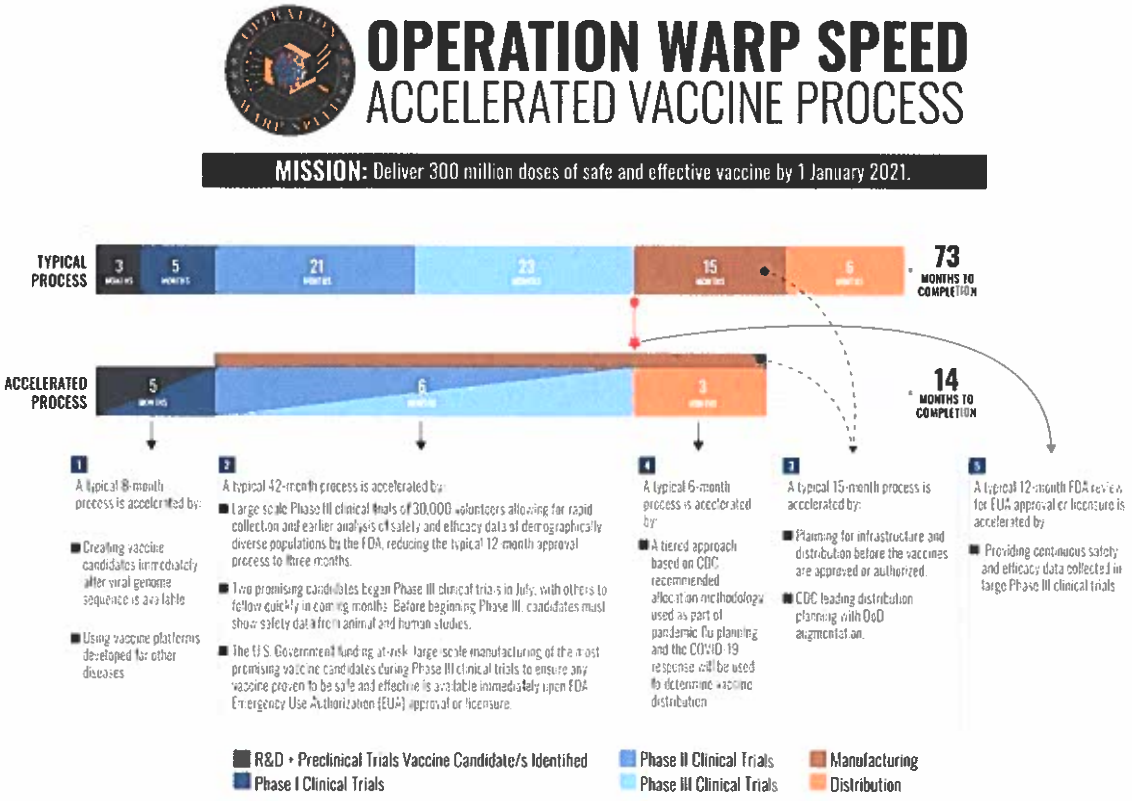
EO 14000 Supporting the Reopening and Continuing Operation of Schools and Early Childhood Education Providers, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01864/supporting-the-reopening-and-continuing-operation-of-schools-and-early-childhood-education-providers

EO 14001 A Sustainable Public Health Supply Chain, 21 Jan 2021. https://www.federalregister.gov/documents/2021/01/26/2021-01865/a-sustainable-public-health-supply-chain

EO 14002 Economic Relief Related to the COVID-19 Pandemic, 22 Jan 2021. https://www.federalregister.gov/documents/2021/01/27/2021-01923/economic-relief-related-to-the-covid-19-pandemic

EO 14005 Ensuring the Future is Made in All of America by All of America's Workers, 25 Jan 2021. https://www.federalregister.gov/documents/2021/01/28/2021-02038/ensuring-the-future-is-made-in-all-of-america-by-all-of-americas-workers

APPENDIX E
OPERATION WARP SPEED ACCELERATED VACCINE PROCESS



[1] "Coronavirus: Operation Warp Speed," U.S. Department of Defense, accessed May 22, 2021, https://www.defense.gov/Explore/Spotlight/Coronavirus/Operation-Warp-Speed/.

APPENDIX F
AREAS FOR FUTURE INQUIRY

The unprecedented collaboration between the U.S. government and the private sector was a key factor in the U.S. gaining control of the pandemic. The Seminar's analysis uncovered that there were no pre-existing playbooks on how to effectively tackle a pandemic. With no pre-determined protocol, multiple departments and agencies contacted various companies with different requests and directions. As the COVID-19 response continues, the private sector is still partnering with one another and the government. While the analysis was performed over several months and presents a holistic review of current challenges and national actions it is far from complete. The Seminar recommends the USG and oversight bodies consider additional questions to inform future crisis response:

- How can the U.S. government maintain surge capacity?
- Should there be organizations like the Coast Guard Auxiliary and Civil Air Patrol for pandemics?
- What should be the role of major manufacturers (like aerospace and automotive) in future crisis? Should this be exercised outside of crisis?
- What is the role of automation in future pandemics? Should there be a defined strategy that addresses this?
- Can the DPA be used to apply to services in addition to products? The example of the automotive industry providing manufacturing process design services and supply chain access to ventilator producers is an interesting example of the array of products and services that American industry can provide in future mobilizations.
- As the nation moves to greater integration of information technology into daily life and the economy, a lot of this capability is based on intellectual property. What role does IP play in DPA and how can it be capitalized on and scaled for mobilization?
- Should the U.S. government consider expanding its network of global health sensors?
- In what ways did the USG's pandemic response support supply chain resiliency and in which ways it might have hampered long-term recovery by supplanting them?
- Why did the U.S. government fail to solicit and consider best practices in pandemic management from foreign countries such as South Korea, China, etc....?
- What is the role of organizational culture (public and private sector) on pandemic and crisis responses?