

A new acquisition model for the next disaster: Overcoming disaster federalism issues through effective utilization of the Strategic National Stockpile

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Abstract

Using primary data collected from interviews with federal and state government officials and secondary data related to PPE distribution and state healthcare statistics, we discovered evidence that the use of the Strategic National Stockpile (SNS) to distribute personal protective equipment to state and local agencies in need during the height of COVID-19 was indeed poorly designed to cope with the COVID-19 emergency, leaving many states with shortages of badly needed medical supplies. As a result, many states struggled to organize an uncoordinated procurement response—which we suggest is due to federalism issues. To overcome federalism challenges and increase future disaster preparedness, we recommend four necessary reforms to the SNS that include (1) the incorporation of uncompensated industry experts into SNS administration, (2) the provision of an emergency production board for times of crisis, (3) elevated political leadership for the SNS, (4) improvement of federal-state supply chain governance.

Evidence for practice

- During COVID-19, the expectation of state governments to receive federal assistance to address the unanticipated shortage of essential goods exacerbated the PPE emergency.
- Federal actions via the Strategic National Stockpile (SNS) were unable to meet the sudden increase in demand, bringing disaster federalism into question.
- To improve federal support during disasters, we recommend increasing the federal government's procurement responsibilities for disaster management.
- We propose four empirically-based reforms to the SNS, including: (1) the incorporation of uncompensated industry experts into the SNS administration; (2) the establishment of an emergency production board; (3) increased political leadership and visibility for the SNS; and (4) policies for improved federal-state coordination and supply chain governance.

INTRODUCTION

Since the COVID-19 pandemic burst upon the world, personal protective equipment (PPE) shortages have been at the core of discussions on federal and national responses to global pandemic emergencies. In the U.S., the federal government's authority to steer PPE distribution was grounded in the Defense Production Act (DPA; Cecire, 2020). During the initial stages of the health emergency, the National Resource Prioritization Cell (a decision-making entity established within the

COVID-19 Supply Chain Task Force) was responsible for allocating PPE across the country, using demographic data, federal supply data, private sector supply chain data, and medical data provided by states and healthcare providers to determine PPE distribution priority areas (FEMA, 2020). The Government Accountability Office (GAO) reported that the federal government could deliver over 400 million PPE units by September 1, 2020 (GAO, 2020). Although FEMA, the Department of Health and Human Services (DHHS), and the Department of Defense (DoD) collaborated to

distribute PPE to state and local governments, the federal government's lack of access to valid, reliable, and timely data regarding domestic supply chains for goods, including PPE, has complicated its response to the COVID-19 pandemic (Finkenstadt & Handfield, 2021). Several months into the pandemic, PPE shortages remained a serious issue, with multiple categories of PPE listed weekly on the medical device shortage list, affecting the continuity of operations in nursing homes and hospitals (McGarry et al., 2020). According to the most recent data from the U.S. DHHS, nearly one-third of physicians experienced PPE shortages during the height of COVID-19, resulting in four out of 10 physicians turning away patients in need of care (Peters et al., 2022). In addition, we observed numerous documented instances in which federally procured and distributed PPE was found to be expired, damaged, or otherwise defective. ¹ In June 2021, the Biden administration issued an interagency report which noted supply chain weaknesses in several sectors, including critical medical supplies (The White House, 2021a).

This urgency to find PPE on an extraordinarily large scale, with associated continued shortages, suggests that federal actions could not meet this surge of demand and brought the federal government's supply chain preparedness strategies under scrutiny (Handfield et al., 2020). According to the data published by GetUsPPE²—the largest non-governmental source of PPE in the U.S. during the initial months of COVID-19—between March 2020 and June 2021, States in the U.S. issued over 23,000 PPE requests due to shortage, and this organization was able to deliver over 17.5 million pieces of donated PPE items to make up for the shortage at the federal level. Several members of the U.S. Congress raised concerns about the federal government's PPE procurement and distribution procedures, as well as persistent PPE supply shortages.³ Several state and local representatives have publicly criticized the management of the federal PPE supply chain (Cecire, 2020). Intuitive federalism during disaster management (Wehde & Choi, 2022) contributed to the aggravation of the PPE emergency, as the reliance on the federal government for the distribution of critical supplies prevented state governments from preparing for and responding swiftly to the unexpected shortage of critical goods (Harland et al., 2021). Everyone believed that the federal government was prepared to respond to disasters of this type (Handfield & Finkenstadt, 2022). In practice, there was not enough “inefficient slack” to ensure responsiveness (Finkenstadt & Handfield, 2021); therefore, the federal government should prioritize revising the stockpile strategies to build more effective disaster response networks to mitigate and prepare for future crises.

To contribute to this discussion, this paper aims to answer the following two questions:

Why was the federal strategy for PPE distribution ineffective? What reforms are necessary to enhance preparedness for future disasters?

Our goal is to assess the problems that the pandemic has exposed in the United States Strategic National Stockpile (SNS) and to propose actions to ensure that, when the next medical emergency occurs, the U.S. will have a responsive and agile medical supply chain that can be relied upon and will not be burdened with a similar set of paralyzed responses as occurred during the COVID-19 pandemic. Recognizing the principles of federalism and, as a constitutional matter, the state's primary responsibility for the lives and welfare of its citizens, the challenge is to improve the federal response to rapidly developing national crises (Kettl, 2020).

In developing our recommendations, we analyzed secondary data about FEMA PPE distribution and information gathered through semi-structured interviews with state procurement officers and government representatives between September 2020 and March 2021 to determine how the SNS fared as the COVID-19 pandemic reached the United States. In addition, we conducted in-depth interviews with members of the SNS, the former Assistant Secretary of Pandemic Response, who served until 2019, and several members of the FEMA White House Task Force established during the crisis. Then, we examined the federal government's current policy options for achieving an appropriate response.

THEORETICAL BACKGROUND: THE ROLE OF THE GOVERNMENT IN DISASTER RESPONSE AND THE STRATEGIC NATIONAL STOCKPILE

Disaster management and federalism

According to FEMA (2019), an emergency is any natural or man-made incident that results in extraordinary levels of mass casualties, damage, or disruption, severely impacting the population, infrastructure, environment, economy, national morale, and/or government functions. Emergencies vary based on the speed of their onset, the magnitude of their impact on affected populations, and the local infrastructure and government's capacity to respond and recover (Christensen et al., 2016). If an emergency exceeds the local government's response capacity and necessitates state and federal intervention, this is a “disaster” (Wehde & Choi, 2022). In the U.S., disaster management is usually classified into the phases of (1) mitigation, (2) preparedness, (3) response, and (4) recovery (FEMA, 2019). Large-scale disasters generate national crises, necessitating collaborations between agencies and different levels of government to effectively manage these phases (Jung et al., 2019; Simo & Bies, 2007). In such situations, disaster management is a crucial intergovernmental function for mitigating the repercussions of the disaster on society (Donahue & Joyce, 2001; McGuire & Schneck, 2010). Typically, the state and local governments are responsible for disaster management. However, when lower-level government capacities are depleted, federal

government intervention is required to provide funding sources and resources (Wehde & Choi, 2022). Over the years, disaster management research has demonstrated that federal assistance is required when disasters have a nationwide impact, especially during the response phase (Bel et al., 2021; Downey & Myers, 2020; McGuire & Schneck, 2010; Quarshie & Leuschner, 2020). Regrettably, federalism and disconnect between federal, state, and local actions have frequently been identified as the leading cause of disaster response failure (Birkland, 2006; Birkland & DeYoung, 2011; Birkland & Waterman, 2008).

COVID-19 is the most recent instance of a global disaster. COVID-19 was also a large-scale disaster, as it impacted governments with a series of disruptions that manifested rapidly and spread across the nation (Harland et al., 2021). During the initial response to COVID-19 in the United States, state and local governments were tasked with implementing a coordinated response to minimize the disruption of several critical supplies and services (Bel et al., 2021; Bryce et al., 2020; Wolf-Fordham, 2020). The situation became particularly dire for PPE as states rapidly depleted their available supply and hoped for additional federal resources. Unfortunately, coordination between the states and the federal government during the COVID-19 response was ineffective (e.g., Hodge, 2021; Huberfeld et al., 2020).

In the U.S., disaster federalism during COVID-19 has led to “federal inaction, indifference and sometimes outright hostility” (Knauer, 2020, p.29), revealing a deep divide, with different public organizations competing for the same resources against each other rather than collaborating (Harland et al., 2021; Hodge, 2021; Kettl, 2020). This disconnect is at least partially the result of the federalist structure of the American government, in which the U.S. Constitution divides powers and responsibilities between state and local governments and the federal government (Briffault, 1994). State and local governments have “police power,” which is the general authority to regulate behavior without specific enumeration (Hodge, 1998). They are constitutionally charged with “frontline” pandemic response duties, including the implementation of lockdowns of areas or industries, quarantine of affected populations, and other public health measures such as mandatory immunization programs. Consistent with this role, state and local governments can tailor their responses to the unique circumstances in their respective jurisdictions (McConnell, 1987). In contrast, the federal government typically lacks police power or other comprehensive authority when it comes to public health; in the context of a pandemic, the federal government is primarily limited to its ability to spend federal funds. In most instances, the federal government lacks direct regulatory authority, but it has greater access to resources than state and local governments (Wang & Weinstein-Tull, 2022). States and local governments are the primary implementers of pandemic response policy, while the federal government is expected to play a supporting role by using its spending power to acquire and distribute resources among states and

localities (the so-called “intuitive federalism”; Wehde & Choi, 2022).

As a result, while states anticipated federal funding and resources, the U.S. federal system hindered the nation’s ability to source medical products from global manufacturing suppliers (Kettl, 2020). Several months into the pandemic, states and healthcare providers were still competing to obtain and maintain critical medical supplies in a market environment characterized by unprecedented conditions (Finkenstadt et al., 2020).

What unfolded during COVID-19 highlighted the need for better governance of critical supplies (such as ventilators and PPE), for which government procurement activities should be managed by a centralized federal system (Finkenstadt & Handfield, 2021; Handfield et al., 2020). To assist governments in preparing for future disasters and national crises, it is essential to extract the lessons learned from COVID-19 and use them to overcome the limitations of disaster federalism, especially in terms of coordinating the supply and demand of essential items during disasters.

The characteristics of the Strategic National Stockpile

When discussing disaster federalism in the United States and the distribution of critical items, the role of the SNS becomes central.

The SNS was founded during the final years of the Clinton Administration (Bhanot, 2004). A consolidated appropriations bill enacted in 1998 budgeted \$51,000,000 to the Centers for Disease Control and Prevention (CDC) for pharmaceutical and vaccine stockpiling activities. The following year, the U.S. DHHS established a stockpile of vaccines and antidotes to respond to biological or chemical agent attacks on the U.S., then referred to as the National Pharmaceutical Stockpile (NPS; Gottron, 2020). In 2002, the U.S. Congress formalized this stockpile under its current name and established its funding at \$640 million (Esbitt, 2003). The CDC describes the SNS as a repository of potentially life-saving pharmaceuticals and medical supplies for use in a public health emergency where local supplies have been or may be depleted (CDC, 2014). The SNS “formulary” contains a broad array of medical products, including pharmaceutical interventions (such as vaccines, antimicrobials, antidotes, and antitoxins) as well as non-pharmaceutical interventions (such as ventilators and PPE) (Siripurapu, 2020).

In normal times, SNS supplies are held in two distinct groups (Banner, 2016). A small portion (approximately 2%) of the supplies are maintained in “12-hour Push Packages” that are designed to be rapidly distributed to locations across the U.S., thereby providing local authorities with a variety of emergency response equipment without the need for specific requests. The remainder of the SNS inventory is stored as “Managed Inventory.” Notably, the

CDC and the SNS are not the first responders to an emergency; rather, the SNS assists state and local authorities with their emergency responses, a coordinated effort requiring cooperation and communication among federal, state, and local authorities (Redd & Frieden, 2017).

The Strategic National Stockpile role during COVID-19

The disruptions caused by COVID-19 put a sudden and significant strain on the supplies stored in the SNS. Despite the SNS's purpose to provide for emergency health security and to respond in the event of a bio-terrorist attack or another public health emergency, the SNS had not attained public prominence before the COVID-19 pandemic, nor did it benefit from a level of funding commensurate with its mission (Finkenstadt & Handfield, 2021).

Prior to the arrival of COVID-19 in the United States in February 2020, the SNS's medical assets amounted to approximately \$8 billion. However, the stockpile had not been adequately replenished for many years. Particularly, it was discovered that the supply of personal protective equipment (PPE) had not been replenished since the 2009 H1N1 pandemic, that the expiration dates of many of the products (such as masks) had passed, and that many of the items were unusable (Kamerow, 2020). The Trump administration attempted to invoke the DPA, which allowed the President to direct private companies to prioritize orders for the federal government for national defense purposes, in order to partially address these issues. The federal government required corporations such as 3M and General Motors to produce respirators and face masks.

However, the U.S. Congress acknowledged that these actions had “sporadic and relatively narrow” effects (Congressional Research Service, 2020). The supply of critically needed medical supplies remained insufficient throughout the initial months of the crisis, and, in March 2021 (one year after the national emergency declaration), the Food and Drug Administration still identified a number of medical devices, including various forms of PPE, as being in a persistent state of shortage.⁴

The SNS's failures have drawn scrutiny from the public, government agencies, and committees. For example, a *New York Times* report details that, even during the early efforts to increase the Stockpile's supplies to respond to COVID-19, \$626 million was diverted to purchase anthrax vaccines from Emergent BioSolutions—money which, according to some involved in managing the SNS, should have been used to buy PPE and ventilators.⁵ In April 2020, a shipment of ventilators was diminished by more than 2000 due to a contracting dispute, which had prevented government contractors from adequately maintaining the ventilators in storage.⁶ By November 2020, only 142 million N95 masks had been delivered and were being held

in inventory by the SNS, despite efforts to increase the Stockpile's quantities of essential supplies.⁷ During the same period, state governments had to compete for access to goods they could not otherwise obtain through the Stockpile or by utilizing the DPA.⁸

These events have generated numerous research opportunities. In the past 2 years, a number of authors have provided valuable insights into disaster federalism in the United States during COVID-19 (e.g., Hodge, 2021; Huberfeld et al., 2020; Wehde & Choi, 2022) and highlighted issues related to federal government support through the SNS (e.g., Finkenstadt et al., 2020; Handfield et al., 2020). However, these studies have not yet provided a comprehensive understanding of how the federal government utilized SNS during the COVID-19 emergency, whether and why the federal strategy was ineffective, and what reforms are necessary to improve federal support through SNS and increase preparedness for future disasters. Using empirical evidence, the purpose of this paper is to contribute to this area.

EMPIRICAL METHODOLOGY

We used a mixed-methods approach to answer our research questions and provide empirical evidence on the previously outlined areas (Hendren et al., 2022; Mele & Belardinelli, 2019).

Analysis of the federal government's PPE distribution strategy

Although the purpose of this study is not to test a theory, to gain a better understanding of the federal government's distribution strategy, we sought to determine what factors influenced the federal government's allocation of PPE to different states. To accomplish this, we began by analyzing the literature's proposed models and evidence regarding the prediction of critical goods use and demand during health emergencies (e.g., Fechter-Leggett et al., 2022; Patel et al., 2017). Based on this evidence, we develop an analytical model with variables that the federal government should consider when allocating PPE to each state. These variables can be divided into two categories: variables that track the pandemic's impact (such as the number of COVID-19 cases and deaths per capita) and pertinent state health statistics (such as the percentage of influenza and pneumonia deaths recorded in 2019, the number of nursing homes facilities per capita and the percentage of at-risk adults in 2019). We included two additional control variables—the variation in unemployment each state experienced during the first months of COVID-19 and the political orientation of the state's governor—which represent additional relevant factors to consider based on existing disaster federalism literature (Downey & Myers, 2020). The model can be expressed as follows.

TABLE 1 PPE distribution and state health statistics (last update: June 12th, 2020).

Statistic	Mean	Standard deviation	Min	Max
PPE distributed	3,506,672	4,069,436	631,282 (Montana)	19,760,393 (New Jersey)
COVID-19 cases	39,116	61,379	561 (Montana)	380,156 (New York)
COVID-19 deaths	2111	4065	11 (Alaska)	24,348 (New York)
Influenza and pneumonia deaths (as a share of total population)	12.49%	2.99%	5.8% (Vermont)	22.6% (Mississippi)
Number of nursing homes facilities	295	277	14 (District of Columbia)	1214 (Texas)
At-risk adults (as a share of all adults ages 18 or older)	38.14%	3.69%	30% (Utah)	49.3% (West Virginia)
Variation of unemployment rate (February–June 2020)	189.84%	101%	4.7% (Kentucky)	532.14% (Massachusetts)

TABLE 2 Correlation table ($p > .1^{NS}$; $p < .05^{***}$; $p < .01^{**}$; $p < .001^{***}$).

	1	2	3	4	5	6	7	8
1- PPE distributed per capita	1							
2- COVID-19 cases per capita	0.478***	1						
3- COVID-19 deaths per capita	0.528***	0.925***	1					
4- Influenza and pneumonia deaths	-0.069 ^{NS}	0.059 ^{NS}	-0.023 ^{NS}	1				
5- Number of nursing homes facilities per capita	0.230*	0.076 ^{NS}	0.101 ^{NS}	0.024 ^{NS}	1			
6- At-risk adults	-0.214 ^{NS}	-0.259*	-0.186 ^{NS}	0.413***	-0.060 ^{NS}	1		
7- Variation of unemployment rate	0.031 ^{NS}	0.352**	0.425***	-0.1774 ^{NS}	0.1718 ^{NS}	-0.1988 ^{NS}	1	
8- Governor party	0.225*	0.271*	0.3319**	-0.0517 ^{NS}	0.0189 ^{NS}	-0.0282 ^{NS}	0.1474 ^{NS}	1

To test this model, we combined secondary data retrieved from two sources:

Table 1 reports the main descriptive statistics for these variables, while Table 2 includes the correlation matrix.

$$\begin{aligned} \Sigma \text{PPE per capita} = & (\beta_1 \cdot \Sigma \text{COVID19 cases per capita}) + (\beta_2 \cdot \Sigma \text{COVID19 death per capita}) \\ & + (\beta_3 \cdot \text{Influenza and pneumonia deaths}_{2019}) + (\beta_4 \cdot \text{Number of nursing homes facilities per capita}_{2019}) \\ & + (\beta_5 \cdot \text{Percentage of at-risk adults}_{2019}) + (\beta_6 \cdot \text{Variation of unemployment}) + (\beta_7 \cdot \text{Governor party}) + B \end{aligned}$$

1. FEMA⁹ regarding the distribution volume of PPE state-by-state (last released on June 12th, 2020; last updated on March 18th, 2021); and,
2. Kaiser Family Foundation (KFF)¹⁰ regarding cases, deaths, and unemployment rate during the first year of COVID-19, and percentage of adults at risk, influenza and pneumonia deaths, and the total number of nursing facilities (recorded in 2019).

Using this information, we created a profile for each state in terms of PPE received, the impact of COVID-19 on the population, and other general health and demographic statistics from prior years.

Analysis of the reasons for the federal government's PPE distribution strategy failure

We realized that qualitative data collection through one-on-one interviews with subject matter experts could have produced rich empirical evidence to answer our questions regarding the interaction between federal and state responses and the reasons for the federal government's lack of support. (Ospina et al., 2018). Specifically, we understood the significance of collecting information from both (1) state acquisition agencies and (2) federal government representatives. As a result of the SNS's

failure to deliver, the majority of the responsibility for meeting hospitals' dire PPE needs fell to local state officials, the vast majority of whom had never faced a disaster of such epic proportions. State procurement agencies were solely responsible for navigating the networks of national and local government demand requirements, battling a bewildering array of upstream PPE suppliers to serve their constituents. Under these conditions, our initial interviews focused on state procurement officers to document how the COVID-19 response unfolded.

To tackle this scale and complexity, we were introduced to a network of state acquisition officials through the National Association of State Procurement Officers (NASPO). Between October 2020 and February 2021, members of the NASPO network were invited to participate in a research project to understand the array of state procurement strategies deployed during COVID-19. While the scope of the interview was broader, a significant number of questions with state representatives focused on the interaction with the federal government, the relative resources received from the federal levels (in terms of inventory of critical goods, supply market knowledge, and monetary funding), what worked and what did not work in terms of federal support, and what types of reforms are required to improve the coordination between state and federal governments. The number of interviews and interviewees was not predetermined; interviews were conducted until a diverse range of concepts and themes began to emerge from the data and a sufficient level of theoretical saturation was reached. Due to the impossibility of conducting face-to-face interviews, meetings were conducted via various video links, and each participant was subsequently contacted via email for follow-ups.

Ultimately, we organized 66 interviews with 91 interviewees from 47 states and the District of Columbia (see Appendix A for more details about the interview sample). Each interview lasted about an hour, producing about 20 pages of transcription. We also collected archival data from news reports and transcripts of Chief Procurement Officers' (CPO) monthly calls (organized by NASPO) during the ongoing pandemic. We were unable to interview CPOs from three states—Arkansas, Kansas, and West Virginia. Although it was not possible to formally involve informants from these three states, the research's key findings were shared with their representatives via NASPO (see Handfield et al., 2021). We confirmed that the themes that emerged from the interviews and the main conclusions were consistent with the experiences of these state agencies.

In addition to these interviews, we conducted recorded, written conversations with executive leaders of the SNS. In addition, we spoke with the Assistant Secretary for Pandemic Response, who held this position until 2019. We also conducted interviews with members of the Joint Acquisition Task Force (JATF), with one author serving as a consultant to the Task Force. The DoD created the JATF to advise the US Air Force on supply chain relief

methods and sources for the DoD, FEMA, and DHHS. The team had several COVID-19-related goals. First, if other federal agencies were too stretched or unable to buy what they needed, the team would execute contracts to buy goods for national purposes. Second, prepare the Air Force Research Lab (AFRL) team for potential capacity expansion efforts that were missed in mainstream coverage, with AFRL, the executive agent for DPA Title III funding, executing. These data became critical in interpreting the quantitative results provided by our modeling effort as well as the interview data gathered from state agencies.

The research protocol was approved by the Office of Research Integrity of Florida International University, IRB protocol number IRB-20-0492.

The interview data were analyzed using conventional content analysis and inductive coding to develop themes and findings for each research question (Glaser & Strauss, 1967; Hsieh & Shannon, 2005; Strauss & Corbin, 1990). Researchers independently coded the interview transcripts and discussed disagreements to reach a consensus. Following the qualitative data analysis method of Gioia et al. (2013), the themes discussed by the interviewees were categorized under two aggregate dimensions: (1) disaster federalism through the SNS during COVID-19 and (2) reforms necessary to enhance the SNS and federal support for future disasters. The resulting coding approach and data structure are depicted in Figure 1. The detailed description of each theme in the following sections, along with illustrative quotations, will aid in elucidating our qualitative data and analysis (Miles et al., 2019).

RESULTS: ANALYSIS AND PERCEPTION OF THE STRATEGIC NATIONAL STOCKPILE DISTRIBUTION STRATEGY

Data analysis: Determinants of PPE distribution state-by-state

Step-by-step regression was used to validate the model designed to analyze the factors that influenced the federal government's PPE distribution strategy. The results (included in Table 3) reveal intriguing patterns concerning the factors that appeared to determine the amount of PPE distributed per capita to each state.

Only two variables seem to impact the allocation of PPE from the federal government: the number of COVID-19 deaths per capita ($\beta = .529$, $p < .001$, variance inflation factor = 1.018, tolerance = 0.982) and the variation of unemployment between February and July 2020 (control variable; $\beta = -.247$, $p < .05$, variance inflation factor = 1.222, tolerance = 0.818). COVID-19 cases per capita, influenza and pneumonia deaths in 2019, at-risk adults in 2019, the governor's party, and the number of nursing facilities per capita in 2019 were all excluded from the stepwise regression procedure. As such, we cannot conclude that they

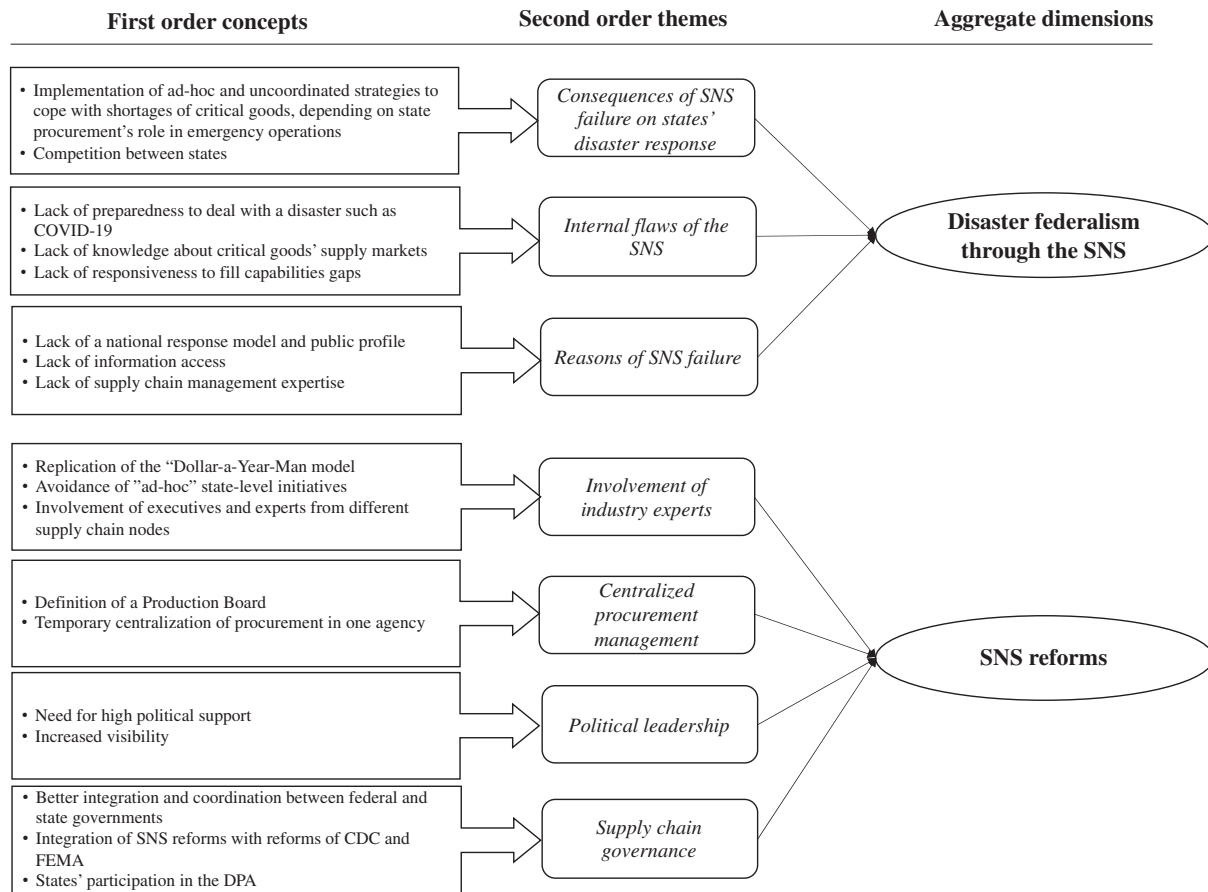


FIGURE 1 Themes emerged from the interview data and coding approach.

TABLE 3 Stepwise regression model results.

PPE distributed per capita	β	Std. error	T	p-value
Included variables				
(Constant)	0.478	0.082	5.82	0.000***
COVID-19 deaths per capita	0.529	0.121	4.37	0.000***
Variation of unemployment rate	-0.247	0.101	-2.44	0.015*
Excluded variables				
COVID-19 cases per capita	0.127	0.231	0.55	0.582 ^{NS}
Influenza and pneumonia deaths	-0.058	0.120	-0.48	0.631 ^{NS}
Number of nursing homes facilities per capita	0.161	0.121	1.33	0.183 ^{NS}
At-risk adults	-0.115	0.123	-0.93	0.352 ^{NS}
Governor party	0.045	0.102	0.44	0.660 ^{NS}

Note: $N = 51$; $F = 19.09$ ($p = .000$ ***); $R = .567$; $R^2 = .321$.

influenced (positively or negatively) the distribution of PPE to each state.

To further examine the state-by-state PPE allocation, we performed a Pareto analysis and categorized each state according to (1) PPE distributed, (2) COVID-19 cases, (3) COVID-19 deaths, and (4) the number of nursing home facilities (see Appendix B for a detailed view of the results).

This additional analysis confirms the disconnection between the PPE distribution strategy utilizing SNS and state requirements. In some states, such as Kansas (A for the number of PPE distributed and nursing home facilities, but C for the number of COVID-19 cases and deaths), Minnesota (A for the number of PPE distributed and number of nursing home facilities, but B for the number of COVID-19 cases and deaths), District of Columbia (B for

the number of PPE distributed but C for number of COVID-19 cases, deaths, and nursing home facilities), Kentucky (B for the number of PPE distributed and nursing home facilities, but C for number of COVID-19 cases and deaths), Oklahoma (B for the number of PPE distributed and nursing home facilities, but C for number of COVID-19 cases and deaths) and Oregon (B for the number of PPE distributed but C for number of COVID-19 cases, deaths and nursing home facilities), the federal distribution of PPE seemed to be greater than the actual needs. On the contrary, in states such as Indiana (B for the number of PPE distributed but A for the number of COVID-19 cases, deaths, and nursing home facilities), Arizona (C for the number of PPE distributed and nursing home facilities, but B for the number of COVID-19 cases and deaths), Nebraska (C for the number of PPE distributed and COVID-19 deaths but B for the number of COVID-19 cases and nursing home facilities) and South Carolina (C for the number of PPE distributed but B for the number of COVID-19 cases, deaths, and nursing home facilities), there appears to be a mismatch between federal assistance and actual state needs.

We recognize that there are additional variables that could be considered (for example, the headquarters of the major provider of N95 masks and other PPE, 3 M, are based in Minneapolis, and the State of Minnesota is one of the states that received more supply than needed). The main takeaway from this analysis is that the federal government's allocation of PPE was not in line with state needs and was inconsistent across states, and it could not be fully explained and understood through the variables included in the model based on available data. This raises an important question: how does the federal government allocate critical supplies in emergency situations like COVID-19, where demand vastly outnumbers supply? For example, an interview with a large mask manufacturer revealed that the manufacturer's monthly demand for N95 masks was more than 1B per month, despite the fact that their typical volume of orders was never more than 2 M per month. This disparity in supply and demand necessitates a radical rethinking of federal allocation and distribution policies.

Consequences of the SNS failure to support States' needs for medical supplies

Through the interviews held with state officials, it was clear that they perceived that the federal government did not seem to have a systematic allocation strategy for the distribution of PPE and that the patterns of doing so appeared to be erratic or "ad hoc."

During the initial response to the emergency, an attempt was made to source supplies on an expedited basis to address rapidly increasing hospitalization rates and the corresponding shortages of desperately needed supplies, such as ventilators. Furthermore, many planning

and interventionist strategies were implemented to compensate for the difference in critical materials by foraging supplies, such as universities' 3-D printing of face shields. However, these precautions were insufficient to prevent fast supply exhaustion, and by late March 2020, most materials in the SNS had run out.

Meanwhile, any scarce resources available were being competed for by various federal agencies as well as state and local governments, resulting in inequitable distributions of stockpiled materials, supply hoarding, and severe medical supply shortages across the country, benefiting better-funded areas at the expense of their less well-prepared counterparts. Federal responses to this situation came only after the SNS had been depleted of key materials, resulting in the DPA being invoked to secure a supply of PPE in mid-to-late March. Unfortunately, the global supply of raw materials needed to manufacture these goods was already depleted by April. During this time, the White House failed to define the federal government's role, and several intergovernmental clashes (federal vs. state, state vs. state, state vs. local) further slowed a timely response to the crisis, resulting in many deaths.

During our interviews, more than half of the procurement officers who worked in the Emergency Operations Centers of states that experienced a high COVID-19 surge mentioned a lack of appropriate PPE support from the federal government several times.

If you think that the federal government supported us properly, you are a believer. Initially, we did get some supply, but I don't think anywhere near the amount that we were hoping to.

We did receive products from FEMA, but the vibe we had on it is that we were never too sure what was coming. Or when it was coming.

Emergency management got some product from FEMA, but I would say it wasn't at reliable intervals, and it often wasn't necessarily what we needed.

There was no big National Stockpile to dole out, so there was anything coming our way. I know other states experienced FEMA diverting their orders last minute.

FEMA cut off funding effective September 15th for all non-healthcare PPE [...] this decision put several states in a very difficult situation.

I heard many, many stories about products ordered and coming in, but they could not get it because FEMA stopped it at customs and took it.

As time went on, working with the vendors, they [the federal government] started putting limits on each state so that they could provide a little bit to each state, but that was further down the line.

At the same time, Interviewees from a variety of states (not necessarily those most affected by COVID-19) reported receiving a reasonable and timely supply of federal PPE.

They get federal distributions that the emergency management team is showing us [...] they get, from the federal government, so many of these gloves. They are shipping them, and they are tracking per county, how many are coming in of N95 and gowns and gloves to our hospital agencies- directly to the hospital.

We did receive shipments from FEMA [...] we did get lots of help and received some shipment of N95 and other types of PPE.

We worked through FEMA, which is our normal partner for an emergency, and they were able to get us the large amounts of PPE that had to go into federal sites for testing [...] They send us truckloads of PPE.

This heterogeneous distribution strategy hampered states' ability to respond quickly and provide hospitals with what they required. To address this situation, our interviews revealed a diverse range of approaches that functioned relatively independently. They can be classified into two groups.

Some state procurement offices were fortunate enough to receive support from the governor's office and were designated as the sole point of contact for critical PPE sourcing for all state agencies, or they served as key partners in the state's Emergency Operations Center. Procurement offices were given significant autonomy and financial resources to source PPE, allowing them to make independent decisions based on their delegated authority. Because of this situation, these states were able to compensate for the lack of federal support by negotiating directly with Asian suppliers, utilizing liaisons or corporate contacts in China to help vet, negotiate, and arrange shipments with PPE manufacturers. In some cases, the governor's political contact led to connections that could be used to the state's advantage.

Other states were in different positions. In several cases, a state procurement coordinated response was not implemented because of a lack of competencies, overworked managerial support, and overburdened administrative responsibilities. Procurement was not centralized, and state procurement offices had a minimal role in their

state's PPE sourcing effort. State agencies typically operated independently to carry out their own PPE procurement, which resulted in higher prices, logistical complexities, intra-state competition and rivalry, and the use of opportunistic PPE intermediaries who were unable to deliver the contracts adequately.

In conclusion, because coherent federal allocation strategies were never enabled, states were left to set up disaster response on their own, and their PPE procurement strategy could have been more effective.

The inherent design flaws of the Strategic National Stockpile

The interviews with SNS members revealed several important insights into the nature of the SNS, including a critical point: the SNS was never designed to deal with a global pandemic of this magnitude. This was clear from several comments made by one of the emergency managers.

Prior to COVID, we were promoting a level of secrecy around the program and didn't publicize what we did. We are now playing catchup to build a capability to create a different model than we did prior to the pandemic. Historically, all pandemic-related material was a function of supplemental funding for the SNS. In a typical year, we have a significant number of areas for funding. If someone in the DHS says there is a new therapeutic, it competes with money for other drugs. And as a result, there really wasn't a steady fund for flu-related medicines. Flu-related commodities like masks competed with our normal stream of funding for other things. But there were always higher priority medicines to buy with the funding we had.

It was also clear that the SNS was unaware that the majority of medicines and supplies (e.g., masks and gowns) were sourced from China and not manufactured in the United States. The head of the SNS spoke with us about the difficulties of running a center designed for much smaller disasters than COVID-19.

Just-in-Time is very efficient to manage a supply chain—but when we had a shock to the system like COVID, there was no extra capacity we could tap into. We didn't realize until it was too late that the engine of the COVID material supply chain was the Wuhan area. If you shut it down, there is no buffer, the engine has stopped, and there is no capacity available. We saw the coming in

January, but what do you do with that information? Our model for disaster response when we moved under FEMA was primarily around response management to a point event, like bioterrorism. But a national crisis, which required intelligence, demand, and supply analysis, and how to monitor what was happening, was much bigger than the SNS complex. Our senior management had no idea how to manage that.

In effect, the SNS was unable to gain visibility into what was happening in commercial markets and required a mechanism to monitor and service the various nodes across the country. Individuals we interviewed admitted they were not logistics professionals and lacked the necessary training to distribute supplies across the country and manage inventory flows. The center was not intended to handle a national pandemic. It lacked the necessary government funding to develop the intelligence, analysis, and risk awareness needed to properly prepare for and manage a national pandemic event. We then further explored what capabilities should be to enable this level of preparedness in the future in interviews with SNS managers.

Disaster federalism issues and reasons for SNS failure

We identified three primary reasons why the SNS could not effectively support states' needs and the requirements for improving their capabilities in the future by combining analyses of transcribed interviews with state procurement officials and SNS managers with secondary data collected.

Lack of a national response model and public profile

The SNS was managed and treated as a government resource with low priority, which contributed to the stockpile being severely underfunded and thus lacking the supplies needed to respond forcefully to the pandemic. Instead of remaining at the forefront of national policy over the years, the SNS lacked a strong voice in decision-making and clout in the federal bureaucracy. This occurred because the SNS was initially designed to deal with small-scale emergencies rather than large-scale national disasters. Siloed within HHS and lacking an appropriate model for dealing with disaster on a larger scale, those concerned about the potential for supply chain problems were unable to effect necessary changes prior to the onset of the pandemic in the United States, due in no small part to HHS's leadership's focus on medical concerns rather than stockpile supply chains. As stated

directly by a senior manager in the SNS, new types of capability are required to address this issue.

The SNS should be large enough to become a distinct operational division within the HHS, which can solve a variety of problems. We haven't had a strategic focus, and this has now been recognized as a leadership and organizational failure. We are not set up to process a lot of information, and many of our leaders come from a clinical, scientific environment, and they are not wired to think about how supply chains operate.

Lack of information access

SNS lacked access to the information required to know when those needs arose, in addition to having an insufficient public clout to effect change as needed. The SNS is tasked with analyzing markets to assess the global availability of PPE and ventilator components, as well as developing sourcing plans for any key needs that may arise. However, this task can only be completed if reliable and real-time information on the status of supplies and potential disruptions is available. Critically, SNS lacks the capabilities to manage its own inventory, including the lack of modern barcoding or another system to track supply receipt, use, and depletion. However, SNS require more ways to ensure that they receive accurate and up-to-date information about what supplies are needed and where they are needed. This issue was also brought up by some of the SNS managers.

When you are managing risk in supply chains, you are often dealing with a quantified "best guess," and that often means getting the best people who can utilize the best available information to make the best bets. There traditionally has been a cultural reluctance to make decisions, as clinical mindsets want to know the granularity of the situation, which is often not available in supply chains. We are investing in creating a control tower, which has critical KPIs but is not so granular that it isn't effective. It should include information on what is happening in the commercial supply chain, current lead times on materials, and working with Resilinc to have access to events going on around the globe that will impact those materials.

Lack of supply chain management expertise

In addition to not knowing when needs arise that necessitate change, SNS lacks the personnel and capacity to

determine the content of the changes needed to address supply issues. In particular, there appears to be a lack of knowledge about supply chains and strategic sourcing in the SNS administration. Such knowledge is critical because of the effects of emergencies on supply chains, such as changes in East Asian markets that prevented the United States from obtaining PPE during the COVID-19 pandemic. The lack of current supply chain capabilities was mentioned several times in our interviews with the SNS leaders.

Prior to COVID, strategic logistics was not a core part of our team, and we were more focused on contracting and procurement. My team (largely made up of army personnel) was given the daily task of surveillance and analysis of supply chains. One of the reasons why we never had conversations with commercial distributors of medical supplies was that it was a problem to get data from them directly. And we could not see the fill rates and had no way of managing distribution. Our only way to operate was pro rate distribution—which is not a terribly effective way (based on population only).

DISCUSSION: HOW SHOULD THE US FEDERAL GOVERNMENT REVISE THE STRATEGIC NATIONAL STOCKPILE MOVING FORWARD?

The COVID-19 experience exposed the flaws in the procurement system that underpins the SNS. The lessons learned from this exposure, on the other hand, present an opportunity to improve the SNS so that the government has the tools it needs to respond to the next public health emergency. What can governments learn from this experience to avoid a repeat of this situation in the event of a new, unfortunate large-scale disaster?

In light of the constitutional federalist principles by which the United States operates, the challenge in proposing reforms in response to the failures of the SNS is to improve the effectiveness of pandemic responses without contravening the federal-state division of powers. Others have identified the vesting of primary responsibility for public health in state and local governments as a cause of pandemic response failure and thereby challenged the cooperative federalist approach (Blum, 2020; Coglianese, 2022; Hodge, 2021).

Starting from the input collected from the interviews, we propose four reforms for the SNS. Any response must be mindful of the constitutional allocation of authorities between the federal and state governments to address public health crises. As the American Bar Association noted, under “the U.S. Constitution’s 10th Amendment and U.S. Supreme Court decisions over nearly 200 years, state governments have the primary authority to control the spread of dangerous diseases within their jurisdictions.”¹¹ But

the states’ first responsibility for the public health of their citizens obviously does not preclude a vital role for the federal government, especially in a national (and international) health crisis. Therefore, the recommendations below seek not to displace the states’ constitutional prerogative but to suggest how the federal government could better coordinate a national response through enhanced capacity and leadership (Knauer, 2020). In particular, the recommendations seek to allocate increased responsibility for procurement to the federal government during disaster management and afford commensurately greater leeway to state and local authorities to shape the emergency response.

Direct involvement of industry experts

During COVID-19, several states seek assistance from executives from the private sector to cope with the lack of support from the federal government and knowledge about supply markets. Supply chain experts from multinational corporations were called in to help secure PPE and support critical supply chain activities, such as supplier vetting and logistics process design. In some cases, this support was paid. Nonetheless, it was mostly voluntary, and we were told of numerous companies that made supply chain experts available to state Emergency Operations Centers. This reflects the “good Samaritan” effect discussed in the disaster management literature (e.g., Quarantelli, 1996; Rodriguez et al., 2006), in which private firms and citizens volunteer their expertise and support to governments during times of national crisis.

This solution was first used during World War II (WWII). The so-called “Dollar-a-Year Men” were experts from some of the largest companies in the United States (for example, Ford and General Motors) who had practical knowledge of production and supply chains gained through their careers (Fleischmann, 1952). They were hired to advise and assist the government in increasing the supply of, and the nation’s capacity to produce, desperately needed war materials.

Several state representatives validated the importance of this practice, as did our discussion with SNS managers, who described how military-style leadership is not as well positioned to make decisions based on demand and supply data.

We were always designed to be a bridge, to allow industries to get back on their feet after a large demand spike, and to plug the gap, and help them get back on their feet. We operate more like a trigger pull (not a valve), where you shoot at the problem but don’t know how to reload. We don’t operate like a valve that has products flowing in and products flowing out. If an event happens, we deal with it knowing that it goes out quickly, and we don’t expect it to keep going...

Military guys like us don't always act on information, and so seeing a demand signal and deciding how to reply—we were not built like that, but have to be built like that in the future.

Implementing the Dollar-a-Year Man model in the context of the SNS would avoid an unstructured use of this approach by each state, especially given that only a few states have access to and proximity to companies with reliable supply chain expertise and are prepared to support disaster response. While incorporating production and supply chain experts into the SNS decision-making process may reduce their availability to serve at the state and local levels, the end result would be to protect state and local emergency response capabilities. Integration of expert advisors into the federal emergency response effort has the potential to centralize supply chain knowledge and prevent disparities in supply information from exacerbating competition between state and local authorities.

This policy change would also help to alleviate the SNS's lack of information and expertise (Finkenstadt et al., 2020). Expert advisors could collaborate with SNS administrators to identify what goods are needed and where, the characteristics of the supply market for those goods, and any competing demands, drawing on their private-sector (and likely international) knowledge and connections. This would allow for the integration of medical, production, and supply chain management expertise in an area of government that is currently dominated by medical knowledge, with the potential benefit of the SNS being much better equipped to assess the health of its supply lines so that HHS can protect the nation's health more broadly. As a result, for this scheme to be successful, executives and experts from every link in the supply chain, including representatives from healthcare facilities, which are the primary users of supplies, must be involved. In this regard, the recent national supply chain directive emphasizes that the SNS should contribute to medical supply chain resiliency (rather than being a static inventory lever), and its prescribed responsibilities should change (The White House, 2021b).

However, as the United Kingdom's complex experience during the early stages of the pandemic demonstrated,¹² it is critical for the integrity of a public supply chain that it does not appear politicized or subject to conflicts of interest. One of the recurrent criticisms of the practice of inviting industry executives into the government's decision-making process is the potential for conflicts of interest and favoritism. While this is a valid concern if the practice were employed government-wide continually, this is less critical in emergency circumstances. Its deployment is also contemplated by the DPA as presently enacted: “[t]he President is ... authorized, to the extent he deems it necessary and appropriate ... to employ persons of outstanding experience and ability

without compensation.”¹³ This indicates that circumstances in which the government would need to invoke the DPA (such as large-scale disasters in which supply chains are strained to the point of breaking) also justify the employment of outside experts despite any potential conflict that might arise.

A centralized procurement management approach

The second type of reform, developed based on interview data, is the implementation of a centralized approach to procurement management, coordinated through the use of a central production board.

This solution was also used for the first time during WWII. To increase production efforts, the United States government established the War Production Board, which was envisioned as a new administrative agency with full power and responsibility for fully mobilizing industrial resources to ensure the most effective prosecution of war procurement and production (Civilian Production Administration, 1947). Shortly after its establishment, it would absorb the functions of other rearmament agencies, such as the Office of Production Management. The WPB was also given additional authority to direct the procurement and production operations of all federal agencies. To summarize, the WPB was given the authority to take over the procurement activities of any government agency, including the armed forces, and use them to meet the needs of the war effort.

The WPB's powers make it a difficult model to imitate today. After all, concentrating the procurement authority on one agency raises the prospect of such authority being used coercively. Indeed, such considerations justify the establishment of a WPB-style procurement board to oversee production and distribution in the event of a public health emergency that jeopardizes the security of medical supply chains (Maier & Kumekawa, 2020). During COVID-19, the DPA's powers were insufficient and, in many ways, exacerbated federal-state divisions by delegating vast and misdirected authority to the federal government while leaving the states with constitutional and practical responsibility for their citizens' health and welfare. Neither is the SNS sufficient. States and localities are left to compete among themselves in the absence of federal coordination in producing and obtaining critically needed supplies (Kettl, 2020). By shifting supply concerns to the federal government, a centralized federal production board would allow states and localities to devote their limited resources to their constitutional mandate of protecting public health and safety.

Further, while there is no guarantee that any given public health emergency will rise to the same level of crisis as a global conflict, it is worth noting that because of the number of Americans who have died because of COVID-19 (more than 1 million people as of December

2022¹⁴), it is pivotal to ensure that the unpreparedness to a threat of such magnitude will not be repeated. A senior SNS official noted the implications of this deficiency during COVID-19.

The Department of Health and Human Services does not really know how to plan. They have a science-based approach based on large-scale scenarios. But when boundaries are put on those scenarios, it becomes more of a public health view—not a supply and demand view of the world. If scientists determined that conditions were met, it determined the response. Science has a difficult time predicting stuff. What we need on the response side is a group looking at pandemics like a hurricane and predicting where they will go and how much damage they will inflict. But what science does is look forensically at the problem, studying the hurricane itself, but only after some time do they realize that the storm will cause damage. This is a difficult way to respond: you are reacting after the storm has passed!

A WPB-modeled production board for the SNS would not need to be a permanent body. Indeed, such a body should be regarded solely as an emergency measure. However, the authority to create such a body must exist in the law before it is required, or else the difficulty of responding to crises will be exacerbated. Any attempt to establish such a body in response to a future disaster would require legislative authorization, while Congress may and has acted quickly to address current crises. The experience of the COVID-19 pandemic demonstrates that even minor delays in response can lead to crippling shortages of needed supplies. Failure to provide for a federal body to respond to supply chain emergencies prior to their arrival leads not only to inadequate responses, but also to competition among states and local governments while Congress and existing federal agencies struggle to develop a strategy.

Stronger political leadership

One of the most pressing issues confronting SNS managers during COVID-19 was a lack of political visibility and support (Finkenstadt et al., 2020). Nobody of comparable public importance or stature could stand up and demand that the SNS shortages be addressed until it was too late. For example, an SNS executive described how, due to a lack of political leadership, funding for the stockpile was never adequate.

Because we were so cloistered and so entrenched in bioterrorism stuff, we were off

the grid. People didn't even understand what we were doing or even how to reach out to us. A lot of people were making decisions about pandemic planning but couldn't connect to us to plan. And as a result, we ended up dealing with rotten apples and a lot of expiring items in the stockpile. We get new items to source, and we get appropriations, but we can't satisfy all of our needs to replenish plus get the new requirements. If we have ten programs to cover, we have enough funding for six. We have to come up with a better way to decide how to fund the six—and we simply didn't realize the global vulnerability we had to pandemics.

Addressing this shortcoming will require two changes, one structural and one political.

First, the SNS must be relocated such that it is no longer buried in the administrative maze, which is the DHHS. Part of the failure to fill the gaps in the SNS was due to a disconnect between the highest levels of power and the administration of the Stockpile, which is left to the care of an Assistant Secretary (Handfield et al., 2020). Delegating this critical matter so far down the organizational chart has deprived SNS of the political power to demand measures to address critical shortages or information on the current crisis and its effects on supply availability. If the goal is to expand and secure the SNS, a high level of political access is required.

The second necessary change is for high-level political figures, not just administrative ones, to take the SNS's mission seriously. The funding, manpower, and administrative control required to implement those political reforms are all contingent on political will. As a result, it is critical that key political figures, including the President, engage with the SNS and the realities of keeping the stockpile stocked with the materials needed to respond to public health emergencies.

These recommendations to increase the SNS's political visibility would also strengthen the federalist system for disaster response. The more resources devoted to meeting and expanding SNS supply capacities ahead of emergencies, the more leeway state and local governments will have in responding to emergencies when they occur. With confidence in the availability of supplies and federal government support, federal and state authorities can focus on tailoring disaster response efforts to specific circumstances across the country.

Improvement of supply chain governance

As noted previously, the federal government haphazardly distributed PPE to the states. The federalist government structure defines and limits the roles and responsibilities of federal government and state agencies. This razor-thin

line denotes uncharted territory: how to design a governance system that combines centralized federal government coordination with more decentralized and distributed state decision-making? Our interview data confirmed that during COVID-19 (as in previous disasters; Birkland, 2006; Blum, 2020; Kettl, 2020), several tensions arose between these two levels as a result of states' expectations of receiving substantial federal support and the federal government's inability to meet such expectations.

This pressing issue must be addressed in order to improve preparedness for future disasters. While we do not claim to provide a comprehensive solution in this study, we can identify some exploratory best practices and future opportunities based on input from state and federal government representatives.

Better integration and coordination between federal and state governments during disaster response

Although the federal government can improve drug discovery, disease monitoring, and SNS management, we should consider a more regional and localized approach to domestic PPE production and distribution. State governments and health authorities have a better understanding of real-time needs, and better coordination would aid in regional production supplies and PPE distribution. According to our discussions with state procurement officers, regional "group purchasing" associations could be used to band together the demand requirements of several smaller states, resulting in a more unified and stronger market presence for PPE and other critical supplies. State and local governments must improve their use of cooperative purchasing contracts through organizations such as NASPO and GSA to design regional supply chains, establish and maintain production agreements with regional producers, and rotate PPE consumption among healthcare entities during normal times. Interviewees also suggested that other organizations (such as GovBuy) could be used for this purpose, providing state procurement organizations with a leveraged approach to purchasing.

Integration of SNS reforms with reforms of CDC and FEMA

As previously stated, the SNS was not designed to respond to a disaster on the scale of COVID-19. A comprehensive SNS reform would focus on increased market intelligence, improved inventory tracking across the network, early warning communication to key stakeholders, a dedicated stockpile of materials deployed across distributed distribution centers, and allocation strategies defined to deal with the fair and equitable distribution of limited supplies to states. These enhancements must be

designed in tandem with reforms of related entities, such as the CDC and FEMA, and should take natural and man-made disasters into account as a multi-scaled social scenario. The goal is to design scalable supply chains and governance to deal with disasters that span multiple states and regions, rely on better-prepared disaster operations as the baseline, and conduct exercises with participants from all stakeholders to simulate large-scale disasters.

States' participation in the DPA

President Biden signed an executive order in January 2021 directing the current administration to identify shortfalls in the supply of materials needed for pandemic response and how to improve the use of the DPA to address them (The White House, 2021c). In this regard, the DPA is unclear on how the federal government allocates products or materials that are in short supply and are desperately needed by various sectors of the economy. Several state and federal representatives interviewed suggested that state participation in the definition of more objective criteria would ensure better clarity (and more effective planning) on how the DPA can be used to obtain critical materials and how they will be allocated to the states.

CONCLUSION AND MAIN CONTRIBUTIONS

The shortages that occurred early in the COVID-19 pandemic highlighted the SNS's deficiencies and the federal government's inability to support state and local governments' needs during disaster response. To avoid another crisis depleting the nation's supply of critical medical equipment, our research suggests that the SNS be reformed so that it has the procurement capacity to deal with the next public health emergency. To improve preparedness, we propose four policy reform examples—direct involvement of industry executives, the formation of a centralized production board, increased political visibility, and improved federal-state supply chain governance—which represent promising steps toward preventing another supply shortage from exacerbating an existing health crisis.

These policy recommendations, derived directly from our interview data, were validated (and echoed) by Nicole Lurie, former Assistant Secretary of Pandemic Response, in both the interview and her testimony to the United States Congress.¹⁵ The proposed reforms address the majority of these issues and, if implemented, would address the SNS's critical failures due to disaster federalism issues. They would represent an expansion of the SNS's ability to ensure a supply of material to support local and state government response to public health emergencies based on empirical evidence, thus contributing to the ongoing

debate about disaster management and the role of central and federal governments during disaster response (Birkland, 2006; Birkland & DeYoung, 2011; Birkland & Waterman, 2008; Hodge, 2021; Huberfeld et al., 2020; Wehde & Choi, 2022).

From a public management perspective, the proposed reforms fit within the cooperative federalist framework by seeking to improve each level of government's performance at its constitutionally mandated task. In particular, with respect to the reforms proposed, the improvements would be to the federal government's ability to acquire resources needed to address a pandemic, as well as information related to where those resources are needed throughout the U.S. Improved resource management at the federal level, through the SNS, would, in turn, make more resources available to address the concerns of state-level officials as expressed during the interviews.

These solutions are certainly open to further debate and discussion, as much work remains to be done in this critical area. These proposals are meant to be potential improvements to the current federal response system. We acknowledge that they are not comprehensive solutions to the problem. However, they can provide guidelines for effectively navigating the thorny federalism issues described earlier in our paper during disaster management, recognizing the gray boundary that exists in these situations between the federal government and the states.

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ENDNOTES

- ¹ See Andrew Jacobs, "FEMA Sends Faulty Protective Gear to Nursing Homes Battling Virus," *New York Times*, July 24, 2020, at <https://www.nytimes.com/2020/07/24/health/coronavirus-nursing-homes-PPE.html>.
- ² <https://getusppe.org/data/>.
- ³ See Letter to Pandemic Response Accountability Committee Chair Michael Horowitz, June 8, 2020, at <https://www.warren.senate.gov/imo/media/doc/>. Also see US Senate Committee on Homeland Security and Governmental Affairs, "COVID19 Part II: Evaluating the Medical Supply Chain and Pandemic Response Gaps", May 19, 2021. <https://www.c-span.org/video/?511884-1/hearing-covid-19-us-medical-supply-chain>.
- ⁴ <https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/medical-device-shortages-during-covid-19-public-health-emergency>.
- ⁵ See Chris Hamby & Sheryl Gay Stolberg, *How One Firm Put an 'Extraordinary Burden' on the U.S.'s Troubled Stockpile*, *N.Y. Times* (Mar. 6, 2021), <https://www.nytimes.com/2021/03/06/us/emergent-biosolutions-anthrax-coronavirus.html>.

- ⁶ See David E. Sanger, et al., *A Ventilator Stockpile, With One Hitch: Thousands Do Not Work*, *N.Y. Times* (Apr. 1, 2020), <https://www.nytimes.com/2020/04/01/us/politics/coronavirus-ventilators.html>.
- ⁷ See Stephanie Armor, et al., *U.S. Supplies of COVID-19 PPE Fall Short of Targets*, *Wall Street Journal* (Dec. 9, 2020), <https://www.wsj.com/articles/u-s-supplies-of-covid-19-ppe-fall-short-of-targets-11607509800>.
- ⁸ See Monika Evstatieva, *A Revamped Strategic National Stockpile Still Cannot Match The Pandemic's Latest Surge*, NPR (Nov. 23, 2020), <https://www.npr.org/2020/11/23/937978556/a-revamped-strategic-national-stockpile-still-cant-match-the-pandemics-latest-su>.
- ⁹ See <https://www.fema.gov/news-release/20200727/fema-publica-los-ultimos-datos-de-covid-19-para-cada-estado-0>.
- ¹⁰ See <https://www.kff.org/coronavirus-covid-19/>.
- ¹¹ See <https://www.americanbar.org/news/abanews/publications/youraba/2020/youraba-april-2020/law-guides-legal-approach-to-pandemic/>.
- ¹² See <https://www.nytimes.com/interactive/2020/12/17/world/europe/britain-covid-contracts.html>.
- ¹³ See The Defense Production Act of 1950, as amended, 50 U.S.C. § 4560(b)(1) (2018) https://www.fema.gov/sites/default/files/2020-03/Defense_Production_Act_2018.pdf.
- ¹⁴ See <https://covid.cdc.gov/covid-data-tracker/#datatracker-home>.
- ¹⁵ See <https://www.hsgac.senate.gov/imo/media/doc/Testimony-Lurie-2021-04-141.pdf>.

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APPENDIX A: INTERVIEW SAMPLE

Organizations interviewed	Number of interviews	Interviewees
Alabama	1	Purchasing Director
Alaska	1	Central Procurement Officer
Arizona	1	Senior Procurement Manager, Deputy State Procurement Administrator
Arkansas	No interview	
California	1	Chief Procurement Officer
Colorado	1	Chief Procurement Officer
Connecticut	1	Director of Procurement
Delaware	1	State Contract Procurement Administrator, Deputy Director Government Support Services DOMB, State Contract Procurement Supervisor
District of Colombia	3	Deputy Chief contracting Officer for the Office of Contracting and Procurement, Chief Operating Officer for the Office of Contracting and Procurement, Central Procurement Officer, Chief Contracting Officer for Information Technology for Office of Contracting and Procurement, Leader for Surplus Property and for Business Resources, Chief Contracting Officer for Public Safety and Justice Group, Chief Contracting Officers for Health and Human Services, Assistant City Administrator
Federal Bureau of Investigation (FBI)	1	Section Chief of Financial Crimes Section, Special Assistant to the Deputy Assistant Director, Public Affairs Specialist
Florida	1	Central Procurement Officer and Director State Purchasing
General Motors	1	Director of GBS Asset Solutions
Georgia	2	Manager Contract Management and Marketing, Group Category Manager—Goods
Hawaii	2	State Procurement Officer (1), State Procurement Officer (2)
Idaho	1	State Purchasing Manager
Illinois	1	Chief Procurement Officer
Indiana	1	Deputy Commissioner Procurement Division
Iowa	1	Chief Procurement Office
Kansas	No interview	
Kentucky	1	Executive Director Kentucky Finance and Administration Cabinet, Deputy Executive Director, Division of Goods Services and Procurement, Shared Services Branch
Louisiana	2	Director of State Procurement Division, Vehicle and Fuel Contract Analyst, Manager One Time Buy Bid Team, Supervisor Commodity Contracts Team, Manager Contract Commodity Team, Supervisor Blanket Order Bid Team, Business Analytics Specialist, Assistant Deputy Director of Grants and Administration
Maine	1	Chief Procurement Officer, Director of Operations, Director of Procurement Services, Procurement Analyst II
Maryland	1	Chief Procurement Officer, Director of Procurement
Massachusetts	1	Assistant Secretary for Operational Services
Michigan	1	Chief Procurement Officer, Director of Enterprise Sourcing, Category Director for Professional Services and Commodities
Minnesota	1	Chief Procurement Officer and Director for Office of State Procurement, Acquisitions Manager
Mississippi	1	Director of Office of Purchasing, Travel and Fleet Management
Missouri	1	Director of Purchasing
Montana	1	Contract Officer, Chief Procurement Officer
National Governor's Association (NGA)	3	Chief Operating Officer
Nebraska	1	Chief Procurement Officer and Deputy Director and Materiel Administrator for Department of Administrative Services

Organizations interviewed	Number of interviews	Interviewees
Nevada	1	Department of Administration Purchasing Division Administrator
New York	1	Chief Procurement Officer
New Hampshire	1	Director of Bureau of Purchase and Property
New Jersey	1	Deputy Director Department of the Treasury, Acting Director Division of Purchase & Property
New Mexico	1	Director and Chief Procurement Officer
North Carolina	1	Director, Department of Administration, Deputy State Purchasing Officer- Procurement Education, Assistant Secretary for Procurement Contracting at DHHS, Deputy State Purchasing Officer- Strategic Sourcing
North Dakota	2	Director, Procurement Contracting, Procurement Officer II
Ohio	1	Chief Procurement Officer, Deputy Chief Procurement Officer, Contracts Manager, Procurement Manager
Oklahoma	1	State Purchasing Director
Oregon	3	Chief Procurement Officer
Pennsylvania	1	Chief Procurement Officer
Rhode Island	1	Purchasing Agent
South Carolina	1	Division Director for the Division of Procurement Services, Deputy State Procurement Officer, State Director of the Office of State Procurement, Procurement Manager and Team Lead for Agency Sourcing Teams for Higher Education and Law Enforcement & EMD, Director of Business Operations, Materials Management Officer, State Engineer, CPO for Construction projects
South Dakota	1	Director, Office of Procurement Management
Strategic National Stockpile	1	Emergency Management Specialist Information and Planning Branch
Strategic National Stockpile	1	Director of Planning Information and Planning Branch
Assistant Secretary of Pandemic Response	1	Former ASPR leader
White House Supply Chain Resilience Committee	1	Acting Deputy Director
Tennessee	1	Chief Procurement Officer
Texas	1	State Chief Procurement Officer
Utah	1	Chief Procurement Officer
NASPO/NASPO ValuePoint	2	Chief Operations Officer
Vermont	1	Purchasing Agent, Commodity Procurement Administrator, Director of Procurement Contracting
Virginia	1	Director, Division of Purchases
Washington	1	Statewide Enterprise Procurement Manager
West Virginia	No interview	
Wisconsin	2	Chief Procurement Officer, Procurement Supervisor, Enterprise IT Sourcing Section, Procurement Supervisor, Enterprise Sourcing Section
Wyoming	1	Purchasing Manager

APPENDIX B: PARETO ANALYSIS

The following table presents a Pareto analysis by state based on the distribution of PPE, COVID-19 cases, and the number of nursing homes. As a methodological note, we classified as class A those states whose values

for the dimensions under consideration exceeded the sample-wide mean. Class B consists of states where the value of the variable under consideration is greater than the subsample's mean value, excluding class A states. Class C is comprised of the remaining states.

	PPE distributed		COVID-19 cases		COVID-19 deaths		Number of nursing homes facilities	
California	A	3.58%	A	7.00%	A	4.36%	A	7.88%
Connecticut	A	2.69%	A	2.22%	A	3.80%	B	1.35%
Florida	A	2.63%	A	3.38%	A	2.65%	A	4.57%
Georgia	A	2.66%	A	2.71%	A	2.12%	B	1.86%
Illinois	A	8.02%	A	6.51%	A	5.75%	A	4.79%
Kansas	A	2.28%	C	0.54%	C	0.22%	A	2.19%
Louisiana	A	2.91%	A	2.21%	A	2.75%	B	1.84%
Maryland	A	2.87%	A	2.98%	A	2.61%	B	1.34%
Michigan	A	6.10%	A	3.27%	A	5.53%	A	2.93%
Minnesota	A	2.07%	B	1.45%	B	1.14%	A	2.41%
New Jersey	A	11.05%	A	8.29%	A	13.04%	A	2.40%
New York	A	8.83%	A	19.06%	A	22.61%	A	3.78%
Ohio	A	5.57%	A	1.98%	A	2.25%	A	6.32%
Pennsylvania	A	4.06%	A	4.08%	A	5.58%	A	4.54%
Texas	A	3.13%	A	4.05%	B	1.72%	A	8.06%
Alabama	B	1.28%	B	1.10%	B	0.68%	B	1.51%
Colorado	B	1.07%	B	1.43%	B	1.44%	B	1.48%
District of Columbia	B	1.14%	C	0.48%	C	0.46%	C	0.09%
Indiana	B	1.67%	B	1.92%	A	2.17%	A	3.53%
Kentucky	B	1.02%	C	0.60%	C	0.44%	B	1.81%
Massachusetts	B	1.88%	A	5.22%	A	6.88%	A	2.36%
Mississippi	B	1.42%	B	0.93%	B	0.78%	B	1.35%
Missouri	B	1.05%	B	0.79%	B	0.78%	A	3.45%
North Carolina	B	1.73%	B	1.93%	B	0.96%	A	2.82%
Oklahoma	B	0.97%	C	0.38%	C	0.33%	B	1.93%
Oregon	B	0.95%	C	0.25%	C	0.15%	C	0.77%
Tennessee	B	1.54%	B	1.40%	C	0.40%	A	2.10%
Virginia	B	1.68%	A	2.62%	B	1.39%	B	1.63%
Washington	B	1.93%	B	1.22%	B	1.08%	B	1.36%
Wisconsin	B	1.03%	B	1.08%	B	0.61%	A	2.34%
Alaska	C	0.36%	C	0.03%	C	0.01%	C	0.11%
Arizona	C	0.84%	B	1.50%	B	0.99%	C	0.92%
Arkansas	C	0.86%	C	0.52%	C	0.15%	B	1.51%
Delaware	C	0.61%	C	0.50%	C	0.46%	C	0.30%
Hawaii	C	0.36%	C	0.03%	C	0.02%	C	0.29%
Idaho	C	0.39%	C	0.16%	C	0.08%	C	0.48%
Iowa	C	0.58%	B	1.13%	B	0.58%	A	2.87%
Maine	C	0.43%	C	0.13%	C	0.09%	C	0.62%
Montana	C	0.35%	C	0.03%	C	0.02%	C	0.46%
Nebraska	C	0.41%	B	0.80%	C	0.17%	B	1.31%
Nevada	C	0.72%	C	0.51%	C	0.44%	C	0.44%
New Hampshire	C	0.43%	C	0.26%	C	0.27%	C	0.49%
New Mexico	C	0.48%	C	0.46%	C	0.38%	C	0.47%
North Dakota	C	0.61%	C	0.15%	C	0.07%	C	0.53%
Rhode Island	C	0.63%	B	0.79%	B	0.75%	C	0.53%
South Carolina	C	0.67%	B	0.79%	B	0.53%	B	1.22%
South Dakota	C	0.50%	C	0.28%	C	0.06%	C	0.69%
Utah	C	0.50%	C	0.64%	C	0.12%	C	0.66%

	PPE distributed		COVID-19 cases		COVID-19 deaths		Number of nursing homes facilities	
Vermont	C	0.55%	C	0.05%	C	0.05%	C	0.23%
West Virginia	C	0.52%	C	0.11%	C	0.08%	C	0.82%
Wyoming	C	0.37%	C	0.05%	C	0.02%	C	0.25%

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