NATIONAL INFRASTRUCTURE ADVISORY COUNCIL

THE PRIORITIZATION OF CRITICAL INFRASTRUCTURE FOR A PANDEMIC OUTBREAK IN THE UNITED STATES WORKING GROUP

FINAL REPORT AND RECOMMENDATIONS BY THE COUNCIL

January 16, 2007

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National Security Telecommunications Advisory Committee (NSTAC)
Nuclear Sector Coordinating Council
Partnership for Critical Infrastructure Security (PCIS)
Public Health and Healthcare Sector Coordinating Council

Executive Summary

> *Some will say this discussion of the Avian Flu is an overreaction. Some may say, "Did we cry wolf?" The reality is if the H5N1 virus does not trigger pandemic flu, there will be another virus that will.*
>
> - Department of Health and Human Services (HHS) Secretary Michael Leavitt, November 2005

Background and Methodology

Though its timing, severity, and ultimate strain remain a mystery, a pandemic promises to test the critical infrastructure of both the United States and the world. Public health officials have long maintained the potential for pandemic influenza is not a matter of *if*, but rather a matter of *when*. To avoid an economic and social catastrophe, pandemic preparedness demands full public- and private-sector participation. With that in mind, U.S. Department of Homeland Security (DHS) Secretary Michael Chertoff joined Secretary Leavitt in May 2006 to ask the National Infrastructure Advisory Council (NIAC) to provide them and President Bush with recommendations regarding the prioritization and distribution of pandemic countermeasures to the essential workers in our nation's Critical Infrastructure and Key Resource (CI/KR) sectors.

Given the scope and scale of a pandemic, the Federal government has repeatedly asserted it cannot handle all pandemic preparedness, response, and recovery efforts on its own. In their letter to the NIAC, the Secretaries highlighted the necessity for the public and private sectors to prepare for this serious threat. The Secretaries also emphasized their understanding that successful pandemic planning requires coordination across all CI/KR sectors.

> *While many CI/KR businesses have contingency plans to respond to threats from natural and manmade disasters, most fail to account for the potential extreme health impact and containment strategies specific to pandemics. CI/KR owner-operators know the activities and personnel in their operations that are most critical and they know the considerations necessary to maintain essential levels of service; this knowledge must be linked with knowledge of the impacts, response strategies, and countermeasures that will be available in a pandemic…*[1]

The Secretaries asked the Council to address six specific issues key to protecting the nation's economy and social stability in light of the looming pandemic threat. The six key issues are:

- Identifying and defining "critical services" that must be maintained in a pandemic;
- Establishing criteria and principles for critical service prioritization;
- Defining critical services priority (with principles for variation, if needed);
- Identifying critical employee group(s) in each priority critical service;
- Building a structure for communication and dissemination of resources; and
- Identifying principles for effective implementation by DHS and HHS.

[1] Letter from Secretary Michael Leavitt and Secretary Michael Chertoff to Erle A. Nye, NIAC Chair, 5/17/06

In response to the joint request, and given the expedited nature of the request, the Council reconfigured an existing NIAC Working Group. In turn, the Working Group created a Study Group to investigate a variety of pandemic preparedness-related issues across all CI/KR sectors in its attempt to answer the six key issues outlined above.

To understand the private sector's needs and abilities in the face of a pandemic, the NIAC designed a survey and distributed it through numerous channels across all CI/KR sectors. The survey asked respondents to answer six questions based on the issues identified by the Secretaries. The Report addresses the strategic questions (Questions 5 and 6) and the operational- and tactical-level questions (Questions 1-4) in the Recommendations section.

Findings

Question 1 of the NIAC Survey asked recipients to rank critical goods and services needed to produce their critical goods and services. The priority assigned to each of these types and groups of others' goods and services was highly dependent on the respondent's particular production needs. Consensus emerged as a few specific choices repeated themselves frequently across all of the surveys. Largely, most of the top priorities across sectors were basic goods or services, such as electricity or communications, which a particular infrastructure requires to operate. Most priority goods and services were not specific or limited inputs (e.g., raw materials), unless the sector essentially produces one major product, such as the Nuclear sector.

As evidenced by survey responses and the Study Group's workshop deliberations, all sectors generally identified similar cross-sector interdependencies and rationales. Each sector placed different emphasis on the various interdependencies and rationales based on their goods, services, and special business requirements unique to their sector. Most sectors identified electricity (including those producing electricity) in their top priorities, followed by telecommunications, fuel, transportation, and water. Appendix C lists sector responses.

The NIAC identified and assessed cross-sector interdependencies to address the three key factors needed to improve overall pandemic planning and response, including: identifying cross-sector impacts to specific critical sector operations; identifying the potential for significant cascading consequences; and prioritizing sectors to target vaccine allocation. Members uncovered numerous key interdependencies relative to external critical goods and services:

- The interdependent relationships most often cited include basic municipal and other infrastructure support requirements such as energy, IT, communications, and water.
- The surveys also identified some less obvious critical goods and services, including basic physical security requirements, financial services for businesses and workers, and food and healthcare to sustain workers and their families.
- The surveys highlighted the role these interdependencies played in terms of a company's other supply chains, specifically the essential role transportation plays as a bridge between all levels of the supply and distribution chain.

Question 2 asked survey recipients to identify the criteria used to prioritize critical goods and services established in Question 1. Given the wide distribution among the types of businesses across and within sectors, the survey first offered basic criteria and guidance designed to define

"critical." The survey also asked for supplementary rationale justifying why each business responded in a particular way. Appendix C contains the sector narratives for how and why a sector identified particular goods and services as critical.

Survey responses included assumptions about the criticality of goods and services based on individual business assessment of what respondents believed most important for the nation. In some instances, sectors defined "critical" based on outside influences, including corporate business operations plans or Federal, State, and local mandates; this was the case for several highly regulated sectors. While the survey provided an excellent start to this study, the Council believes much effort remains to fully define and refine these categories and justifications.

Question 3 asked survey recipients to describe what their company produces internally for critical goods and services. The survey asked recipients to identify and rank their critical goods and services while providing justification for "loss or diminishment" impacts in providing these critical goods and services to their customers. Appendix C defines, to the best ability of the NIAC, the major critical goods and services for all sectors. Some findings include:

- Basic critical infrastructure sectors generally provide a few major critical goods and services (e.g., potable water and wastewater treatment, electrical generation and distribution, and postal and shipping services).
- Sectors, including Food and Agriculture, Commercial Facilities, and Chemical, manufacture and distribute goods that may require thousands of line items of goods to be assessed and prioritized to determine each one's criticality.
- There are numbers of low-density, single-source businesses (e.g., baby formula producers) and goods/services (e.g., chlorine for water treatment, ATM maintenance).

The last of the four operational survey questions gets to the heart of the NIAC's charge. The Survey asked recipients to provide total worker numbers for their businesses, discuss potential impacts in the event of these workers' absence, and describe what actions the businesses already performed to mitigate negative operational effects from the potential absence or loss of these workers.

Critical Employees: Tiers 1 -3

Banking and Finance: 1,562,000
Chemical: 322,618
Commercial Facilities: 84,000
Communications: 796,194
Electricity: 375,000
Emergency Services: 1,997,583
Food and Agriculture: 750,000
Healthcare: 6,999,725
Information Technology: 2,358,800
Nuclear: 86,000
Oil and Natural Gas: 328,674
Postal and Shipping: 464,744
Transportation: 198,387
Water and Wastewater: 608,000

TOTAL: 16,931,725

Employees: Tier 1 Only

Banking and Finance: 417,000
Chemical: 161,309
Commercial Facilities: 42,000
Communications: 396,097
Electricity: 50,000
Emergency Services: 1,997,583
Food and Agriculture: 500,000
Healthcare: 6,999,725
Information Technology: 692,800
Nuclear: 86,000
Oil and Natural Gas: 223,934
Postal and Shipping: 115,344
Transportation: 100,185
Water and Wastewater: 608,000

TOTAL: 12,389,077

These initial survey responses provided a solid baseline from which to explore and refine worker categories and numbers. The categories and numbers provided in Appendix C of this final NIAC Report reflect the exceptional efforts of both workshop participants and Study Group members to further refine the findings by utilizing the survey results as a baseline.

Recommendations

The Council acknowledges the preparedness work done to date with the private sector and CI/KR owner-operators and recommends the government continue to engage these players to augment communications distribution to the critical workforce. The following lists **communications-related recommendations**. **For a more detailed explanation of all recommendations, please see the Recommendations section of this report**.

A1. Pre-define, to the greatest extent possible, a consistent pandemic communications plan, complete with tailored communications to specific target audiences based on various possible pandemic scenarios.

A2. Develop and pre-position, to the greatest extent possible, communications in all distribution channels, including radio, TV, telephone, print, and online media.

A3. Continue to engage the private sector to augment the distribution of communications to the critical workforce.

A4. The public- and private-sector critical infrastructure partners should continue refining their existing communications plans, processes, and success metrics through a series of response exercises. These exercises should include participation from appropriate state and local representatives when feasible. The Federal government, in consultation with the critical infrastructure owners and operators, should develop a mechanism to refine and identify those priority workforce groups within and across the 17 CI/KR sectors.

Below is a list of **dissemination-related recommendations**. For an explanation of all recommendations, see the Formal Recommendation section.

B1. Continue developing a clearly defined vaccine and antiviral medication distribution strategy. Consider the Council's work on pandemic prioritization as a starting, not an ending, point for further discussion and clarification about the Federal government's ultimate distribution strategy.

B2. Consider alternative distribution strategies and guidance to give owner-operators a stronger voice in determining which employees receive higher prioritization for vaccines and antiviral medications. Build flexibility into distribution frameworks to allow the private sector to receive, distribute, and, with appropriate medical support, dispense vaccine and antiviral medications to their critical workforce.

B3. More clearly define response and containment roles and responsibilities. The NIAC recommends the Federal government continue to better define its expected response timelines and milestones.

B4. All public- and private-sector partners should continue educating relevant stakeholders on pandemic plans, processes, and priorities.

B5. Engage appropriate resources to ensure adherence to the distribution strategy and the economical use of limited vaccine and antiviral resources.

The three pillars of the *National Strategy* helped frame the following three sets of recommendations. The first set relates **to Pillar #1: Preparedness and Communications**.

C1. The public and private sectors should align their communications, exercises, investments, and support activities absolutely with both the plan and priorities during a pandemic influenza event. Continue data gathering, analysis, reporting, and open review.

The recommendation below addresses **Pillar #2: Surveillance and Detection**.

D1. The NIAC recommends the Federal government improve its effort to engage key elements of the private sector in proactive surveillance and monitoring activities, including:

- Extending public health surveillance to occupational health professionals;
- Developing a formal framework designed to engage international components of U.S. corporations in global bio-data collection efforts;
- Supplementing existing surveillance investments, acquisition, monitoring, and response capabilities to increase threat visibility and geographic coverage; and
- Engaging data acquisition and management resources within the commercial workforce in surveillance, collection, and analysis.

The recommendation below addresses **Pillar #3: Response and Containment**.

E1. Develop a clearly defined vaccine and antiviral distribution strategy to ensure deployment as planned and consider alternative distribution methods engaging the private sector in directly distributing antiviral medications and vaccines to in-scope critical workforce.

E2. Public and private partners should work closely to define more clearly response and containment roles and responsibilities, as well as response timelines and milestones.

E3. The Federal government must do a better job in educating all stakeholders on plans, processes, and priorities.

E4. Using this report's findings as a baseline for future work, the Federal government should develop an innovative and easy-to-use mechanism to identify the priority workforce groups clearly.

E5. Engage appropriate resources to ensure adherence to distribution strategies and the economical use of limited vaccine and antiviral resources.

Approach and Methodology

NIAC Pandemic Study Background

In a May 17, 2006 letter, DHS Secretary Michael Chertoff and HHS Secretary Michael Leavitt tasked the NIAC with providing critical infrastructure prioritization recommendations, including distributing countermeasures, during a pandemic influenza event. The Secretaries identified six key issues for the Council to address:

- Identifying and defining "critical services" that must be maintained in a pandemic;
- Establishing criteria and principles for critical service prioritization;
- Defining critical services priority (with principles for variation, if needed);
- Identifying critical employee group(s) in each priority critical service;
- Building a structure for communication and dissemination of resources; and
- Identifying principles for effective implementation by DHS and HHS.

The Federal government asserted it lacks the ability to handle all response capabilities required to prepare for and respond to a pandemic influenza. The *National Strategy* recognizes pandemic preparedness and response "cannot be viewed as a purely federal responsibility, and that the nation must have a system of plans at all levels of government and in all sectors outside of government that can be integrated to address the pandemic threat."[2] Pandemic preparedness and response will require active participation from the private sector and, consequently, the NIAC can play an important role. In his letter to Secretary Chertoff, HHS Secretary Leavitt states it is "essential for the U.S. private sector to be engaged in all pandemic preparedness and response activities and equally essential for CI/KR entities to be engaged in pandemic planning given our society's dependence upon their services."[3]

The NIAC represents a coordinated effort by both government and private-sector entities to offer recommendations on national critical infrastructure security in key economic sectors.[4] NIAC Recommendations assist in policy development for either the White House or the Federal agency the Council supports. Given the NIAC's past successes at bolstering the public-private-sector partnership and its proven ability to work under tight deadlines, Secretaries Leavitt and Chertoff identified the Council as an effective advisory body to address these pandemic-related issues.

Working Group Conversion

Rather than organize a new group, the NIAC decided to reconfigure a preexisting Working Group with the expertise to provide a report and recommendations on Chemical, Biological and Radiological (CBR) Events and the Critical Infrastructure Workforce. This group's research on the impact on the critical infrastructure workforce from a biological incident naturally lent itself to a pandemic-specific challenge.

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[2] http://www.whitehouse.gov/homeland/pandemic-influenza.html

[3] Letter from Sec. Leavitt to Sec. Chertoff, 5/17/06

[4] NIAC Charter

As the CBR Working and Study Groups shifted their focus to a pandemic influenza event in the United States, they also reevaluated their membership and looked to fill underrepresented areas and expand further into new areas. This process entailed using current members and subject matter experts to refer potential new members or speakers. Beginning on June 28, 2006, with weekly conference calls, the Study Group began incorporating new members from numerous different organizations and skill sets, including representation from HHS, DHS, and the following CI/KR sectors as presented in Homeland Security Presidential Directive-7 (HSPD-7):

- Banking and Finance;
- Chemical;
- Commercial Facilities;
- Telecommunications;
- Dams;
- Emergency Services;
- Energy (including Dams, Electricity, Oil and Natural Gas, and Nuclear)
- Food and Agriculture;
- Information Technology;
- Postal and Shipping;
- Public Health and Healthcare;
- Transportation; and
- Water and Wastewater Management.

Background and Methodology

After adding members and subject matter expertise to the Study Group, the Working Group began to refine its approach in determining each sector's definition of critical and essential workforce. As defined in the HHS Pandemic Influenza Plan,[5] these workers ensure ongoing operations at businesses, organizations and, by extension, entire critical infrastructures. At the Working Group's outset, the members decided to pursue the following four data collection methods:

- Distribution of a sector assessment survey to critical sector representatives and organizations;
- Research and discussion on existing public or private pandemic studies;
- Review of existing pandemic plans, programs, and pandemic exercises; and
- Interviews with key subject matter experts.

[5] http://www.hhs.gov/pandemicflu/plan/

The Working Group also identified four key analytical methods to aid its efforts:

- Inductive data analysis;
- Data modeling;
- Expert opinion; and
- A sector assessment survey.

The sector assessment survey served as the focal point for all data collection efforts. The Working Group held numerous discussions intended to introduce and refine the questions it expected to generate the most important and useful hard data from the survey's recipients.

After careful consideration, the Working Group settled on six data collection questions linked to the issues in the NIAC charge. Each question also included clarifying questions to add a greater level of detail to the Council's understanding of critical goods, services, and workers. When applicable, the survey asked recipients to expand on their answers in the comments section.

Sector Assessment Survey

*Question 1: Identify external critical services that must be provided to your organization in a pandemic in order for you to provide your essential services***;**

A. What goods and services are critical to your operations?
B. Please identify rationale for criticality ratings as public safety, public health, economic survival, interdependently critical, or other?
C. Are there key interdependencies to each critical good/service?

After careful discussion, the Working Group defined goods and services as critical if they met the following four criteria:

- Essential to national security and homeland security;
- Components of systems, assets, and industries upon which the economy depends;
- Components of systems, assets, and industries upon which public health depends; and
- Fundamental to privately owned critical infrastructure.

Question 2: Establish criteria and principles for critical service prioritization;

A. What criteria did you use for the prioritization of critical goods and services established in Question 1 (e.g., business function, exposure vulnerability, legal mandate)?

Question 3: Define internal critical service priorities;

A. What is your company's #1 most critical good and service that you must continue to provide during a pandemic?
B. What are your company's #2 most critical goods and services that you must continue to provide during a pandemic?
C. What are your company's #3 most critical goods and services that you must continue to provide during a pandemic?
D. What is the impact of the loss or diminishment of any of these critical goods and services to your customers or consumers?

Question 4: Identify internal critical employee groups within each critical service priority;

A. What is critical employee group #1? How many are represented in this group?
B. What is critical employee group #2? How many are represented in this group?
C. What is critical employee group #3? How many are represented in this group?
D. What is the impact of the loss or diminished availability of any of the critical employee groups?
E. Has your organization identified a plan to reduce the vulnerability of exposure to the above groups? If no, will your organization develop such a plan?

*Question 5: Make recommendations to build a structure for communication and dissemination of resources within your company***;**

A. Has your company developed or is it developing a plan to ensure you can effectively communicate with your employees before and during a pandemic?

Question 6: Identify principles for effective implementation by DHS and HHS.

A. What do you consider the most critical activities for DHS and HHS to undertake to support your company in the maintenance of essential services in a pandemic?

The survey also sought more granular information by asking recipients to provide specificity and examples to their responses whenever possible. Furthermore, it asked recipients to answer from their company's perspective as both consumer and provider. For instance, the Water and Wastewater Management sector requires essential inputs like chlorine from the Chemical sector to produce an essential output for every other sector—clean, potable water.

To gather accurate and representative information, the supporting Study Group distributed the sector assessment survey through the sectors by utilizing the Partnership for Critical Infrastructure Security (PCIS) and the National Security Telecommunications Advisory Council (NSTAC). Each recipient who responded then emailed the completed survey back to the supporting Study Group to be "scrubbed" of any identifying characteristics such as a company name or easily recognizable product. After removing any identifying marks, the supporting Study Group then aggregated results and recorded response rates by sector. Table 1 displays these rates.

The supporting Study Group distributed 518 surveys and received varying sector response rates with an overall response rate of 29 percent. Some sectors proved far more responsive than others. Despite excellent coverage in certain areas, such as the Nuclear sector, the supporting Study Group encountered a dearth of information in other areas, especially in some of the larger and more diverse sectors. While a 29 percent response rate often reflects solid participation for a typical "cold survey," this survey went to a focused group of sector representatives. Moreover, three sectors accounted for 90 percent of all responses.

September 8, 2006 Workshop

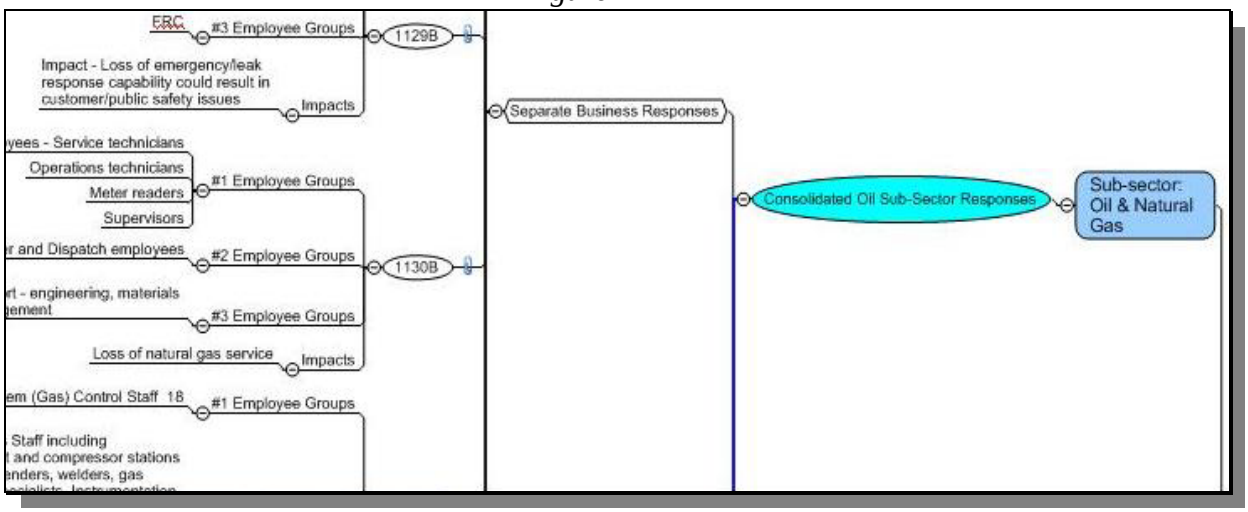
Another critical step involved convening an all-day meeting in Washington, D.C. in early September to discuss response rates, or lack thereof, to the sector assessment survey. At this meeting, the supporting Study Group reasserted its mission and identified areas of opportunity to focus on as the Working Group began to develop recommendations for the Council's review.

The workshop also allowed the supporting Study Group to review its data collection and aggregation methods, particularly its visual mapping of sector responses. Before the meeting, the support team focused on inputting answers to Questions 1, 3, and 4 into a response map. For classification's sake, the staff categorized Question 2 as a sub-question under Question 1. At this point in the research cycle, the supporting Study Group continued aggregating Questions 5 and 6 for the final report and recommendations but deemed the responses less relevant to the workshop itself. The visual aggregation divides assessment responses by questions and then further divides responses by sector and sub-sector according to question. The questions outlined in the map include:

- Identify external critical services that must be provided to your organization in a pandemic in order for you to provide your essential services. (Consumer response and Producer response);
- Establish criteria for critical service prioritization. (Consumer response and Producer response);
- Define internal critical service priorities. (Consumer response and Producer response); and
- Identify internal critical employee groups within each critical service priority.

Below represents a visual sample of the actual map used to support discussion during the September 8 workshop.

Figure 1



Other Methodologies

The supporting Study Group also used other methods to gather information, define, and construct its approach. Beginning at its inception, the supporting Study Group held weekly, well-attended conference calls where Working and Study Group members met with subject matter experts to:

- Receive briefings;
- Develop the sector assessment survey;

- Discuss responses as they arrived;
- Identify areas of concern; and
- Address presentation and writing plans.

These calls highlighted both how the Working Group would move forward and the direction its report and recommendations would take. In addition to the recurring supporting Study Group calls, the Working Group also convened weekly to discuss progress and identify potential supporting Study Group needs. These conference calls allowed Working Group members to voice concerns and provide necessary guidance as the report and recommendations progressed.

Following the sector assessment survey distribution, the supporting Study Group also held numerous calls with recipients to answer questions and clarify the survey on a case-by-case basis. As the survey deadline neared, the supporting Study Group held many open calls to make itself available to all recipients wanting more information or assistance clarifying their response. Many sectors also held their own private meetings to discuss aggregating their answers and presenting a unified, overarching response.

Pandemic Assumptions

Before beginning its work, the NIAC agreed upon seven assumptions as a baseline for its pandemic prioritization study, adopting many of these assumptions from other government studies and planning documents, including the Homeland Security Council's *Implementation Plan for the National Strategy on Pandemic Influenza*[6] and the Pandemic Influenza Plan from HHS.[7] These assumptions stem from scientific data collected from past pandemics and other outbreaks, as well as established public health axioms regarding individual behavior and disease spread. The assumptions guiding the work of the Council include:

- **Susceptibility to pandemic influenza virus will be universal.**
  - No one will have natural immunity.
  - A pandemic vaccine may not yet be widely available to cover large populations.
  - Antiviral medications will be in short supply.
  - Non-medical countermeasures will have limited effect.
  - *Once a pandemic begins, it may be unstoppable.*

- **The clinical disease attack rate will be 30 percent in the overall population during the pandemic. Among working adults, an average of 20 percent will become ill from influenza during a community outbreak.**

- **Worker absenteeism may be as high as 40 percent during peak periods.**
  - *Absenteeism will include those who are ill with pandemic influenza.*
  - *The "worried well," those concerned they might have influenza or those who want to reduce contact with ill individuals, will be considered absent.*
  - *Include those who stay at home to care for ill family members.*
  - *Absenteeism might include otherwise healthy parents who remain at home to care for children out of school.*
  - *Some individuals may get ordinary influenza, and assume it is pandemic influenza, and they may opt to stay at home.*
  - *Include misdiagnosis or overly cautious measures in absenteeism assumption.*

- **Some persons will become sick from pandemic influenza but might not develop clinically significant symptoms. These persons can transmit pandemic influenza and will likely develop immunity to subsequent infections.**

- **Each wave of the epidemic during its peak will adversely impact infected communities for six to eight weeks.**

- **Expect multiple waves of illness, with each wave lasting two to three months.**
  - *Waves will move across geographic areas causing effects on communities to vary.*
  - *Severity of waves, including symptoms and infectiousness, will vary by wave.*

- **Effectively half of all infected will seek medical care.**

[6] http://www.whitehouse.gov/homeland/pandemic-influenza-implementation.html
[7] http://www.hhs.gov/pandemicflu/plan/

Major Cross-Sector Interdependencies

By issuing Homeland Security Presidential Directive-7 (HSPD-7), President Bush formally designated 13 Critical Infrastructure and 4 Key Resource sectors essential to the nation's economic security and social stability. The government largely treated these Critical Infrastructure and Key Resource (CI/KR) sectors as discrete and unrelated entities for public- and private-sector coordination and management.

Over time, public and private critical infrastructure partners recognized each of these individually complex entities links horizontally to each of the other 17 CI/KR sectors. In other words, each sector is interdependent and reliant on the critical goods and services of nearly all other sectors in order to sustain their critical operations. For example, the Water and Wastewater Treatment sector remains fundamentally indispensable to all Americans; it is also indispensable to most, if not all, other CI/KR business sectors.

The Water sector is not alone. It too relies on other sectors for a host of critical functions, including:

- The **Energy** sector to power its equipment operations;
- The **Chemical** sector to provide materials necessary to treat the water supply; and
- The **Transportation** sector to deliver the critical supplies from the Chemical sector.

The interdependencies do not end there. The Water sector relies directly and indirectly on the Food and Agriculture sector as well as the Healthcare sector to protect the health and safety of its workforce and customers. In whatever way the sectors formally define and manage themselves, these operational "cross-sector-interdependencies" exist, and while they reflect national strengths, they represent one of the nation's most critical and complex vulnerabilities.

The Utility of Single Points of Failure in Identifying Cross-Sector Interdependencies

NIAC members agree effective pandemic and all-hazards disaster planning and preparedness must account for potential major "single-point failures" within a sector. Though relegated to a single critical sector or sub-sector, these single-point failures threaten to cause substantial economic or social disruption for a given region or even the nation as a whole. Single-point failures include failures of individual businesses or failures of small numbers of similar businesses representing the sole source providers of an essential good and/or service. The Council identifies numerous examples of these sole-source providers and vulnerabilities in the NIAC Survey within and across *all CI/KR sectors*, including vaccine manufacturers in the Healthcare sector, baby formula producers in the Food and Agriculture sector, and ATM maintenance workers in the Banking and Finance sector.

Individually, single-point failures possess the ability to cause extensive local and even national disruptions. However, when single-point failures occur within interdependent sectors, they may trigger additional interdependent failures cascading across sectors. This results in even greater national impact. In other words, the potential effects of single-point failures, coupled with

functional intra- and cross-sector network interdependencies, significantly increase the opportunity for cascading consequences (e.g., the August 2003 North American blackout[8]). To identify the most critical workers for vaccine priority, pandemic planners must assess the essential cross-sector CI/KR interdependent relationships, along with each sector's specific critical goods and services.

Public- and Private-Sector Pandemic Planning, Preparation, and Response

The NIAC strongly believes the scope and scale of the challenge of identifying and managing cross-sector interdependencies represents something neither a single business nor most major business associations have the ability to resolve completely. It is incumbent on the Federal government to assist CI/KR sectors and that businesses recognize and manage their interdependent strengths and vulnerabilities for disaster mitigation. Furthermore, the Council believes the private sector needs a better understanding of the likely implications and impacts of these interdependencies within and across sectors before, during, and after a pandemic outbreak.

If the Federal government can substantially refine its prioritization scheme for CI/KR sectors and workers based on a comprehensive analysis of sector and cross-sector interdependencies, it will strengthen the nation. The Council presents its findings, including some key observations and recommendations, below addressing what the private sector and the government can do to improve processes and outcomes in assessing both sector and cross-sector interdependencies to reduce vulnerability to potential cross-sector failures and in prioritizing critical workers.

NIAC Survey and Workshop Findings

The findings from the NIAC Survey together with the Working and Study Group's weekly teleconferences and September 8, 2006 workshop discussions encouraged and facilitated dialogue among the expert respondents, participants, and members focusing on identifying and defining key sector issues. The NIAC uncovered numerous cross-sector interdependencies. Through an iterative scheme of research, subject matter expert presentations, analysis of survey responses, and targeted collaboration with other sector experts, both the Working and supporting Study Group greatly improved their shared understanding of what constitutes critical cross-sector interdependencies. Moreover, this study highlights the implications of disruptions to these interdependencies for the sectors in general and for critical worker prioritization specifically.

[8] The 2003 North American electrical blackout: An accidental experiment in atmospheric chemistry, www.atmos.umd.edu/~russ/BlackoutFinal.pdf

Goods and Services

Question 1 of the NIAC Survey asked respondents to rank order those critical goods and services they would need to produce their critical goods and services. Of note, critical goods or services from other businesses consumed by the respondent business to produce their critical goods and services constitutes an interdependency with that other business or sector. From its review of the surveys, the NIAC aligned these products into four general groups:

1. **Direct Inputs –** Products (e.g., raw materials, chemicals, key components and assemblies, equipment and repair parts, consumable supplies, and specialty contract services) directly input into a business' production processes.
2. **Municipal and Other Infrastructure Goods and Services** – Products (e.g., electrical, oil/gas, fuel, water, communications, and waste management) supporting a business' production processes.
3. **Indirect Inputs** – Goods and services (e.g., food and agriculture, emergency services and healthcare) a business may not directly consume but ones it deems essential to sustain its workforce and overall work environment.
4. **Support Inputs** – Other goods and services (e.g., transportation, postal and shipping, information technology, and banking and finance) supporting a business' process of receiving direct inputs and producing and delivering the business' critical goods and services.

The priority assigned to each of these types and groups of others' goods and services depended upon the respondent's particular production needs. However, after the supporting Study Group reviewed the completed surveys, a consensus or group of top priorities began emerging as a few specific choices frequently reappeared throughout all of the surveys. Largely, most top priorities across sectors were a basic good or service, such as electricity or telecommunications, which a particular infrastructure needs to operate. Most priority goods and services were not specific or with limited survey inputs (e.g., raw material), unless the sector essentially produces one major product, such as the Nuclear sector.

Council members repeatedly addressed the inherent difficulty in defining the importance of one sector's goods and service versus another sector's essential goods and services in the context of a pandemic outbreak. In general, the NIAC agreed the stated priorities for goods and services for all sectors are valid and defensible. However, the survey highlighted the fact businesses may consider certain essential goods and services more critical given their link to the production functions of many, if not all, CI/KR sectors. For example, even though a business might find a particular raw material to be essential to producing a critical good, most respondents cited the need for basic electricity availability ("keeping the lights on") as their highest priority. Respondents indicated electricity retains an indispensable role in sustaining overall production and business functions.

Clearly, if the United States cannot maintain electrical generation and distribution, most businesses will be unable to function. Even if the Energy sector maintains operations during a pandemic wave, no one should interpret this achievement as a panacea for all other sectors. As sector representatives reminded the NIAC, even with an operating electric grid, sectors still

require raw materials to produce goods and services, complete financial transactions supporting employees and operations, and transportation assets to move raw materials and chemicals.

Interdependencies

To uncover any remaining critical interdependencies across sectors, NIAC Survey Question 1 asked respondents to define and, if possible, prioritize the key interdependencies for each of their critical goods and services. Table 1 provides an example of the types of cross-sector interdependencies and assessments identified in this question as recorded for the Public Health and Healthcare sector.

Table 1: Healthcare Sector

Critical Goods/ Services	Rationale	Criteria	Inter-dependency
Water	Health and safety	Service delivery	Water – immediate
Electricity and Power	Health and safety	Service delivery	Electricity – beyond 24 hours
Transportation and shipping	Interdependency	Service delivery	Transportation of critical medical materi
Communications	Interdependency	Service delivery	Communications with suppliers, EMS, police, safety, employees
Food and agriculture	Interdependency	Service delivery	Provision of food for inpatients
Public safety, fire, and EMS	Health and Safety	Service delivery	Patient transport, physical security, triage assistance

As evidenced in their survey responses and their workshop deliberations, all sectors generally identified cross-sector interdependencies and rationales similar to those noted for the Healthcare sector. However, each sector placed different emphasis on the various interdependencies and rationales based on their goods and services and special, sector-specific business requirements. Regardless of the differences in goods and services produced by the sectors, most sectors identified electricity (including those producing electricity) in their top priorities, followed by communications, fuel, transportation, and water. Table 2 details the top priorities identified by a sampling of specific sectors in their surveys. Please note all sector responses appear in Appendix A.

Table 2: Sector Examples

Priority	1	2	3	4
Water and Wastewater	Electricity	Chemicals	Fuel	Telecom
Food and Ag	Raw Materials	Power	Labor	Water
Energy	Electricity	Fuel/Coal	Water	Telecom
Banking and Finance	Electricity	Telecom/IT	Transportation	Fuel
Transportation	Fuel	Electric	Telecom	Water
Communications	Power	Fuel	Transportation	Water

Observations on Interdependencies

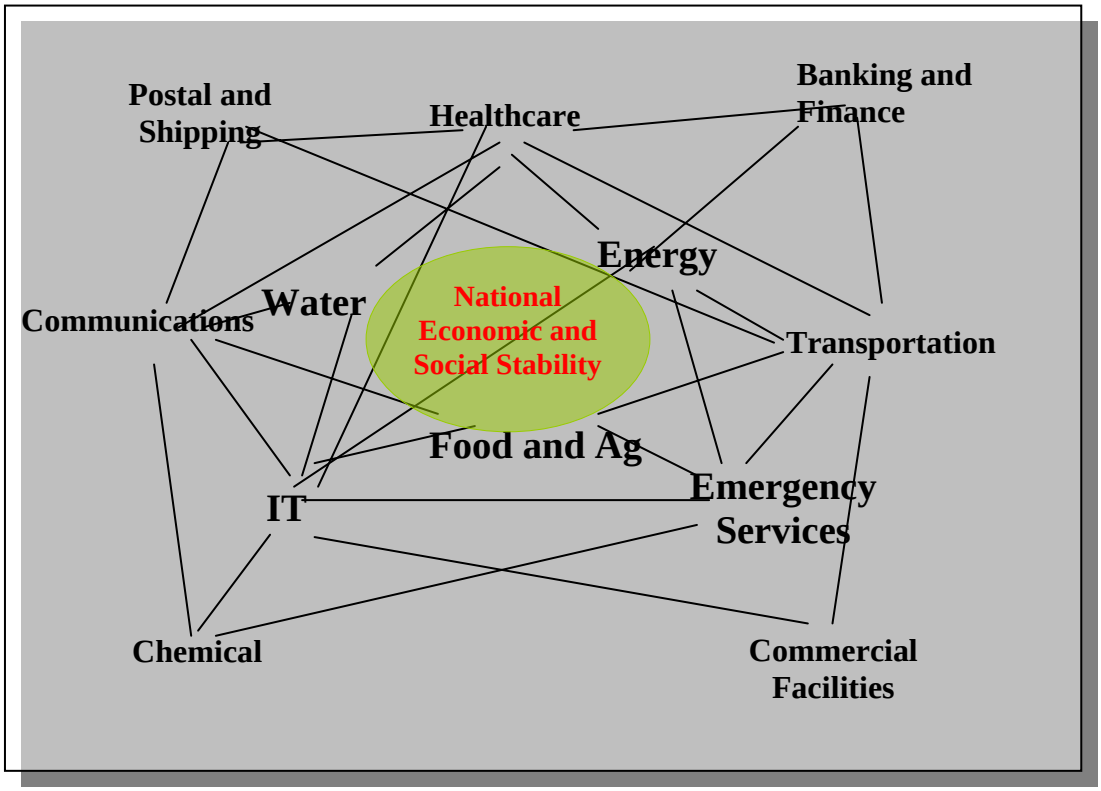
The Council believes it is important to comprehensively identify and assess the CI/KR cross-sector interdependencies to address the three key factors necessary to improve overall pandemic planning and response, including:

- Identifying cross-sector impacts to specific critical sector operations;
- Identifying the potential for significant cascading consequences; and
- Prioritizing sectors and sub-sectors in order to target support for such as vaccine allocation.

NIAC Survey results and deliberations began resolving these three factors. The supporting Study Group noted additional effort would be required to more fully explore the first two factors and model the interdependencies in a manner to improve efforts to refine worker prioritization. Additionally, the NIAC believes these follow-on efforts would expedite the effort to make decisions on support during the pandemic response phases for potential cross-sector cascading failures. The NIAC found the third factor assigning sector prioritization to be the most difficult to resolve in a reasonable manner. For a host of reasons, the NIAC concluded deriving a clean "1 to n" sector prioritization list may be impossible. This report describes a partial list of these reasons below.

- While some sectors like Energy and Water rely upon few primary goods and services, other sectors require a much more diverse and complex portfolio of products.
- For those more complex sectors, most organized themselves functionally into a diverse group of sub-sectors.
- Those sectors with varied goods and services produce a considerable array of products. In terms of pandemic preparedness and response, these products' criticality for each sector ranges from decidedly essential to clearly non-critical.

Figure 2: Sector Interdependent Relationships



The various sector responses provided the Working Group with another significant challenge to prioritizing between sectors in an effective, efficient, and definitive manner. Interdependencies identified in this study reflect the relationships between sectors in their provision of critical goods and services. Largely, business-based interdependencies do not come from a national perspective of sustaining our nation's economy and protecting its social stability. As a result, the NIAC found that while rank ordering among sectors may not be practical, graphically representing the interrelationships based on their critical business-based and national goal interdependencies remains useful. Figure 2 above depicts the relationships between sectors and the goal of sustaining national economic and social stability.

Figure 2 does not depict sector prioritization. Instead, the graphic underscores the point certain sectors cited other sectors more often because they related to the provision of their critical goods and services. While not directly culled from the surveys, the graphic assumes how sectors might respond to the challenge of sustaining national economic and social stability over time. With this in mind, all sectors identified specific critical goods and services they produced and considered essential to sustain other sectors and as well as sustaining national economic and social stability.

Recommendations for the Next Level of Analysis

Throughout this study, sector respondents, supporting Study, and Working Group participants provided the Council with expert insight as well as qualitative and quantitative assessments of their sectors. These insights established a baseline for what constitutes key CI/KR cross-sector goods and services and interdependencies. The NIAC believes the Federal government can use

the interdependencies identified in this study to establish a follow-on study and the next level of analysis, including the following:

- **Refine responses for each key study area**. Given the limited time respondents had to answer the NIAC Survey, Question 1 answers typically included only broad definitions for goods, services, and worker types and cross-sector interdependencies. For example, one survey identified transporting critical medical material as essential, but the respondent did not specify types of critical materials, what priorities (if any) were established, or the quantity of medical materials.

- **Broaden analysis to include a review across sectors based on national priorities**. From the broader context of overall "national interest," the NIAC lacked enough information to formally assess or rank sectors based on national criteria, such as sustaining basic subsistence support for their workers and customers, as well as the public. For example, while electricity and communications were top priorities for business, the more immediate national interest needs in a pandemic may be for food, drinking water, emergency services, and healthcare.

- **Extend the business-level analysis to uncover second and third order issues and effects**. The Council believes most respondents lacked sufficient time to fully assess the basic infrastructure support of their sector or business. In general, responses contained only general statements about issues such as requiring electricity/power, water, and/or transportation. Additionally, most survey responses lacked sufficient granularity in their data that might provide answers to the following:
  - If a business says electrical power is a high priority for its sector, how many of that sector's businesses already possess adequate electricity generation reserves? Do these businesses possess sufficient generator fuel onsite to support their own electrical requirements for an extended period?
  - If a business indicates water, fuel, and/or chemicals, are critical goods and services necessary for production, how many sector businesses have on-site reserve water and/or fuel tanks and chemical stockpiles to provide some level of backup for a specified period? How many days or weeks will those reserves last?

- **Define the impacts and implications caused by disruptions**. To date, the private sector has not fully defined the impacts of disruptions to providing a critical good or service or the potential cross-sector implications and consequences.

- **Include data from critical medium and small businesses**. The NIAC found survey respondents from the largest and most diverse sectors generally lacked the necessary time and access to information about other partners in and across sectors, especially those potentially critical medium- and small-sized businesses.

Survey Findings

Overview

The NIAC pandemic survey asked recipients to answer six questions based on the six issues identified to the NIAC in the original charge from the DHS and HHS Secretaries. Of the six questions, this report addresses the strategic ones, Questions 5 and 6, in the Formal Recommendations section. Questions 1-4 represent the operational- and tactical-level questions responding to explicit concerns about critical goods and services, functions, and workers.

The following review describes how the Council formulated and presented these interrelated questions in its effort to have the survey flow logically from one to the other in answering the NIAC's charge. This review also details what the NIAC anticipated and realized for each question, an analysis of what worked well, and what members still feel the public and private sectors need to accomplish.

Flow and Interrelationships

Prior to identifying the most critical workers, the Council initially needed to know the most critical products (at the national, regional, and local level) produced by CI/KR businesses. The first four survey questions prompted business and sector representatives to identify these products and the community, commodity, and business practice they affect. For instance, the highly critical Chemical sector produces Chlorine, a critical input for several other sectors. The loss of Chlorine would adversely affect those sectors, compromising the ability to purify drinking water and generate nuclear power.

- The first question asked recipients to identify and rank their external critical goods and services according to specific criteria. Respondents ranked them based on the importance of the external critical goods and services necessary to their business' production and delivery efforts. In other words, respondents ranked their critical goods and services based on their criticality down the chain through all their suppliers (e.g. raw and finished component supplies and materials and municipal infrastructure support), as well up their delivery/distribution chain (e.g., final production, wholesale distribution, and retail actions to the end-user/customer).
- The second question identified the most critical internal goods and services a company produces based on the criteria identified in the Survey instructions.
- The third question asked recipients to identify the critical internal goods and services essential to the business operations and vital to creating and sustaining critical internal goods and services.
- The fourth question asked recipients to identify the types of workers most critical to sustaining their company's operation and critical business functions. In other words, respondents used the critical functions they previously identified and prioritized to further prioritize the most critical workforce categories they deemed essential to sustain the functions needed to produce their most essential goods and services.

Additionally, based on the four primary question groups, NIAC workshop participants and Study Group members considered how the NIAC might differentiate these critical workers into "tiers" of criticality. In all cases, NIAC members needed to justify how they came to their conclusions for each of their sectors. The manner in which these four question groups interrelate and build upon each other demanded that business and/or sector respondents review and rework their earlier answers to ensure they integrated and addressed the most critical issues.

Question 1: Identify and Define Critical Goods and Services

The survey's first question targeted external critical goods and services provided to (consumer) and provided from (producer) the respondent's company and/or sector. Question 1 required respondents to rank these external critical goods and services. It also asked them to provide a rationale for their criticality ratings. Respondents could cite public safety, public health, economic survival, interdependently critical, or other. Finally, the survey asked respondents to describe and prioritize the key interdependencies between internal and external operations and critical goods and services.

The NIAC designed Question 1 to require the respondent to first look outward at the business' operating environment. From this perspective, respondents would be better able to identify their operational context and the critical goods and services they need and provide to others in the supply and distribution chain. The Council believes the survey responses coupled with the expert dialogue at the workshop highlighted many of the sectors' key goods and services, thus fulfilling the general intent of this question. Given the time available, the NIAC was unable, in many cases, to explore the critical goods and services in detail. Largely, these critical goods and services were noted as critical variables (input and output), but both respondents and the NIAC lacked sufficient time to investigate the second- and third-order implications of these critical input and output variables. Appendix C compiles the actual responses from the sectors to this question.

In the process of assessing the critical goods and services identified in the survey, the Council uncovered a number of key, and previously overlooked, sector and cross-sector interdependencies relating to external critical goods and services.

- The interdependencies cited most often addressed basic municipal and other infrastructure support requirements, including energy, IT, communications, and water. These requirements serve as the operational foundation for nearly all businesses, including energy, water, information technology, and communications.
- The surveys also identified some less obvious critical goods and services, including basic physical security requirements, financial services for businesses and workers, and food and healthcare to sustain workers and their families.
- In its review of the surveys, the NIAC highlighted the important role these interdependencies played in a company's other business supply chains, specifically the essential role transportation plays as a bridge between all levels of the supply and distribution chain.

This Report's Major Cross-Sector Interdependencies Section provides a detailed review and analysis of the intra- and inter-sector interdependencies and suggestions of survey respondents, workshop participants, supporting Study, and Working Group members.

Question 2: Criteria and Principles for Critical Service Prioritization

The second question clarified and justified responses provided in Question 1. Question 2 asked recipients "What criteria did you use for the prioritization of critical goods and services established in Question 1 (e.g., business function, exposure vulnerability, or legal mandate)? If the correct response in your organization is 'I do not know, have not thought about it, or still being debated,' then provide that answer."

For this question, the NIAC intended to further refine the respondent's justifications in Question 1. In the first question, respondents identified their critical goods and services, but in the second the survey asked them to justify their critical goods and services and identify the factors underlying their decisions (e.g., laws, regulatory mandates, and established business continuity plans). Given the wide variance between the types of businesses across and within sectors, the survey first offered basic criteria and guidance designed to define "critical." Then, in order to better assess the differences and similarities across businesses, the survey asked for supplementary rationale that justified why each business responded for each item in a particular way. While the differences between businesses and sectors were difficult for non-experts to identify and define, having the sector's narrative for how and why a sector selected particular goods and services as critical significantly aided all the sector representatives. Additionally, these narratives helped the NIAC better understand the expert responses from the other sectors.

Survey responses included assumptions about the criticality of goods and services based on individual business assessment of what respondents believed to be important for the nation, such as basic energy and water products. In some instances, sectors defined "criticality" based on outside influences, including corporate business operations plans or Federal, State, and local mandates; this was the case with several highly regulated sectors. While the survey provided an excellent start to this study and helped the Council improve its understanding of the issues across sectors, NIAC members believe substantial effort remains to fully define and refine these categories and justifications.

Question 3: Defining a Priority for Critical Goods and Services

The survey's first two questions reviewed the external and internal operating environments. Question 3 asked survey recipients to describe what their company produces internally for critical goods and services. It asked them to identify and then rank their critical goods and services. Following this, the survey asked recipients to justify the impacts of "loss or diminishment" in the provision of these critical goods and services to their customers.

The Council designed this question to establish the business sectors' essential outputs as a baseline for identifying their critical functions and workers. Based on the survey responses, workshop discussions, and the efforts of the supporting Study and Working Groups, Appendix C defines, to the best ability of the Council, major critical goods and services for all sectors. From these responses, the NIAC identified much of what it anticipated. It also learned many new, previously unapparent items about each sector and sub-sectors, including:

- Basic critical infrastructure sectors generally provide fewer major critical goods and services (e.g., potable water and wastewater treatment, electrical generation and distribution, and postal and shipping services).
- Sectors, including Food and Agriculture, Commercial Facilities, and Chemical manufacture and distribute goods potentially requiring thousands of line items of goods to be assessed and prioritized to determine each one's criticality.
- Numbers of low-density, single-source businesses (e.g., baby formula producers) and goods/services (e.g., chlorine for water treatment or ATM maintenance) exist.

Due in part to the inherent diversity and varying complexity of the sectors, the NIAC found it difficult to identify all critical single-source and second- and third-order goods and services in a number of sectors. In managing the survey and assessment process, the sectors generally fell into very diverse groups based on a number of variables. These differences represented key implications about what the survey uncovered and how much remains for each sector to address:

- For those sectors more uniform in operations (e.g., electricity and water), highly regulated (e.g., nuclear), and owned or operated by a limited number of large businesses (e.g., postal and shipping), the Council was able to better manage the assessment process and the survey responses were more inclusive.
- In those sectors and sub-sectors with extremely divergent operations, the NIAC confronted a more difficult task in managing the assessment. To date, these responses remain less comprehensive and definitive.
- In nearly all cases, the sector and sub-sector survey respondents and NIAC members represent the larger businesses in a sector. Therefore, those medium and smaller businesses potentially providing critical single-source goods and services lacked a direct voice in this discussion.

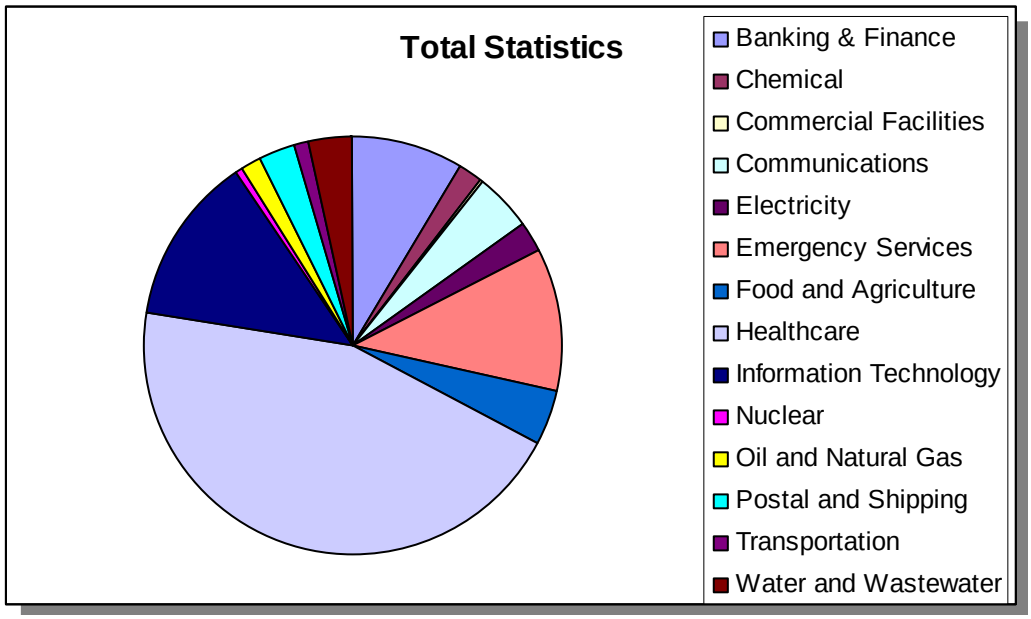
Question 4: Identifying Critical Employee Groups in Each Priority Service

The last of the four operational survey questions gets to the heart of the NIAC charge. The Survey asked recipients to not only identify their most critical worker types, but also to provide total numbers of workers in these types for their business. Furthermore, it sought to describe what activities businesses already perform to mitigate negative operational effects from their potential absence or loss. The figure below lists the numbers of employees each CI/KR sector indicated as critical. Each sector provided a rationale for their definition of critical and their reasoning behind their tiering strategy. Appendix C includes these items.

Critical Employees: Tiers 1 -3

Banking and Finance: 1,562,000
Chemical: 322,618
Commercial Facilities: 84,000
Communications: 796,194
Electricity: 375,000
Emergency Services: 1,997,583
Food and Agriculture: 750,000
Healthcare: 6,999,725
Information Technology: 2,358,800
Nuclear: 86,000
Oil and Natural Gas: 328,674
Postal and Shipping: 464,744
Transportation: 198,387
Water and Wastewater: 608,000

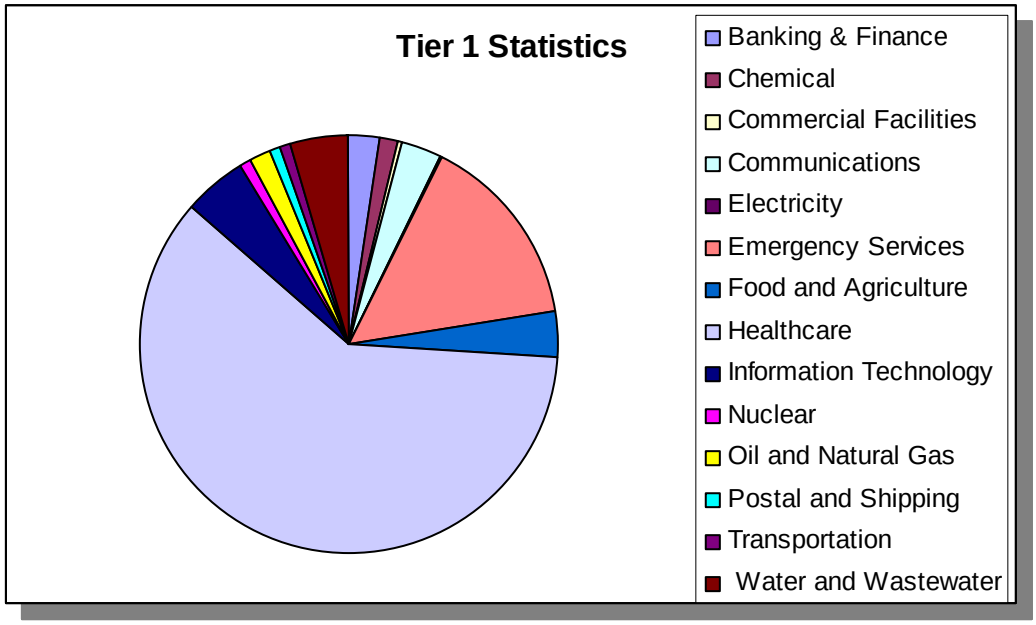
TOTAL: 16,931,725



Employees: Tier 1 Only

Banking and Finance: 417,000
Chemical: 161,309
Commercial Facilities: 42,000
Communications: 396,097
Electricity: 50,000
Emergency Services: 1,997,583
Food and Agriculture: 500,000
Healthcare: 6,999,725
Information Technology: 692,800
Nuclear: 86,000
Oil and Natural Gas: 223,934
Postal and Shipping: 115,344
Transportation: 100,185
Water and Wastewater: 608,000

TOTAL: 12,389,077



In 2005, HHS commissioned two Federal advisory committees to guide planning and form the basis for further discussion, including this NIAC study, of how to allocate in an equitable fashion the medical countermeasures that will be in short supply during the early stages of a pandemic influenza outbreak. The two advisory committees—the Advisory Committee on Immunization Practices (ACIP) and the National Vaccine Advisory Committee (NVAC)—both provided recommendations, which HHS detailed in Appendix D of its Pandemic Plan.[9] Though

[9] http://www.hhs.gov/pandemicflu/plan/appendixd.html

comparing the two sets of numbers is complicated, there are a few interesting findings to note. For example, the final percentages for vaccine prioritization for critical workers detailed in this report are 15.8 percent of all critical workers in Tier 1 and 21.2 percent for all tiers. However, given their extreme requirements during a pandemic, the high percentage of Tier 1 critical workers in the Healthcare and Emergency Services sectors skews the data. If removed, the NIAC numbers for Tier 1 critical workers represent only 4.8 percent of the entire CI/KR workforce (excluding Healthcare and Emergency Services) and the numbers for all tiers of critical workers represents 11.4 percent of the total CI/KR workforce (excluding Healthcare and Emergency Services). The total for all critical workers in all CI/KR sectors (excluding Healthcare and Emergency Services) equals only 2.6 percent of the total U.S. population.

It is also important to note the NVAC/ACIP studies did not include all the sectors represented in the NIAC study. The HHS Plan excluded the Banking and Finance, Chemical, Commercial Facilities, Food and Agriculture (except food transportation), and Postal and Shipping sectors. The HHS plan also used different definitions for "essential workers." Other than Public Health and Healthcare, the HHS Plan placed all CI/KR workers in Tier 2. Even without factoring in sector differences, the NIAC study numbers represent an 11.4 percent decrease in the numbers of identified HHS Tier 1/2 critical workers. Adjusting the numbers to reflect only those sectors included in both the HHS and the NIAC study reveals the NIAC Tier 1 is 39.5 percent smaller than the Tier 1/2 allotment of workers laid out in the HHS plan.

NIAC Figures

Sector	Total	Tier 1	Percentage	Less Health/ES	Tier 1-3	Percentage	Less Health/ES
Banking & Finance	6,000,000	349,500	5.8%	5.8%	1,562,000	26.0%	26.0%
Chemical	1,825,300	161,309	8.8%	8.8%	322,618	17.7%	17.7%
Commercial*	19,872,800	42,000	0.2%	0.2%	84,000	0.4%	0.4%
Communications	1,818,622	396,097	21.8%	21.8%	796,194	43.8%	43.8%
Electricity	1,600,000	50,000	3.1%	3.1%	375,000	23.4%	23.4%
Emergency Services	2,257,419	1,997,583	88.5%	NA	1,997,583	88.5%	NA
Food and Ag	22,072,000	500,000	2.3%	2.3%	750,000	3.4%	3.4%
Healthcare	13,062,000	6,999,725	53.6%	NA	6,999,725	53.6%	NA
Information Technology	8,494,000	692,800	8.2%	8.2%	2,359,800	27.8%	27.8%
Nuclear	175,000	86,000	49.1%	49.1%	86,000	49.1%	49.1%
Oil and Gas	1,444,740	223,934	15.5%	15.5%	328,600	22.7%	22.7%
Postal & Shipping	1,720,000	115,344	6.7%	6.7%	467,744	27.2%	27.2%
Transportation	3,012,000	100,185	3.3%	3.3%	198,387	6.6%	6.6%
Water and Waste	1,480,000	608,000	41.1%	41.1%	608,000	41.1%	41.1%
	84,833,881	**12,322,477**	14.5%	**4.8%**	**16,935,651**	20.0%	**11.4%**

**Commercial sector total numbers do not include the 4 sub-sectors considered less critical in a pandemic.*

HHS Figures – NVAC/ACIP Recommendations

HHS Annex D	Tier 1	Tier 2
Banking & Finance	0	0
Chemical	0	0
Commercial Facilities	0	0
Communications	0	1,080,000
Electricity	0	364,000
Emergency Services	0	2,990,000
Food and Agriculture	0	**
Healthcare*****	8,500,000	300,000
Information Technology	0	***
Nuclear	0	****
Oil and Gas	0	****
Postal & Shipping	0	0
Transportation	0	3,800,000
Water and Waste	0	****
Totals	**8,500,000**	**8,534,000**

***Food and agriculture, water, and fuel transportation are only included under Transportation.*

****Information technology is included with Communications.*

*****Incorporates all power, water, and sewerage systems under "utility workers."*

******HHS number was between 8 and 9 million, this represents the mean.*

HHS-NIAC Comparisons

HHS-NIAC Tier 1/2 Comparison		
HHS	***NIAC***	***Δ***
17,034,000	16,935,651	<0.6%

HHS Tiers 1/2 vs. NIAC Tier 1		
HHS	***NIAC***	***Δ***
17,034,000	12,322,477	<27.7%

Revised NIAC Tier 1 Figures*		
HHS	***NIAC***	***Δ***
17,034,000	11,154,324	<34.5%

Revised NIAC Tier 1-3 Figures*		
HHS	***NIAC***	***Δ***
17,034,000	13,749,289	<19.3%

**excludes Postal and Shipping, Food and Agriculture, Commercial, Chemical, and Banking and Finance.*

10

Much of what the Working Group learned about critical workers followed directly and logically from what respondents identified in previous questions as critical goods, services, and functions. For example, the worker survey response directly linked to and described a situation where some percentage or number (if either was available) of broadly classified worker types are required to sustain essential operations. Given the limited time, available resources, and the difficulty in defining essential, survey respondents generally did not go into detail in discriminating between various worker types for specific critical functions. Respondents identified some unique worker categories. However, in all cases, these initial survey responses provided a good baseline to further explore and refine worker categories and numbers. The categories and numbers provided in Appendix A reflect the exceptional efforts of the workshop participants, supporting Study, and Working Group members to refine the findings by utilizing the survey results as a baseline.

One of the most significant challenges sector representatives faced involved identifying total numbers of broad categories of workers or the sector as a whole. This difficulty stems mostly from a lack of common understanding and oversight mechanism in government or business for what fully constitutes most sectors and sub-sectors:

- HSPD-7 broadly identifies 17 CI/KR sectors but does not detail all the sub-sectors and business types in each.
- Existing Bureau of Labor Statistics (BLS), Economic Census, and other national sources of business and worker type statistics do not align cleanly with each other or the HSPD-7 taxonomy for sectors.
- No other common, consolidated government or private-sector source exists for business information covering all details about all sectors and sub-sectors.
- For highly diverse sectors, ensuring full expert representation in the survey and work group membership was extremely difficult.
- No single expert source/group yet exists in government or the private sector for all CI/KR sectors, including the PCIS/SCC/GCC or trade associations.

Recommendations from Survey Questions 1 - 4

Within the time and resources available, the Council significantly improved the nation's overall awareness and understanding about critical goods, services, and critical workers across all CI/KR sectors. At each step in the process, the NIAC made substantial advances and identified areas where the Federal government, in coordination with its public- and private-sector partners, should conduct additional study to further refine and validate the outcomes. The following recommendations address the issues raised in Questions 1-4:

- In collaboration with CI/KR owner-operators and Sector-Specific Agencies (SSAs), DHS should improve and validate the national definitions for CI/KR sectors, including:
  - Defining all the types of businesses and functions included within each CI/KR sector and sub-sector;
  - Differentiating between businesses and operations within those CI/KR businesses that function in total or in part across sectors (e.g., chemical and pharmaceutical manufacturers), and assigning these to specific sectors and sub-sectors; and
  - Distinguishing between worker categories that function across sectors (e.g., pilots and truckers who operate within the Transportation sector and pilots and truckers who operate within the Postal and Shipping sector); and
  - Assigning cross-sector workers and functions to specific sectors and sub-sectors.

- DHS should coordinate with the BLS and the Economic Census Agency to develop consistent national categories for reporting based upon HSPD-7 and clearly discriminating between worker categories by sub-sector.

- Utilizing the outcomes outlined in this report as the baseline, DHS should create a comprehensive follow-on project to study each CI/KR sector and sub-sector in detail to model and refine information on critical businesses, goods and services, and worker types.

- Utilizing the outcomes outlined in this report as a baseline, DHS should also establish a follow-on study to assess essential cross-sector interdependencies and identify resulting critical businesses, goods and services, and worker types.

Recommendations

Question 5: Communication and Dissemination of Resources

In its discussions with pandemic influenza experts, its survey of hundreds of CI/KR owner-operators, and in ongoing internal discussions, the NIAC achieved consensus on several recommendations for this report. The Council feels strongly, if enacted, these recommendations would represent a solid extension of the Federal government's ongoing work and additional private-sector efforts preparing the U.S. for the potentially devastating effects of a severe pandemic outbreak.

The series of recommendations outlined in this section of the report stem from two documents: the *National Strategy for Pandemic Influenza* and the *HHS Pandemic Influenza Plan*.[11] The NIAC believes both of these documents serve as essential building blocks for the nation's ability to prepare for, respond to, and recover from the challenges posed by a pandemic influenza outbreak in the United States. As Working Group Co-Chair Chief Rebecca Denlinger remarked during the October 12, 2006 NIAC Meeting, "Without this fine work, we would be significantly behind much of the modern world, and without the strategic framework from which we will continue to enhance our nation's preparedness and response capabilities."

As part of its pandemic assessment survey, the Council polled recipients directly regarding two distinct sets of recommendations. In Question 5, the NIAC asked respondents to make recommendations to build a structure for communication and dissemination of resources within their own companies. Question 6 examined the public sector response and asked recipients to identify principles for effective implementation by DHS and HHS.

Given its decidedly infrastructure-centric approach to this study and report, the NIAC believes there are opportunities to consider a differing prioritization framework and methodology. Beyond this differing prioritization approach, the Council would suggest the private sector represents an important partner of the Federal government in developing and implementing a response and communications infrastructure, one leveraging the vast distribution and communications infrastructures owned and operated by the private sector.

Each of the following recommendations addresses actions the President, along with the DHS and HHS Secretaries can take to improve pandemic preparedness in the United States.

A. Recommendations – Communications

The tremendous scope and broad reach of the impacts from an influenza pandemic underscore the importance of clear, concise, and consistent information from the public and private sectors. The *National Strategy for Pandemic Influenza* recognizes pandemic planning and response necessitates government leaders at all levels articulate clearly the actions and priorities the government will take and those it expects from its private-sector partners. The following lists communications-related recommendations:

[11] http://www.hhs.gov/pandemicflu/plan/

A1. Pandemic Communications Plan

The NIAC recommends Federal, State, and local government officials pre-define, to the greatest extent possible, a consistent pandemic communications plan complete with tailored communications to specific target audiences based on various possible scenarios as the pandemic may unfold. Under some scenarios, containment succeeds while other scenarios show containment fails to slow virus transmission. In other scenarios, outbreaks begin in large urban areas before the virus slowly moves into rural areas, while others predict a near-simultaneous spread across America's urban and rural landscapes. Regardless of how a pandemic outbreak eventually emerges, and regardless of the success of various response strategies, the communications plan must account for all scenarios as well as the extended duration of the pandemic.

A2. Pre-Position Communication Channels

The NIAC recommends government develop and pre-position, to the greatest extent possible, multilingual communications and messaging in all distribution channels, including radio, television, telephone, print, and online media. The Council believes these multiple distribution channels, working in concert and delivering a consistent message, will provide the greatest communications coverage possible to every target audience.

A3. Public-Private Engagement

The NIAC acknowledges the Federal, State, and local governments' preparedness work with critical infrastructure owner-operators. To build on these achievements, the Council recommends the government continue to engage the private sector to augment the distribution of communications to the critical workforce.

A4. Ongoing Refinement

Finally, the NIAC recommends public- and private-sector critical infrastructure partners continue to refine their existing communications plans, processes, and success metrics through series of response exercises. If the Federal government adopts the prioritization elements of the framework outlined in this report, the Council recommends the Federal government, in consultation with the critical infrastructure owners and operators, develop a mechanism to further refine and clearly identify those priority workforce groups within and across the nation's 17 CI/KR sectors.

B. Recommendations - Dissemination of Resources

Similar to the tremendous progress made in planning, rehearsing, and enabling communications, parallel success stories exist in the area of resource distribution and allocation. For example, the NIAC commended HHS, and more specifically CDC, for its earlier work prioritizing critical workers within the health and public health provider sub-sectors. These efforts should continue to garner the priority and attention they have warranted to date. The following lists resource dissemination-related recommendations for consideration by the Secretaries and the President:

B1. Clearly-Defined Strategy

Continue developing a clearly defined vaccine and antiviral medication distribution strategy. The NIAC strongly believes this pandemic prioritization work should be considered a starting, not an ending, point for further discussion and clarification about the Federal government's ultimate vaccine and antiviral medication distribution strategy in general and especially for the CI/KR.

B2. Private-Sector Distribution

The Council recommends the Federal government consider alternative distribution strategies and guidance that would give critical infrastructure owners and operators a stronger voice in determining which employees receive higher prioritization for vaccines and antiviral medications. Federal, State, and local government officials should build flexibility into their distribution and dispensing strategy and framework, a flexibility allowing the private sector to receive, distribute, and, with appropriate medical support, dispense vaccine and antiviral medications to their in-scope critical workforce.

The NIAC doubts government resources, at all levels of government, will be capable of coordinating with the entire critical infrastructure workforce in a timely, efficient, and accurate manner. CI/KR owner-operators have tremendous transparency into the physical location and disposition of this workforce at nearly all times and all levels, and most large businesses have internal occupational health and other medical resources to assist in the process. This type of access and situational awareness could prove valuable as a key component of a medical countermeasures distribution strategy.

Cognizant that many State and local planners have unsuccessfully tried to engage owner-operators and that legal concerns often stymie such discussions, the Council recommends private-sector planners meet with State and local representatives to help implement Federal guidance.

B3. Roles and Responsibilities

Results of this study suggest the Federal government has more work to do in its ongoing efforts to define response and containment roles and responsibilities for all public- and private-sector partners more clearly. The NIAC urges the Federal government to more clearly define response and containment roles and responsibilities.

Owner-operators involved in this study have expressed a strong degree of confusion about the roles of the multiple Federal, State, and local officials both now and in the future. The Federal government should continue to work with CI/KR owner-operators to educate them on the framework detailing how, when, and in what capacity State, local, and private-sector response participants will engage the Federal government before, during, and after a pandemic. Similarly, the Council recommends the Federal government continue to better define its expected response timelines and milestones.

B4. Continuing Education

The NIAC recommends all public- and private-sector partners continue educating their relevant stakeholders on pandemic plans, processes, and priorities, and testing them on their understanding by requesting they participate in exercises and drills.

B5. Monitoring Distribution Metrics

Engage appropriate resources to ensure adherence to the distribution strategy and the economical use of limited vaccine and antiviral resources. Furthermore, it is important the Federal government identify, collect, and report success metrics once the distribution framework is enacted, metrics can and should include field applications (e.g., real-life experiences and planned exercises).

Question 6: Principles for Effective Implementation by DHS and HHS

The *National Strategy for Pandemic Influenza*, which the White House released November 1, 2005, addresses the complete range of events that "link a farmyard overseas to a living room in America."[12] Within this document, the White House outlined the three pillars that would frame the Federal strategy. The three pillars of the nation's pandemic strategy are:

- **Preparedness and Communication** – Activities that should be undertaken before a pandemic to ensure preparedness, and the communication of roles and responsibilities to all levels of government, segments of society and individuals.
- **Surveillance and Detection** – Domestic and international systems providing continuous "situational awareness" to ensure the earliest warning possible to protect the population.
- **Response and Containment** – Actions limiting the spread of the outbreak and mitigating the health, social, and economic impacts of a pandemic.

In light of these pillars, the Council decided to respond to the sixth question by using the three pillars as a framework for its response. The NIAC believes strongly the response plan and prioritization criteria, once agreed upon, are fundamental to a successful response scenario.

C. Pillar #1: Preparedness and Communication

C1. Aligning Plans and Priorities

The NIAC recommends public and private sectors align their communications, exercises, investments, and support activities with their plans and priorities during a pandemic event. This alignment will require substantial executive-level sponsorship, governance, and oversight to ensure permeation through all levels of government and industry. Clear alignment of message and activity will simultaneously eliminate ambiguity, reduce potential for error in response, and streamline response activities by focusing on what industry deems "critical."

[12] *National Strategy for Pandemic Influenza*, http://www.whitehouse.gov/homeland/pandemic-influenza.html

- Continue data gathering, analysis, reporting, and open review.
- More clearly define roles and responsibilities across all stakeholders in both public and private sectors.
- Continue to develop and refine preparedness and response plans using the Partnership for Critical Infrastructure Security (PCIS) and/or the Critical Infrastructure Partnership Advisory Council (CIPAC) as a vehicle(s) to reach each CI/KR and Sector Coordinating Council (SCC).
- Continue to engage the private sector in public-sector planning and response exercises via PCIS and/or CIPAC as a vehicle to reach CI/KR sector and SCCs, as well as State and local entities (e.g., the National Governors Association (NGA)).

D. Pillar #2: Surveillance and Detection

Among the Council's most significant, if not intuitively obvious, findings include the remarkable surveillance and detection capabilities inherent in the nation's critical infrastructure operating model. The NIAC feels strongly the Federal government could potentially incorporate this surveillance measurement into the National Response Plan (NRP). Furthermore, the Council feels the Federal government remains unengaged with other inherent private-sector capabilities, but might engage them if facts offer some potential in a pandemic preparedness and response scenario.

D1. Bolster Surveillance and Monitoring Efforts

The Council recommends the Federal government leverage key private-sector elements in proactive surveillance and monitoring activities, including:

- Extend Federal public health surveillance operations to occupational health professionals. Nearly every CI/KR sector possesses these resources and the NIAC would argue that by extending its surveillance capabilities to occupational health professionals, the Federal government would significantly augment its traditional surveillance and detection infrastructures.
- Develop a formal framework designed to engage international components of U.S. corporations in global bio-data collection efforts. The NIAC proposes a more robust partnership would further enhance data collection, aggregation, and analysis capabilities offered through relationships directly with host nations or other organizations, including the WHO.
- Supplement exiting surveillance technology investments, acquisition, monitoring, and response capabilities in order to increase threat visibility and geographic coverage.
- Engage data acquisition and management resources within the commercial workforce in surveillance, collection, and analysis. Currently, massive private sector computing capabilities capable of focusing on the pandemic threat lie unused. If utilized, these capabilities could potentially reduce the processing time required to identify a vaccine or antiviral significantly. Or, these capabilities may rapidly speed the time to market for either of these solutions.

E. Pillar #3: Response and Containment

The final pillar addresses the nation's response to a pandemic. Mitigating the effects of any pandemic clearly hinges upon being able to apply a clear strategy in a rapidly developing situation, identifying who is responsible for what, and elucidating a treatment distribution plan. These two core items can only be facilitated if the Federal government pushes for ongoing response education and clearly defines which workforce groups fall in to the essential category.

E1. Clearly Defined Strategy

The Federal government must develop a clearly defined vaccine and antiviral distribution strategy to ensure deployment as planned.

- The Council urges the Federal government, in coordination with other key public and private stakeholders, to consider alternative distribution methods that engage private sector in directly distributing antiviral medications and vaccines to in-scope critical workforce.

E2. Roles and Responsibilities

The NIAC recommends the Federal government work closely with its partners in the CI/KR community to define response and containment roles and responsibilities more clearly.

- Better define response timelines and milestones.

E3. Continuing Education

The Federal government must do a better job in educating all stakeholders on plans, processes, and priorities.

E4. Defining Workforce Groups

Using this report's findings as a baseline for future work, the NIAC recommends the Federal government work with PCIS and/or the CIPAC to develop an innovative and easy-to-use mechanism to identify the priority workforce groups clearly.

E5. Refining Distribution Strategy

The Federal government should engage appropriate resources to ensure adherence to distribution strategy and the economical use of limited vaccine and antiviral resources.

- Identify, collect, and report success metrics.

Next Steps and Further Study

Based on the findings and recommendations in this Report, the NIAC believes there is a sharp disparity between the need to protect critical workforce populations and the strategies of current government plans. While current plans tend to prioritize protecting the most at-risk populations, many plans overlook workers who are critical to maintaining the country's infrastructure and critical services. The Council believes strongly HHS, DHS, and other Federal agencies must retool their plans; the NIAC specifically urges HHS and DHS to focus on:

- Protecting safety and security within communities;
- Maintaining economic viability at a local and national level; and
- Protecting public health and welfare.

Next Steps

The NIAC identified multiple next steps that it believes needs to be taken in order to further the work of this group.

The work of the Council also demonstrates that DHS, HHS, and other Federal agencies need to work more collaboratively. Specifically, they should foster more frequent and more meaningful communication on planning priorities and move forward on those priorities concurrently. The coordination between these two agencies should include representative organizations at the State and local level to ensure direction and guidance from the Federal level is actionable and understood by those individuals who will be executing strategies during a pandemic or other emergency. Ideally, this work will bring in CI/KR owner-operators prior to incidents to review plans and communicate regarding shifting and competing priorities. Without integrating more assertive cross-organization collaboration at all levels of government including an ongoing dialogue with the private sector, no amount of planning will translate to achieving actions during a pandemic response.

The Federal government should examine whether its current plans possesses functionality at all levels of government and the private sector. This is particularly true of current vaccine and antiviral distribution plans, which do not consider private-sector critical workforce populations. For example, Appendix D of the *HHS Pandemic Influenza Plan*, which prioritizes reducing morbidity and mortality ahead of economic impacts, does not really address critical workforce employees as a priority population, with the exception of healthcare workers (mentioned earlier). Instead, it places employees of critical sectors in the next-to-last tier. Federal and State government representatives must also devise a communication plan to disseminate information on planning changes to the local level. This plan should also consider how information would be passed to the private sector. Moreover, it should describe how local-level responders and owner-operators could efficiently provide feedback to planners.

The Group feels the Federal government should commission an additional study to research the degree to which contract workers, full-time equivalents (FTEs), and employees overseas play a role in maintaining the nation's critical infrastructure, including operating critical government programs and organizations. Many critical public- and private-sector entities rely heavily upon contract labor to conduct vital business functions. Often, talents these contractors possess are not

readily available within their client organizations. These vital contract specialists include maintenance specialists at nuclear power facilities, line workers for power and telephone companies, ATM money handlers, and support specialists for computer software and hardware.

The NIAC believes it is imperative to examine innovative methods to respond to critical infrastructure impacts during a pandemic. For instance, more government responsibility and support in financial matters during a pandemic may assist critical entities in maintaining operations.

Federal government organizations need to continue streamlining planning mandates and funding streams to limit duplicative work among State, local, and private sector interests. Often, these duplicative efforts slow planning and, worse, response in times of crisis. Simplicity in planning and funding will provide a higher readiness level and a more efficient response before, during, and after a pandemic outbreak.

The complexity of interdependencies among CI/KR sectors cannot be understated. Furthermore, as business operations change and criticalities evolve, interdependencies shift in importance. The NIAC believes these interdependencies must be mapped clearly, so sectors are better able to protect their critical assets in the wake of a severe pandemic influenza and better prepared to defend themselves against potential cascading failures across sectors.

Finally, the government and private sector must continue taking steps to build and maintain public-private partnerships. These partnerships will be critical in both planning for and responding to a pandemic event. Information sharing, communicating needs, and potentially valuable assets will make preparedness efforts more thorough and effective. Similarly, these existing relationships will pay dividends during a response. Established lines of communications with previously identified partners will be the backbone of a streamlined response.

At the national level, organizations can continue to foster these relationships through the CIPAC, PCIS, the Overseas Security Advisory Council (OSAC), and other established nexus points. These partnerships also need to be locally established and maintained through face-to-face interaction and established collaboration systems that may be in place through state or local emergency management agencies (or homeland security offices).

Suggestions for Further Study

The Council also identified further areas of study it believes would provide added value to the work it was able to achieve on the issue of pandemic prioritization. While not formal recommendations, these suggestions are logical follow-on actions for the Federal government to enact based on the above and ensuing recommendations.

- The NIAC strongly believes the Federal government should develop an appropriate forum to identify, quantify, and qualify potential prioritization and distribution methods and channels. This forum may fall under the purview of the Vaccine Prioritization Interagency Group. The NIAC understands this group is scheduled to meet with representatives of the private sector, but Council members feel strongly this group, or another group, must have full participation from the private sector. Private sector CI/KR

representation must have a voice at the table alongside representatives from all relevant Federal departments and agencies.

- The NIAC noted the focus of its NIAC prioritization study and recommendations differs from existing Federal and State plans, including the findings of two Federal advisory committees, the Advisory Committee on Immunization Practices (ACIP) and the National Vaccine Advisory Committee (NVAC). Both the ACIP and NVAC provided recommendations to HHS on the use of vaccines and antiviral drugs during a pandemic influenza.[13] Unlike previous efforts, this study focused on the following four principles:

  - Maintaining national and homeland security;
  - Ensuring economic survival;
  - Maintaining public health and welfare; and
  - Identifying and addressing critical interdependencies and single points of failure.

  The NIAC urges the Federal government to take the lead in resolving the differences in the findings and recommendations that resulted from the priority recommendations outlined in this report vis-à-vis other Federal and State prioritization methods and criteria.

- As public and private partners continue their ongoing dialogue regarding prioritization of vaccine and antiviral medications, one issue the Council feels demands further study that is more intensive is the operational method of distributing those medications. After all parties formalize the prioritization tiers and strategies to be used, it will still be necessary to determine exactly which critical workforce members will receive the allotted quantities for a particular sector and how the allotted vaccine will be distributed.

  The Council believes it is important to study further whether manufacturers should deliver the ultimate allotments to Federal and/or State government public health officials or whether they should distribute shipments directly to the private sector, allowing owner-operators and managers to determine exactly which employees receive the vaccine and/or antiviral medication. The NIAC did not reach consensus on this issue. Many thought it would be best for the medications to go directly to the critical infrastructure companies because managers on the ground would have the best feel for which employees should receive the vaccine and/or antiviral medication. On the other hand, some in the NIAC expressed skepticism about this option, noting it would put managers in an untenable position of deciding who would or would not receive vaccine and/or antiviral dose.

  This discussion also asks who will actually vaccinate those employees. For large businesses with onsite medical personnel, this may not be a difficult question, but for smaller companies, there will need to be some arrangement made with outside medical providers to receive and administer the drugs.

[13] HHS Pandemic Influenza Plan, Appendix D: NVAC/ACIP Recommendations for Prioritization of Pandemic Influenza Vaccine and NVAC Recommendations on Pandemic Anti-viral Drug Use: http://www.hhs.gov/pandemicflu/plan/appendixd.html.

- Finally, despite the Council's best efforts, members acknowledge there is a tremendous amount of work yet that all parties need to accomplish. The NIAC urges the Federal government to continue working with the private sector to refine further the critical worker definitions, priorities, and numbers contained in this report. Given the time constraints and uneven response to the survey and study by sectors, the Council believes this report represents a tremendous first step toward securing a realistic, actionable, and workable prioritization framework and strategy for workers in the nation's critical infrastructure sectors. In an effort to continue refining critical workforce numbers and to build upon the achievements of this study, the NIAC suggests DHS continues to work with the Partnership for Critical Infrastructure Security as a vehicle to reach back into each CI/KR sector and SCC over the course of the next 12 months.

Appendix A: Pandemic Primer

> *The avian flu bears the potential for societal disruption of unprecedented proportion. Strong partnerships and smart planning will be our best protection against this threat.*
>
> -DHS Secretary Michael Chertoff

Historical Context

While pandemics appear throughout history, public health officials gathered their best research from the three 20th Century pandemics that struck in 1918, 1957 and 1968. Unique characteristics differentiate these pandemics, including differences in prominently affected populations and the flu subtype's virulence.

History's most infamous pandemic, the 14th Century's "Black Death," reduced Europe's population by as much as two thirds; however, the 1918 Pandemic Influenza actually killed more people in one year than the Plague.[14] The so-called "Spanish Flu" [A (H1N1)] infected 500 million people worldwide and killed an estimated 40 million people, roughly 20 to 40 percent of the earth's 1918 population[15]—a figure exceeding the death toll of World War I. The pandemic's virulence and widespread impact on typically less susceptible demographic populations, including previously healthy young adults,[16] makes the Spanish Flu even more notable. H1N1 displayed numerous unique traits including:

- Extremely high case-severity rate;
- Fatal infection rates peaking in young adults;
- Concurrent infection in swine; and
- Three simultaneous, distinct outbreaks in 1918 and 1919 across Europe, Asia, and North America.[17]

Since 1918, there have been two other significant, albeit less catastrophic, influenza pandemics. The world's most recent pandemic influenza occurred in 1968. Dubbed the "Hong Kong Flu," it killed an estimated 34,000 Americans during the 1968-1969 flu seasons. Eleven years prior, the 1957-1958 "Asian Flu" killed approximately 70,000 Americans and between one and four million people worldwide.[18] Scientists credit timing and advances in medical technology for dramatically reducing a pandemic's lethality in comparison to previous pandemics.

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14 "The Influenza Pandemic of 1918," Stanford University Human Virology, http://virus.stanford.edu/uda/

15 "Pandemic Influenza," Globalsecurity.org, http://www.globalsecurity.org/security/ops/hsc-scen-3_pandemic-influenza.htm.

16 http://www3.niaid.nih.gov/news/focuson/flu/illustrations/timeline/timeline.htm

17 Taubenberger, Jeffery K. and Morens, David M., "1918 Influenza: The Mother of all Pandemics," Armed Forces Institute of Pathology, Rockville, MD and National Institutes of Health, Bethesda, Maryland, Emerging Infectious Diseases, Vol. 12, No.1, January 2006, http://www.cdc.gov/ncidod/EID/vol12no01/05-0979.htm#cit.

18 "Pandemics and Pandemic Scares in the 20th Century," National Vaccine Program Office

The 1957 Asian Flu exhibited a problem often feared during an outbreak's apparent cessation. In early January 1958, the worst appeared over with the number of infections and deaths subsiding; however, during late January and early February 1958, the flu reemerged as a second wave coursed through America's elderly community.[19] As for the Hong Kong Flu one decade later, the first American infections appeared in September, but the strain never became widespread until December 1968.

Current Status

Health officials first recognized the current influenza virus, H5N1 or avian influenza, in birds during in the late 1990s. In 1997, officials in Hong Kong identified avian influenza (H5N1) as the cause of 18 human severe respiratory disease cases, six of which were fatal.[20] These cases represent the first known human H5N1 infections.

The disease affects both migratory and domesticated birds. This deadly avian flu strain first appeared in 1996 on a Guangdong, China and now, according to United Nations Development Group (UNDG), H5N1 infected fowl in 49 different countries across Africa, Asia and Europe[21] as of April 2006. Experts predict migratory birds will eventually carry the highly pathogenic H5N1 virus from either Asia or Europe to North America. To date, bird-to-human H5N1 transmission remains rare, occurring only in cases where humans experienced prolonged, close contact with avian populations. As of November 13, 2006, 258 people across three continents have contracted avian flu, 153 fatally, a death rate approaching 60 percent.[22]

HSN1's potential mutation into an easily transmissible strain, capable of infection through human-to-human contact, concerns experts. Uncertainty exists about exactly how this mutation will affect the virus itself, the currently high human mortality rate elicited comparisons between this influenza virus and the 1918 Spanish Flu virus. If H5N1 maintains its current virulence and emerges as a disease easily transmissible between humans, the ramifications could be catastrophic. Spanish Flu's severe impacts occurred in a world with a much smaller and far less mobile population; however, the access to top-quality healthcare infrastructure and the advances in healthcare technology could negate those variables.

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[19] "Potential Severity: Purdue University Influenza Information." http://news.uns.purdue.edu/html3month/2006/Severity.html

[20] "H5N1 avian influenza: timeline," World Health Organization (WHO), October 28, 2005.

[21] "Incidence of H5N1 Virus: UN World Food Programme, Emergency Preparedness and Response Branch, Statistical map issued by the UN, April 3, 2006, http://www.undg.org/documents/7685-WFP__Global_Avian_Flu_Incidence.pdf

[22] According to the World Health Organization (WHO), http://www.who.int/csr/disease/avian_influenza/country/cases_table_2006_11_13/en/index.html

Pandemic Background

Accurately assessing a pandemic's impact on the critical infrastructure workforce requires a complete understanding of its background and terminology. This section delineates the differences between seasonal and pandemic influenza, explores the effects of previous pandemics, and describes ongoing national and international efforts to prepare for a pandemic.

The U.S. Government's official pandemic website, www.pandemicflu.gov, defines pandemic influenza as a "virulent human flu that causes a global outbreak, or pandemic, of serious illness. Because there is little natural immunity, the disease can spread easily from person to person."[23] A novel influenza subtype causes pandemic influenza. This new strain distinguishes pandemic influenza and seasonal flu: seasonal flu involves viruses to which humans have previous exposure.

Flu Terms Defined

Seasonal (or common) flu is a respiratory illness that can be transmitted person to person. Most people have some immunity, and a vaccine is available.

Avian (or bird) flu is caused by influenza viruses that occur naturally among wild birds. The H5N1 variant is deadly to domestic fowl and can be transmitted from birds to humans. There is no human immunity and no vaccine is available.

Pandemic flu is virulent human flu that causes a global outbreak, or pandemic, of serious illness. Because there is little natural immunity, the disease can spread from person to person. Currently, there is no pandemic flu.

Source: *www.pandemicflu.gov*

Government Preparedness and Response

A pandemic rivaling 1918's severity would affect more than just morbidity and mortality. The Congressional Budget Office (CBO) estimates a pandemic of similar proportions would cost the United States more than $600 billion. While the 1957 and 1968 pandemics were less severe in comparison to the 1918 influenza, both of them still dramatically impacted both the economy and public health.

One cannot underscore the potential effects of a severe pandemic on the domestic and international economies. They may affect any point in a company or sector's business process, from causing input shortages to curtailing consumer activity. To avoid potentially catastrophic impacts, the Federal government encouraged business owner-operators to plan for a pandemic by examining their current business continuity plans and identifying critical employees and systems that must remain operational when an influenza pandemic stresses supply chains or the workforce. Industries providing critical inputs to other sectors are especially important to the economy's resilience as they may cause cascading deficiencies affecting multiple sectors or business practices.

Federal, State, and local governments are preparing for both moderate and severe pandemics. While the number of individuals infected by a pandemic alters by the strain's severity, the Federal government anticipates the number of people seeking advanced medical care will increase ten-fold as the severity increases. These services include hospitalization, respirator support, and activities surrounding deaths from infection.

[23] http://www.pandemicflu.gov

Table 3 shows Health and Human Services estimates based on a moderate and severe pandemic.[24]

Table 3

Characteristic	Moderate (1958/68-like)	Severe (1918-like)
Illness	90 million (~30 percent)	90 million (~30 percent)
Outpatient medical care	45 million (~50 percent)	45 million (~50 percent)
Hospitalization	865,000	9,900,000
ICU care	128,750	1,485,000
Mechanical ventilation	64,875	742,500
Deaths	209,000	1,903,000

Public health officials remain engaged in both domestic and international efforts to better prepare their pandemic response capabilities. Increased vigilance in tracking the status of the pandemic cycle is part of this process. To aid with this goal and to communicate risk information more effectively, the World Health Organization (WHO) defined Pandemic Phases and the U.S. Homeland Security Council (HSC) identified U.S. Pandemic Response Stages. Each list tracks pandemics from pre-pandemic events occurring in animal populations through phases of human infection, to sustained disease in human populations and recovery. The HSC list focuses on the current domestic situation but also integrates international considerations. The HSC designed its Pandemic Stages to work in coordination with the WHO Phases.

[24] http://www.hhs.gov/pandemicflu/plan/part1.html

Table 4 below compares the WHO and HSC Alert Phases.

Table 4

WHO Phases		Federal Government Response Stages	
INTER-PANDEMIC PERIOD			
1	No new influenza virus subtypes have been detected in humans. An influenza virus subtype that has caused a human infection may be present in animals. If present in animals, the risk of human disease is considered to be low.	0	New domestic animal outbreak in at-risk country
2	No new influenza virus subtypes have been detected in humans. However, a circulating animal influenza subtype poses a substantial risk of human disease.		
PANDEMIC ALERT PERIOD			
3	Human infection(s) with a new subtype, but no human-to-human spread, or at most rare instances of spread to a close contact.	0	New domestic animal outbreak in at-risk country
		1	Suspected human outbreak overseas
4	Small cluster(s) with limited human-to-human transmission but spread is highly localized, suggesting that the virus is not well adapted to humans.	2	Confirmed human outbreak overseas
5	Larger cluster(s) but human-to-human spread still localized, suggesting that the virus is becoming increasingly better adapted to humans, but may not yet be fully transmissible (substantial pandemic risk).		
PANDEMIC PERIOD			
6	Pandemic phase: increased and sustained transmission in general population.	3	Widespread human outbreaks in multiple locations overseas
		4	First human case in North America
		5	Spread throughout United States
		6	Recovery and preparation for subsequent waves

Table 5 identifies recommended actions and public health goals needed in any response to an event that changes the status of the pandemic level. The WHO currently classifies H5N1's effects as a "3" in the Pandemic Alert Period.[25] During the pandemic period, it is important to note that the HSC stages may change swiftly in response to rapidly evolving circumstances domestically or overseas.

[25] WHO Global Influenza Preparedness Plan, http://www.who.int/csr/resources/publications/influenza/GIP_2005_5Eweb.pdf

Appendix B: Countermeasures

The public health and medical communities identified multiple methods to combat the spread of pandemic influenza. These countermeasures fall into two broad categories, public health products (both medical and non-medical products), and social constraints. Pharmaceutical products include pandemic influenza vaccines and antiviral medications, whereas non-medical products include masks, gloves, and respirators. Both medical and non-medical products play important roles in limiting the spread of the virus, but given the assumed shortage of vaccines and antiviral medications, non-medical products are likely to play an even more critical role. In response to probable antiviral and vaccine shortages, HHS recently allocated $5 million to assist the ongoing study of non-medical countermeasures. These funds will directly aid in better understanding a non-medical response and provide public health officials with viable options to augment medical countermeasures.[26]

Social distancing strategies represent voluntary and imposed social constraints that might inhibit the spread of pandemic influenza within a community. Isolation and quarantine, meanwhile, while they may be voluntarily employed both are defined formally by government entities, and in specific cases, represent legally applied public health and medical interventions to limit disease spread. Most likely, these proposed social intervention strategies, along with non-medical countermeasures, will be the only disease containment measures available to the public in the first months of a pandemic. Whether viewed individually or together, none of these countermeasures represents a panacea for a pandemic. Estimates are that approximately 15 percent of the U.S. population—half of all people experiencing symptoms—will seek medical care during a pandemic.[27] If this care is unavailable or compromised because of extremely heightened demand, individuals will be at a higher risk during a pandemic. The benefits of these strategies are that none depends on public access to medical care and all assist to reduce the demand for medical care—important facts given the likelihood that hospitals, doctors' offices, and health clinics will be overwhelmed during the peak pandemic waves.

Pharmaceutical Countermeasures

Pharmaceutical countermeasures for pandemic influenza fall into two major categories, antiviral medications and vaccines. Each countermeasure comes with positive and negative characteristics defining how healthcare providers may most effectively use them before and during a pandemic. Beyond the characteristics of the countermeasures themselves, current vaccine and antiviral medication distribution plans may be overwhelmed in a scenario demanding swift, nationwide distribution on a scale required to respond to a pandemic. This is particularly true when trying to reach public- and private-sector entities operating across state borders.

In preparation for a pandemic, Federal, State, local and private sector officials have begun stockpiling two antiviral drugs on the recommendation of the CDC:

- *Oseltamavir* (Tamiflu) and

[26] http://www.rwjf.org/portfolios/features/digest.jsp?id=4352&iaid=141

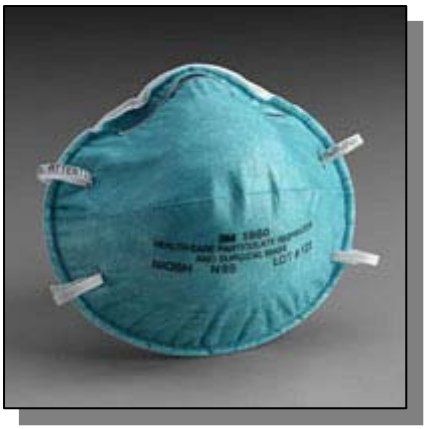
[27] http://www.hhs.gov/pandemic/plan/part1.html

- *Zanamavir* (Relenza).

Doctors may use these medications as a treatment option to reduce the length and severity of influenza symptoms.[28] Physicians may prescribe *Tamiflu* as prophylaxis against influenza. There are specific uses approved for both *Tamiflu* and *Relenza*, but doctors administer them to their patients differently depending on age and health condition.[29] The Federal government started stockpiling each of these drugs; however, capacities remain inadequate for widespread use of the antivirals for years.[30] It is also important to note the influenza virus' rapid mutation capacity may render these drugs ineffective; H5N1 is already resistant to *amantadine* and *rimantadine*, two other antiviral medications physicians previously used against seasonal influenza. Public health agencies recommended against the use of *amantadine* and *rimantadine* in the 2006-2007 flu season due to drug resistance seen in cases of H5N1.[31]

Traditionally, influenza vaccine production cannot begin until after researches identify and isolate the specific strain of an influenza virus. This means vaccine production in response to pandemic influenza cannot begin until the actual pandemic begins. Secondly, standard production restraints constrain the pace and volume of production. Researchers seek to identify new technologies would speed vaccine production and improve the number of vaccinations possible from a given vaccine quantity.

Production capacity in the United States presents a challenge given as only one U.S.-based influenza vaccine plant currently exists. There is also the risk that continuing mutation of the influenza virus after it becomes human-to-human transmissible would render the vaccine ineffective. Unless there is a major scientific breakthrough, it may be many months into the pandemic before adequate doses of vaccine reach the market. HHS stockpiled sufficient vaccines to treat 4 million individuals; scientists developed this vaccine on a strain of pandemic flu isolated in early 2004. HHS is also encouraging research into methods to improve vaccine production rates, to lower the effective vaccination dose, and to diversify vaccine production methods.[32]



In addition to stockpiling antiviral medications and vaccines, the government is also acquiring non-medical countermeasures, such as gloves, respirators, and surgical masks. As of June 2006, the CDC's Strategic National Stockpile contained 32.5 million of these masks.[33] These stockpiled respirators and masks are similar in form and function; there are two notable differences: respirators, such as the N-95 respirator (shown to the right), more effectively filter air than an individual breathes; to assure this wearers

[28] http://pandemicflu.gov/plan/federal/index.html
[29] http://www.niaid.nih.gov/factsheets/fludrugs.htm
[30] http://pandemicflu.gov/plan/federal/index.html
[31] http://www.niaid.nih.gov/factsheets/fludrugs.htm
[32] http://pandemicflu.gov/plan/pdf/panflureport2.pdf
[33] http://pandemicflu.gov/plan/pdf/panflureport2.pdf

must have respirators fit-tested to assure maximum performance. Both barriers may serve two purposes, to limit the spread of disease to healthy populations and to prevent sick individuals from spreading the disease to others. Similarly, gloves will likely be used as standard barrier protection between healthy and sick individuals.

HHS is planning to use these physical non-medical countermeasures in coordination with other behavioral countermeasures to limit the public's susceptibility to catching and/or spreading the influenza virus. Hand-washing education and proper cough etiquette are two examples of highly effective public health recommendations on an individual level. CDC published numerous documents outlining proper etiquette for hand-washing and coughing/sneezing etiquette.[34]

Social Interventions

The public health community is considering a series of measures intended to inhibit the spread of disease. These measures vary in their severity and potential to disrupt day-to-day activities. Federal, State, and local government officials are developing strategies to respond to a pandemic using these methods. These methods have a historical precedent; health officials have used them in the past to assist in controlling previous epidemics, with varying degrees of success. During a pandemic, the goal will be to slow the virus' transmission; delaying the spread of the virus will provide more time for vaccine development while reducing the stress on an already burdened healthcare system.

Isolation: For People Who Are Ill

Isolation refers to the separation of persons who have a specific infectious illness from those who are healthy and the restriction of their movement to stop the spread of that illness. Isolation allows for the focused delivery of specialized health care to people who are ill, and it protects healthy people from getting sick. People in isolation may be cared for in their homes, in hospitals, or in designated healthcare facilities. Isolation is a standard procedure used in hospitals today for patients with tuberculosis and certain other infectious diseases. In most cases, isolation is voluntary; however, many levels of government (Federal, State, and local) have basic authority to compel isolation of sick people to protect the public.

Quarantine: For People Who Have Been Exposed But Are Not Ill

Quarantine refers to the separation and restriction of movement of persons who, while not yet ill, have been exposed to an infectious agent and therefore may become infectious. Quarantine of exposed persons is a public health strategy, like isolation, that is intended to stop the spread of infectious disease. Quarantine is medically very effective in protecting the public from disease.

Source: http://www.cdc.gov/ncidod/dq/sars_facts/isolationquarantine.pdf

The government retains the authority to limit the public's movement during an outbreak. In addition to border closures, isolation, and quarantine generally represent the most widely known movement control methods. Quarantine is a legally enforceable declaration that a government body may institute over individuals potentially exposed to a disease, but who are not symptomatic. If enacted, Federal quarantine laws will be coordinated between CDC and State and local public health officials,

[34] *For more information on how to stop the spread of germs at home, school, and work, log on to* http://www.cdc.gov/flu/protect/stopgerms.htm and http://www.cdc.gov/flu/protect/stopgerms.htm#GoodHealthHabits.

and, if necessary, law enforcement personnel. During previous pandemics, particularly in 1918, many communities used isolation strategies and "reverse quarantine strategies" to prevent the disease's spread to their community from surrounding populations. The government may also enact travel restrictions to limit the movement of people and products between geographic areas in an effort to limit disease transmission and spread. Authorities are currently reviewing possible plans to curtail international travel upon a pandemic's emergence overseas.

Limiting public assembly opportunities also helps limit the spread of disease. Concert halls, movie theaters, sports arenas, shopping malls, and other large public gathering places might close indefinitely during a pandemic—whether because of voluntary closures or government-imposed closures. Similarly, officials may close schools and non-essential businesses during pandemic waves in an effort to significantly slow disease transmission rates. These strategies aim to prevent the close interaction of individuals, the primary conduit of spreading the influenza virus. Even taking steps such as limiting person-to-person interactions within a distance of three feet or avoiding instances of casual close contact, such as shaking hands, will help limit disease spread.

In many instances, the aggressive spread of influenza within communities during the 1918 pandemic was attributed to the close physical association of individuals in public gatherings or the workplace. For instance, Philadelphia officials ignored national recommendations against public gatherings to participate in the war bond parade experts believe likely contributed to the rapid movement of influenza through the city. During the Liberty Loan Drive parade in Philadelphia on September 28, 1918, 200,000 people grouped closely along the parade route. Shortly thereafter, city health officials reported 635 new Spanish Flu cases.[35]

A pandemic will also demand changes in workplace behavior and practices. Businesses may be encouraged to have employees work from home as a means to limit employee interaction. Other steps, such as instituting shift work and altering business processes to minimize employee interaction are likely reactions to a pandemic. DHS' *Pandemic Influenza Preparedness, Response, and Recovery Guide for Critical Infrastructure and Key Resources*[36] provides more detail on strategies to protect businesses and their employees during a pandemic.

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[35] http://www.hsp.org/files/findingaid0217southphilawomen.pdf

[36] http://www.pandemicflu.gov/plan/pdf/CIKRpandemicInfluenzaGuide.pdf

Appendix C: Sector-by-Sector Breakdown

In collaboration with their sector partners, sector representatives wrote and submitted the following sector profiles. In a few cases, the Support Team wrote the profiles and then worked with contacts and expert representatives from the given sector to approve the language and recommendations.

Banking and Finance Sector Profile

Overview

The Banking and Finance sector is a service-based industry providing a wide variety of financial services both domestically and internationally. Financial institutions are organized and regulated based on the services the institutions provide. These categories include:

- Deposit and payment systems and products;
- Credit and liquidity products;
- Investment products; and
- Risk transfer products.

With more than 17,000 depository institutions, 15,000 providers of various investment products, 8,500 providers of risk transfer products, and many thousands of credit and financing organizations, the sector possesses a large amount of assets and includes numerous individual businesses. Financial institutions include:

- Banks;
- Thrifts;
- Credit unions;
- Securities, commodities and derivatives firms/exchanges;
- Insurance companies;
- Pension funds;
- Government-Sponsored Enterprises (GSE); and
- Depository institutions.

Sector Pandemic Planning

A pandemic not only significantly threatens the Banking and Finance sector's day-to-day operations; it also threatens the health and well-being of its employees as well as domestic and global economies. Consequently, much of the sector's recent focus centers on pandemic planning.

The Banking and Finance sector represents the forefront of pandemic planning. On January 26, 2006, its Sector Coordinating Council (the Financial Services Sector Coordinating Council

(FSSCC)) issued its *Statement on Preparations for "Avian Flu*," (Statement).[37] The Statement discusses the unique issues an avian flu pandemic would raise as well as potential business continuity planning implications these issues cause.

In addition to publishing the statement, the sector formed an Infectious Disease Forum[38] at its June 6, 2006 FSSCC meeting. The Securities Industry and Financial Markets Association (SIFMA) provides leadership for the Forum on FSSCC's behalf and holds quarterly meetings, including joint sessions with the Financial and Banking Information and Infrastructure Committee's (FBIIC) Avian Flu Working Group. The sector held two Forum meetings in 2006, both in Washington, D.C.

The sector envisioned the Forum as a venue for FSSCC members with active avian flu working groups or currently researching this issue to collaborate and share information. The FSSCC also designed the Forum to develop and communicate information and strategies FSSCC members and their member organizations to use in preparation for an avian influenza pandemic or other infectious disease outbreak. One of the most significant benefits of the Forum is it provides coordination for pandemic influenza planning between the public and private sectors. The Forum provides an opportunity for collaboration with the FBIIC Avian Flu Working Group to facilitate a better understanding of the sector's issues and needs during an infectious disease outbreak.

Finally, the Forum provides an opportunity to coordinate and collaborate with other sectors the Banking and Finance sector depends on. In 2006, the newly formed Forum engaged both the Telecommunications and Electricity sectors in an effort to begin exploring avenues for further pandemic planning coordination and cooperation. Because of the Forum, the National Communications Service (NCS), the Telecommunications sector, and FSSCC formed a new working group to explore potential "bandwidth" issues associated with the likely increase in telecommuting during a pandemic.

The sector continues to work diligently refining best practices, business continuity plans, and homeland security efforts to better protect employees and financial assets in the event of an influenza pandemic. They will continue looking for opportunities to collaborate and coordinate with Treasury, DHS, and other critical private-sector groups on whom Banking and Finance depends.

Approach to Tiering

The Banking and Finance sector used the following criteria to identify and differentiate "essential" employees into two separate groups, designated Tier 1 and Tier 2.

Tier 1

Employees considered essential to critical financial markets, which the sector defines below:

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[37] See https://www.fsscc.org/reports/2006/fsscc_avian_flu_statement.pdf for the complete Statement.

[38] The members of the Forum are the Securities Industry and Financial Markets Association, the Bond Market Association, the Futures Industry Association, ChicagoFIRST, The Clearing House, the American Bankers Association, BITS, the FS-ISAC, the National Association of Federal Credit Unions, the Financial Services Technology Consortium, the American Council of Life Insurers.

- Federal funds, foreign exchange, and commercial paper;
- U.S. Government and agency securities; and
- Corporate debt and equity securities.

These employees are associated with two groups of organizations providing "core clearing and settlement" services or act as large-value payment system operators and present systemic risk to the entire financial system should they be unable to perform their roles.

The support of wholesale clearing and settlement services during a pandemic requires 75,000 full-time critical resources. This represents slightly more than 1 percent of the sector's full-time employment.

Tier 1 also includes sufficient critical personnel to operate and maintain minimum cash availability to the public through the ATM network (1 ATM per bank branch office). The sector estimates this will require 342,000 fulltime resources representing about 5.5 percent of the sector's employee base. Cash availability will be critical to maintaining public confidence in the financial system and preventing a "run on the bank."

Tier 2
Tier 2 employees are considered critical to essential, daily retail services necessary for the public to:

- Obtain cash on a broader basis through the ATM network and
- Maintain electronic payment systems (checking, wire transfer, ACH, retail lockbox, credit/debit card) throughout a pandemic.

The ability to maintain the retail electronic payment systems will be crucial for the public to continue daily financial and retail activities and ultimately ensuring economic survival during a pandemic. Tier 2 contemplates protecting sufficient personnel to enable continuous ATM cash operations through the ATM network and keep all ATMs available. In addition, Tier 2 would protect sufficient critical resources to maintain retail electronic payments, enabling the public to continue using checks and credit/debit cards on a daily basis. This effort would require protecting an additional 1,145,000 full-time resources, roughly 19 percent of the sector's workforce.

Total Banking and Finance sector resources recommended for protection in Tiers 1 and 2 is 1,562,000, about 25.4 percent of the sector's full-time workforce based on BLS employment figures from August 2006.

It should be noted in the early phases of an actual pandemic, the Banking and Finance Sector intends to closely monitor the impact to its critical services and support resources and offer recommendations to increase or decrease the numbers of eligible sector employees in these critical groups based on actual events as the pandemic unfolds.

Information Sources

1. Individual firm data collected through the Pandemic Assessment Template
2. Federal Reserve Bank Statistics for Large Commercial Banks (2006)

3. Economic Census Data (2002)
4. Bureau of Labor Statistics (August 2006)

Chemical Sector Profile

Sector Essential Goods/Services

Chemistry is an essential part of our everyday lives – its benefits visible throughout society. Vital to industries such as construction, motor vehicles, paper, electronics, transportation, agriculture, and pharmaceuticals, chemicals remain essential to manufacturing. Although some chemical manufacturers produce and sell consumer products such as soap, bleach, and cosmetics, most chemical products serve as intermediate products for other end-goods.

The Bureau of Labor Statistics (BLS) divides chemical manufacturing into seven segments: basic chemicals; including synthetic materials such as resin, synthetic rubber, and artificial and synthetic fibers and filaments; agricultural chemicals, including pesticides, fertilizer, and other agricultural chemicals such as paint, coating, and adhesives; cleaning preparations, including soap, cleaning compounds, and toilet preparations; and other chemical products.[39] The seventh segment, pharmaceutical and medicine manufacturing, for HSPD-7 CI/KR relationships is considered a part of the Healthcare and Public Health sector and will be addressed in that portion of the NIAC Report.

Chemical raw materials are used in more than 70,000 products including food, water supplies, clothing, shelter, health care, computer technology, and transportation. These products influence every part of modern society in a positive way.[40] For example:

- Chlorine serves as a disinfectant. According to the World Health Organization, chlorine's use in water treatment represents one of the most significant advances in public health protection. Chlorine plays a key role in controlling bacteria and viruses in water that can cause human illness.[41]

- A significant amount of each vehicle manufactured relies on chemical processing and products – including polymers, seat cushions, rubber hoses and tires, air-bags, brake liners, brake fluids, nylon seat-belts, etc.[42]

- Cellular telephones would not exist without the silicon chemistry used to develop the microprocessors and plastics that make them lighter, smaller, and portable

- The medical field benefited greatly from chemistry and modern health services depend upon these products. Polymer chemistry can be found in catheters, stethoscope diaphragms, and oxygen tents. PVC resins exist for tubing for IVs and blood transfusions and provide for the safe coatings around wires and cables. Polycarbonate is used in numerous areas such as syringes, surgical instruments, and dialysis filters. Carbon chemistry is used for making synthetic diamonds for sharp, precise surgical knives.

[39] U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs008.htm
[40] American Chemistry Council, http://www.americanchemistry.com/s_acc/index.asp
[41] Chlorine Chemistry Council, http://c3.org/chlorines_everyday_uses/chlorine.pdf
[42] American Plastics Council, http://americanplasticscouncil.org/s_apc/sec.asp?CID=303&DID=902

Latex gloves, sutures, surgical dressings, bandages, and splints are all the result of chemical products.

Sector Essential Workers

To varying degrees, all chemical sector workers are important to sustaining the normal flow of chemical products. When it becomes necessary to balance the needs of protecting workers and maintaining critical goods and services during a pandemic, the Chemical sector can defer certain chemical sector processes (e.g..., research and development, most "back-room" administrative activities, and marketing and sales) for the duration of the outbreak. During a severe pandemic wave, the chemical sector will concentrate on sustaining producing and distributing its most critical goods.

Manufacturing chemicals usually is a continuous process. In other words, once a process begins, workers cannot stop it once it is time for them to go home. Split, weekend, and night shifts are common throughout this sector. Many chemical manufacturers automated their processes with built-in safety features and trained many staff members to operate interdependently. As was evident during the 2005 hurricane season, small emergency teams are prepared to shut down, start up, and operate critical systems. Over the long-term, the sector needs additional staff and a myriad of other services to keep plants running.

The Chemical sector needs numerous primary production and distribution workers to protect those workers who support the most critical plants and their operations. The most important of these workers include the following category types:[43]

- ***Chemical plant*** and ***system operators*** – These workers monitor the entire production process. From chemical ingredient ratios to chemical reaction rates, the operator is responsible for efficiently operating the plant. Plant operators generally advance to these positions after acquiring extensive production process experience and technical training.
- ***Industrial machinery mechanics*** and ***machinery maintenance workers*** –These workers repair equipment, install machines, or practice preventive maintenance in the plant.
- ***Inspectors, testers, sorters, samplers,*** and ***weighers*** – These workers ensure the production process runs efficiently and that products meet quality standards.
- ***Transportation*** and ***material moving workers –*** These workers move materials around the plant or deliver finished products to customers. For these jobs, the sector requires experienced workers with knowledge of chemical hazards, safety procedures, and regulations governing the transport of hazardous chemicals.

Operations during a Disaster

Health safety, security, and environmental preparedness remain a focal point for the chemical sector. Pandemic preparedness, as a part of plant safety and security represents only one facet of the issues facility owner/operators address.

Under typical disaster response scenarios, long-term disruption of most basic chemical operations could normally be handled through heightened production in lesser-impacted areas of the country, or even abroad. The long-term implication of an off-line facility for an extended

[43] U.S. Department of Labor, Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs008.htm

period could become crippling as it could lose its ability to regain market share in a globally competitive industry such as chemical manufacturing. Existing inventories or price spikes might mitigate shorter-term disruptions as supply and demand rebalances itself in the market. However, in a severe pandemic scenario where all chemical plants are affected nearly equally, there may be no immediate reserve or backup available from lesser-impacted areas. Thus, each critical plant must be able to sustain its most critical operations during a pandemic wave with their local in-house assets and resources—workers, materials, etc.

Despite all the Chemical sector's planning to protect its key manufacturing assets, the sector's ability to sustain, and as necessary, bring them back on line rapidly and safely, totally relies upon other CI/KR sectors. For example, during the busy 2005 hurricane season:

- Roads, bridges, and rail lines were often damaged/destroyed – cutting off distribution of finished products as well as the feedstocks necessary to make these products.
- The hurricanes damaged trains and trucks, and, in some cases, companies simply did not have employees to run the equipment, again resulting in major disruptions to our supply chain.
- Electricity supplies were sporadic or non-existent in numerous areas.
- The hurricanes damaged or destroyed pipelines and this curtailed or eliminated much-needed feedstocks (natural gas and petroleum products).
- Chemical facility employees were often left homeless and without transportation because of the storms. One of the first steps taken by many companies was providing shelter, food, clothing, and fresh water to the surrounding communities. These basic services were needed to get the facilities up and running.

Overall, the chemical industry has considerably planned to prepare for disasters, including influenza pandemics. Addressing sector interdependencies at a broad level will be the necessary first step to keep any segment of the economy functioning to provide critical goods and services. Unlike other natural disasters, physical/structural damage should not be an issue during a pandemic, but the absence of sufficient employees at critical points in the system would have the same effect for a company's facility operations.

As noted in the opening section, many essential daily goods and services come from or depend upon chemistry. Much of what the Chemical sector provides as primary goods actually serve as intermediate products for the manufacturing of goods in other CI/KR sectors. The Chemical sector is highly diverse and complex wherein identifying all critical intermediate or end goods is extremely challenging and cannot realistically be concluded in the time available for the NIAC study. For example, the same intermediate chemical product may be used in the production of numerous critical and non-critical end-products manufactured by diverse businesses from other than the chemical sector. It lacks sufficient insight into all the goods produced by others to adequately analyze their criticality to the nation during a pandemic, and thus to definitively state which intermediate chemical products are the most critical.

The sector believes the best way to prepare for a pandemic is for government experts to determine what is most critical to the nation's interests and then "build out" the prioritized list of key goods and services that must be provided to meet the nation's needs. For example, during the Korean War, a government analyst had to determine the amount of iron and steel (e.g., tanks,

guns, munitions, supplies, etc.) needed to support the war effort and then work back to domestic needs and supplies. In responding to a pandemic or other natural disaster, determining which critical services would be the top priority rests with government planners. In general, the Chemical sector would suggest hospital supplies, pharmaceuticals, and other related medical priorities would be at the top of the list along with water purification and food. Therefore, chemicals related to these areas would be deemed most critical with all others to follow depending on the priority given the end-product/good.

Numbers Overview

For the NIAC Report, the number of critical workers in the Chemical sector is based on a comparative analysis of BLS,[44] Economic Census,[45] and other national data, open source information on private-sector chemical workers, and operational particulars provided in surveys and discussions with expert representatives. From these sources, the Chemical sector's total U.S. workforce in 2004 for all categories was approximately 1,825,300; with 887,100 employed in chemical manufacturing, 806,600 in plastics and rubber manufacturing, and 131,600 in direct chemical wholesale operations.

Of the total workers employed in the sector, approximately 1,075,394 workers (60 percent) remain directly responsible for sustaining first-line chemical and plastic/rubber plant production and distribution activities. Given the highly technical nature of operating chemical and hazardous material plants safely effectively, and given the lean efficient workforce employed, there is little redundancy or extra effort available throughout the sector. Thus, the majority of these first-line workers are essential to sustaining critical Chemical sector operations, including those in employment categories:

- *Production and plant first-line management;*
- *Production, plant and system assemblers and operators;*
- *Material recording, scheduling, dispatching, and distributing;*
- *Industrial machinery mechanics* and *machinery maintenance workers*;
- *Transportation and material moving workers; and*
- *Healthcare and safety and occupational health providers*

From this critical worker estimate, for a severe pandemic planning scenario, defining the most critical workers and their total numbers assumes the following:

- There will be a baseline of all workers (50-60 percent) available who, even without vaccine, will not become ill or will not be absent from work to care for ill family members. Thus, they will be able to perform less technical functions while still supporting the sector's most critical tasks.
- The government will define the most critical end-goods/products and services to sustain the national social and economic welfare such that those chemical products that are, or support the manufacture of, these most critical end-goods can be identified. From this, the plants manufacturing these most critical end- and intermediate-products can be identified.

[44] Bureau of Labor Statistics National Employment Matrix 2004-14, http://www.bls.gov/emp/empiols.htm
[45] U.S. Census Bureau 2002 Economic Census, http://www.census.gov/econ/census02/

Given that the government has yet to identify or prioritize most essential products, the Chemical sector assumes that at least 30 percent of all its plants produce end- or intermediate-goods, which support the most critical needs of the nation. Furthermore, of the 1,075,394 critical workers (60 percent of all workers) directly responsible for sustaining first-line chemical and plastic/rubber plant production and distribution activities, approximately 322,618 workers (17.6 percent of all workers) then support the most critical plants producing the most critical end and intermediate chemical products.

Recommendations

The Chemical sector recommends the following critical worker numbers. It provided this narrative detailing how it derived these numbers. The sector also recommends there should be a comprehensive follow-on study to further explore and adequately refine the Chemical sector's critical goods, services, and worker numbers based on the government's prioritized list of the most critical end-goods/products and services to sustain the national social and economic welfare.

- **Tier 1**: **161,309 critical employees (8.8 percent of all workers)**
  - This figure represents 50 percent of the most critical sector workers in the most critical plants. The sector believes companies cannot readily substitute or replace these individuals during a pandemic given their expertise and experience. The sector believes their absence would severely jeopardize the sector's ability to sustain the most critical functions.
  - During the initial period of a pandemic, this 50 percent of the total number of the sector's most critical workers would be expected to work extended shifts without outside relief while also providing whatever additional efforts may be required to sustain operations under those extraordinary circumstances.

- **Tier 2: 161,309 critical employees (8.8 percent of all workers)**
  - The remaining 50 percent of the most critical workers at the most critical plants provide relief for the first 50 percent of critical workers. These workers aid in sustaining critical operations for an extended response period, and they expedite recovery.

Commercial Facilities Sector Profile

Sector Essential Goods/Services

The Commercial Facilities sector is perhaps the most diverse sector among the nation's 17 Critical Infrastructure and Key Resource sectors. As one sector specialist noted, Commercial Facilities includes everything from "A to Z (arenas to zoos)." While not all U.S. commercial assets and facilities are formally included in this sector, the Report does incorporate those assets whose vulnerability and consequence of loss pose a national risk. To assist in effectively managing this diverse sector, it organized itself into eight sub-councils; based on the eight major sub-sector areas with reasonably common characteristics to differentiate its members from other sub-sectors. These eight sub-sectors include:

- **Entertainment and Media:** motion pictures studios, other media outlets;
- **Lodging:** hotels, motels, hospitality centers, etc.;
- **Outdoor Events Facilities:** theme and amusement parks, fairs and expositions, etc.;
- **Public Assembly Facilities:** zoos, museums, conference arenas, etc.;
- **Real Estate:** industrial office, malls, housing, storage, etc.;
- **Resorts:** casinos, gaming entertainment centers, etc.;
- **Retail:** consumable and durable goods, general merchandise, department stores, etc.; and
- **Sports Leagues:** baseball, football, golf, auto racing, etc.

As planners assess and assign risk for such a diverse sector, it is important to evaluate each sector and business type for their individual threat, vulnerability, and consequence characteristics under varying scenarios. For example, an athletic arena may represent a high-risk situation (vulnerability and consequence) when filled with 50,000 spectators, but it may pose little risk during all other times. Additionally, while a high-rise hotel may be at significant risk for a terrorist attack or from a hurricane, the same hotel is likely at little direct physical risk from the threat of a pandemic.

When assessing risk in a pandemic influenza scenario, the following commercial sub-sectors appear less at risk given their physical nature and likely operational response to a pandemic. Thus, while critical for varying reasons, and certainly at high risk under other non-pandemic-specific threat scenarios, the following four sub-sectors will not be included in the final critical worker vaccine prioritization scheme for the Commercial Facilities sector, due to:

- **Public Assembly Facilities:** Owners of these facilities will likely close them voluntarily or government officials may direct owners to close them during a pandemic. Owners and officials must make special consideration to sustain reduced operations at facilities such as zoos and other live animal holding facilities.
- **Sports Leagues:** To protect the safety of their workers and fans, sports leagues are likely to cease operations during a pandemic wave.
- **Resorts:** Resort owners are expected to close their facilities voluntarily for the duration of a pandemic wave given that there will likely be a significant reduction in leisure and business travel. The government may also direct resort owners to close their facilities during a severe pandemic.

- **Outdoor Events Facilities:** These facilities will likely close, either voluntarily or at the direction of the government for the duration of a pandemic although owners and officials will likely need to make special consideration to sustain facilities, such as live animal theme parks and holding facilities, at a reduced operational level.

By virtue of their potential risk and/or their potential value during a pandemic, this report retains the four remaining Commercial Facilities sub-sectors for scrutiny to identify and evaluate their critical goods and services:

- **Lodging:** Owners of most lodging sites will likely close their doors voluntarily out of concern for the health of their workers and given the significant reduction in vacation and business related travel. However, certain lodging sites may need to remain open and will be essential to serve as housing for emergency workers, off-site business operations centers, or temporary medical triage, treatment and holding sites. For example, in the aftermath of Hurricanes Katrina and Rita, this sub-sector worked closely with the U.S. Department of Homeland Security (DHS) and the Federal Emergency Management Agency (FEMA), helping 5,000 hoteliers provide more than 200,000 guestrooms.[46]

- **Entertainment and Media:** Although a large portion may not be critical in a pandemic, the fundamental demand in any disaster for effective, consistent, current, and broadly available risk communications and public awareness campaigns, the entertainment and media sub-sector may have portions that prove a critical element to sustain operations during an extended severe pandemic.

- **Real Estate:** Nearly all businesses rely on some form of a physical structure or facility within which they conduct their business. Many of these businesses occupy physical space leased or rented from, and maintained, by other businesses. With more than 51,000 multi-family housing companies representing more than 6.1 million apartment homes across the United States, many Americans also reside in structures owned and maintained by others.[47] Businesses and associations within the Real Estate sub-sector understand the importance of mitigating impacts from a disruption of the critical services caused by a pandemic.[48]

- **Retail:** The millions of large, medium, and small retail locations represent the last essential link between the producer/grower, manufacturer, distributor, and the end-customer or consumer. Individual retail entities may be more or less critical to a community, region, and the nation depending on what they sell, the customers they serve, and the locations where they operate. In the interdependent supply chain from the raw material producer to consumer, local retail outlets are definitely critical. In sustaining national economic and social stability, the retail outlet is also one of the critical sites government officials should consider protecting and supporting. Simply protecting other critical businesses and infrastructures in the supply chain may be useless if the most essential goods and services cannot reach the local retail outlets and their customers.

[46] American Hotel and Lodging Association, http://www.ahla.com/pdf/Annual-Report-05.pdf
[47] National Multi-Housing Council, http://www.nmhc.org/
[48] Building Owners and Managers Association, http://www.boma.org/Advocacy/SafetyAndEmergencyPlanning/fluresources/boma_panflunews.htm

Similar to other sectors, such as the Chemical and Food and Agriculture sectors, the nation relies on the Commercial Facilities sector to provide a multitude of essential goods and services for our daily lives. However, also like the Chemical and Food and Agriculture sectors, the Commercial sector is a highly diverse and complex sector wherein identifying all the critical intermediate- and end-goods and services presents a challenging task that cannot realistically be concluded in the time available for the NIAC study.

The Commercial Facilities sector believes the best way to prepare for a pandemic is for government experts to determine what goods and services are most critical to the nation's interests. Once identified, the critical infrastructure sectors and sub-sectors are in a better position to develop a prioritized list of the most critical goods and services they must support to meet the nation's needs. In responding to a pandemic or other natural disaster, a determination of which critical services would be the top national priority rests with government planners. From this prioritized list, the Commercial Facilities sector can ascertain the most critical sector and sub-sector goods and services they must sustain to ensure the flow of critical goods and services.

Sector Essential Workers

All Commercial Facilities sector workers are, to varying degrees, important to maintaining the normal flow of commercial goods and services. During a pandemic, however, when it will be necessary to balance worker protection with the maintenance of critical goods and services, owner-operators can reduce or defer certain Commercial sector functions. As noted above, four of the Commercial sub-sectors will either voluntarily or by government direction be essentially closed for a pandemic's duration. While closed, most facilities still require some level of maintenance, security, and infrastructure support. However, these requirements should be sustainable with the 50 to 60 percent of the workforce who will not be absent during a pandemic wave. There may be exceptions for zoos and theme parks housing live animals. There may be veterinarians and technical animal support staff who cannot be readily substituted for and are critical to maintaining animal health for an extended period.

Under the extreme circumstances created by a severe pandemic wave, sector businesses will also voluntarily, and/or by government direction, close or significantly reduce operations in the remaining sub-sectors' non-essential businesses to concentrate on sustaining the most critical goods and services, as defined by the government's prioritized national requirements. For the four Commercial sub-sectors identified above that could potentially have a critical national role in a pandemic response, this Report offers the following assessment of their critical workers:

- **Lodging:** the six primary worker categories critical to maintaining lodging facility operations under normal circumstances as well as for adaptive reuse for other purposes during a pandemic are: management, administration, food and beverage, engineering, grounds maintenance, loss prevention (security), and housekeeping. Workers in each of these categories require specific levels of education and/or training and experience to be fully effective. However, among these categories of workers, the engineering group may be the most difficult to rapidly substitute for as they possess the additional technical training and licensure required to maintain the complex systems ensure electrical, HVAC, water,

communications, and other infrastructure remain functional. Depending on the season and location, ensuring necessities such as effective heating or air conditioning can be critical to occupy a lodging facility.

- **Entertainment and Media:** This sub-sector employs an extremely diverse workforce including highly skilled and trained performers, directors, writers, engineers, and technical personnel, as well as more part-time workers than most business sectors.[49] Because of this diversity and worker redundancy in most skill categories, identifying workers essential to sustaining critical goods and services remains challenging. Until the Federal government produces a nationally prioritized list of requirements for the entertainment and media sub-sector, it cannot identify the most critical workers. However, given its workforce diversity and redundancy and the reduced requirement for producing other typical sub-sector products, sufficient critical workers should be available in all categories without prioritized vaccine protection.

- **Real Estate:** Similar to the lodging sub-sector, the real estate workforce primarily supports operations and maintains a physical environment where others (guests/clients) perform their business and personal functions. Depending on the real estate facility (e.g., apartment versus office building), there are basic management, administrative, engineering, security, maintenance, and housekeeping functions which, to varying degrees, must be supported by trained real estate employees. These positions require different levels of education, training, and experience. However, along with senior key leadership and administrative personnel, the building engineering staff may be the most highly trained and licensed and thus the most difficult to replace rapidly. In addition, without adequate environmental conditions, most real estate facilities would be uninhabitable or, at a minimum, ineffective for their intended or emergency purpose.

- **Retail:** With more than 1.6 million U.S. retail establishments employing more than 24 million employees—nearly one in five American workers—the Commercial retail sub-sector is the largest CI/KR sector employer in the United States.[50] Of note, while retail operations and workers identified by the Bureau of Labor Statistics (BLS) and national and international trade associations, such as the National Retail Federation, generally include all establishments selling goods and services at the retail level, for purposes of the NIAC study, the Retail sub-sector is segregated into the major CI/KR sectors. Food and beverage retailers (e.g., grocery and restaurant) are addressed as a part of the Food and Agriculture sector. Fuel retailers (e.g., gasoline stations) are in the Energy sector under the Oil and Gas sub-sector. Retail pharmacies and drug stores are included in the statistics for the Healthcare and Public Health sector. While there are many different types of retail establishments still to consider (e.g. automotive, sporting goods, furniture and jewelry), arguably most of these operations could, and perhaps should, for the safety of their workers and customers be carefully managed for infection control and social distancing measures, and expect substantially curtailed operations during a pandemic wave. Curtailing or closing many non-essential retail operations may well be in the national interest to reduce morbidity and mortality from the

[49] Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs031.htm
[50] National Retail Federation, http://www.nrf.com/content/default.asp?folder=about&file=main.htm

pandemic; however, the effects on the national economy and social stability from lost retail revenues, worker wages, and other impacts may prove nearly as devastating to the nation.

With these critical retail businesses addressed elsewhere, what and who constitute the most critical businesses and workers in the Commercial Facilities retail sub-sector? While the retail sub-sector believes it can only answer this question by comparison to a government provided list of prioritized national requirements, the most immediate and critical retail operations would seem to follow from the most essential necessities: food, water, energy, and healthcare. As noted above, establishments providing for the retail sale of food, water, energy, and healthcare goods and services are managed by their specific CI/KR sectors for the purposes of this NIAC report. Which worker types remain for the Commercial retail sub-sector that are truly critical to sustain during a pandemic wave? While there may well be certain small specialty stores that must be maintained to support highly specialized needs (e.g., consumer medical equipment repair parts), in general, what remains may be less about a specific product than a particular retail type and location.

Sustaining the availability of the most basic necessities for all Americans is critical to the nation. In urban and larger rural areas, the numbers of retail establishments supplying all types of goods and services is tremendous. The redundancy in types, the numbers of each type in a relatively small area, the opportunity to consolidate chain operations, and the ability to provide support between other retail establishments are more prevalent in an urban setting. The same is not true for rural locations. For these areas, there may only be a few options within a reasonable distance able to provide all necessities.[51] However, one type of retailer in recent years made significant advances supporting rural and underserved populations.[52] The large general or department retail merchandiser with a rural "super center" facility may well be the only reasonable large-scale, effective option for obtaining food, water, fuel, and pharmaceuticals, as well as most other consumable and durable goods, at a regional rural level. Additionally, not only do large chain merchandisers operate numerous retail locations in underserved areas, they also use nationwide delivery systems to ensure stores remain stocked.

For general merchandise retail operations, such as large chain super stores, sales and related occupations account for 65 percent of workers. Office and administrative support comprise the next largest group, accounting for 19 percent of total employment. Management, business, and financial operations occupations account for 2 percent. The remaining percentage of workers spreads across a host of other support and operations occupational specialties including warehouse and material handling, security, grounds and building maintenance, and engineering.[53] From among these worker categories, the most important to sustaining the critical goods and services during a pandemic would be those workers directly identified with the critical merchandise departments (e.g., food, fuel, and pharmacy), administrative, and material handling, movement support, and the building engineering

[51] The U.S. 2000 Census shows 79 percent of Americans live in urban settings, with 21 percent or over 59 million people living in rural settings. http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=&-ds_name=DEC_2000_SF1_U&-_lang=en&-mt_name=DEC_2000_SF1_U_GCTP8_US1&-format=US-1&-CONTEXT=gct

[52] Wal-Mart facts, http://www.walmartfacts.com/

[53] Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs022.htm

support required to sustain the overall facility. By working extra shifts and cross-leveling workers from other less critical departments, facilities could provide most critical goods and services without a vaccine priority. However, there are particular worker specialties where this rapid worker exchange between departments may not be possible (e.g., pharmacists and pharmacy technicians, hazardous material handlers, and building infrastructure system engineers). Of note, about 61 percent of all pharmacists work in community pharmacies that are either independently owned or part of a drugstore chain, grocery store, department store, or mass merchandiser- not in a hospital or medical center.[54] For these most critical workers, located at those most critical rural and underserved stores, some level of priority and protection may be necessary.

Operations during a Disaster

As discussed above, during any disaster, the Commercial Facilities sector will take immediate emergency measures to protect workers and customers and sustain the flow of critical goods and services. Every disaster scenario retains its response peculiarities, and for a pandemic, the operational impacts (duration and scope) are much different than they are for other manmade or natural disasters. On the one hand, closing all non-essential commercial sites is rational given the threat to workers and customers. On the other hand, given duration and scope of a pandemic, the immediate and longer-term need for critical goods and services, and the economic practicality of sustaining an income for all businesses and workers, demand that many remain open.

For most of the Commercial Facilities sector's lodging, entertainment, real estate, and retail businesses that remain operational during a pandemic, there are countervailing forces that may offset normal demands to release workers for the most critical disaster response tasks. Specifically, for lodging, entertainment, and retail facilities, the consumer demand for many normal goods and services may be reduced significantly, thus allowing businesses and business sub-sectors to share or transfer critical workforce capabilities within a business, local urban, or even larger rural community. As discussed, this may not be the case for the remaining rural areas across the nation. For the real estate sub-sector, with businesses exploiting distributed operating models (like teleworking) and curtailing or closing non-essential operations, real estate support for business occupied facilities may also be greatly reduced. However, continuous critical support for real estate housing individuals and families (e.g., apartments, condominiums, residential hotels) will continue at the same or even higher levels throughout the pandemic.

Based on government provided national priorities, each Commercial business type requires a more complete analysis to identify the most critical goods, services, and workers, and to determine the sector's support needs. The NIAC Study provides an excellent, initial platform from which to launch this next study.

Numbers Overview

For the NIAC Report, the number of critical workers in the Commercial Facilities sector is based on a comparative analysis of BLS, [55] Economic Census,[56] other national data, open source information on private-sector chemical workers, and operational particulars provided in surveys

[54] Bureau of Labor Statistics, http://www.bls.gov/oco/ocos079.htm
[55] Bureau of Labor Statistics National Employment Matrix 2004-14, http://www.bls.gov/emp/empiols.htm
[56] U.S. Census Bureau 2002 Economic Census, http://www.census.gov/econ/census02/

and discussions with expert representatives. From these sources, ,the four pandemic-relevant sub-sectors within the Commercial Facilities sector account for approximately 19,872,800 U.S. workers; with 15,034,500 employed in retail, 1,417,000 in real estate, 1,625,400 in entertainment and media, and 1,795,900 in lodging in 2004.[57]

Of the total numbers of workers employed in this sector, approximately 1,195,500 workers (5.5 percent of total workers) are directly responsible for maintenance and repair of buildings and physical plant infrastructure systems and security. Given the highly technical nature of safely and effectively operating and maintaining building systems and given the increased security presence during an emergency, these first-line workers are essential to sustaining critical Commercial sector operations. Within the retail sub-sector, total workers employed in all categories and all locations for general and department merchandise businesses are 2,843,500 (18.9 percent of total retail sub-sector), including 39,040 maintenance and repair workers, 141,860 pharmacists, and 181,879 pharmacy technicians.

From this critical worker estimate, for a severe pandemic planning scenario, defining the most critical workers and their total numbers assumes:

- There will be a baseline of all worker types (50-60 percent) available that, even without vaccine, will not become ill or will not be absent from work to care for ill family members, and thus they will be able to perform less technical functions while still supporting the sector's most critical tasks.
- Available workers can be expected to perform at greater than normal levels. For example, workers may be asked to work on extended or double shifts, under strict infection control and social distancing strategies, and where legal to cross-train and perform duties other than those they would normally conduct.
- Businesses will be expected to adopt whatever emergency measures are necessary to consolidate, curtail, and otherwise adapt their normal business practices, operating hours and days, worker and customer interactions, shift functions, and others to maximize worker and customer protection while optimizing productivity levels for critical goods and services.
- The government will define the most critical end-goods, products, and services to sustain the national social and economic welfare such that commercial goods and services, which either represent or support the manufacturing of, the most critical end-goods can be identified, and from this, the commercial sites providing these most critical end-products can be identified.

Based on the assumptions above, for purposes of providing an initial placeholder estimate on vaccine prioritization for the most critical workers in a pandemic scenario, the Commercial sector assumes for the four key sub-sectors their most critical worker types include:

- **Lodging:** During a pandemic, given the likelihood of generally reduced lodging demands, the numbers of all lodging worker types that should be available are assumed sufficient to sustain critical lodging operations without vaccine prioritization. However, there will be a

[57] The retail sub-sector totals do not match those of the trade association noted earlier due to differences in how the two groups define the businesses. The numbers used for the final analysis are from the BLS.

need for some level of emergency response requirement (emergency worker housing, business off-site usage, temporary medical facility) at a limited number of lodging sites. Given this need as well as the need to sustain all lodging sites environmental systems at some maintenance level, a number of critical building maintenance personnel, security guards, and repair workers should be included in the prioritization scheme as most critical workers.

- **Entertainment and Media:** With a much-reduced demand for most of this sub-sector's important services and without a clear requirement for pandemic-specific entertainment and media support, it is assumed any existing and anticipated new requirements can be met with the critical workers available in all categories without special vaccine consideration.

- **Real Estate:** There are two major types of real estate support categories, those for business and government occupants and those for individual and family residence. During a pandemic, the normal requirement for sustaining real estate services to business occupied facilities for many sector types may be reduced. However, the requirement for supporting residences will not diminish, and in fact may substantially increase, as more people are sequestered in their apartments and homes to avoid potential infection. For planning purposes, some number of critical real estate building maintenance and repair workers should be included in the prioritization scheme as most critical workers.

- **Retail:** With what are likely the most critical retail operations being addressed in other CI/KR sector narratives/numbers (e.g., food, water, energy, and healthcare), what remains for the retail sub-sector falls into two major categories for consideration of criticality: urban and larger rural, and all other rural settings. In the urban and larger rural settings, the numbers of retail sites and workers for all types of retail merchandise are likely sufficient to support sustaining the flow of the most critical goods and services with potentially reduced and/or consolidated operations between retail sites with like goods and services. Unless a government provided national prioritization scheme for goods and services were to indicate otherwise, there is not a clear requirement to provide vaccine prioritization for the vast majority of these urban and larger rural setting retail workers. Notwithstanding, there may be limited numbers of critical sole retail sites located in marginally serviced urban areas should be potentially considered for worker protection. The majority of the protection coverage for critical workers occurs in the latter or other rural areas where certain large retail outlets may be the only reasonable site for obtaining all essential goods and services in an extended region. However, even for the critical retail sites in these areas, the majority of the business' critical functions could still be performed by reassigning similarly trained workers from less critical operations, by reducing operating hours/days, and by working longer shifts. Where there may not be an opportunity to rapidly cross-level workers is in those critical, highly trained and often licensed occupations such as building engineering maintenance and repair, hazardous materials handling and pharmaceuticals.

Recommendations

The Commercial Facilities sector recommends the following critical worker numbers for the NIAC Report, and it provided this narrative detailing how it derived these numbers. The sector also strongly recommends there be an extensive follow-on study conducted to further explore and better refine the Commercial Facilities sector's critical goods and services and worker

numbers based on a government-prioritized list of the most critical end-goods/products and services to sustain the national social and economic welfare.

- **Tier 1: 42,000 critical workers (0.2 percent of all workers)**
  - This figure includes 50 percent of the four sub-sectors most critical workers. Specifically, it includes 5 percent of lodging's most critical maintenance workers, repair workers, and security personnel; 15 percent of real estate's most critical maintenance and repair workers; and 1 percent of retail maintenance and repair workers to sustain the most critical rural and underserved locations (please note pharmacy personnel will be included in the healthcare sector recommendations). The sector believes these workers are critical due to their expertise, experience and licensure, during a pandemic companies cannot be readily substitute or replace these workers and their absence would severely jeopardize the sector's ability to sustain their most critical functions at the most critical sites.
  - During the initial period of a pandemic, this 50 percent of the total number of the sector's most critical workers would be expected to work extended shifts without outside relief while also providing whatever additional efforts may be required to sustain operations under those extraordinary circumstances.

- **Tier 2: 42,000 critical workers (0.2 percent of all workers)**
  - The remaining 50 percent of the most critical workers at the most critical sites to provide relief for the first 50 percent of critical workers, to aid in sustaining critical operations for an extended response period, and to expedite recovery.

Communications Sector Profile

Overview

The Communications sector is comprised of companies that provide a broad array of communications services to the government (Federal, State, and local), private sector, and the public. The sector identified the following sector components as critical:

- Wireless service providers;
- Wireline service providers;
- Other communications service providers;
- Manufacturers, suppliers and vendors;
- Networking companies;
- Information Technology companies that characterize themselves as having a communications infrastructure or provider-related role;
- Communications-related system integrators;
- Owners/operators of infrastructure used within the sector including cable systems, other operators and broadcasters;
- Trade and other associations representing sector members; and
- Infrastructure owners who have national assets used in the Emergency Alerting Systems

Within the Communications sector, services can be grouped into the following general categories:

- Basic Telephony;
- Data Communications;
- Broadband Access;
- Wireless;
- Broadcast;
- Equipment Manufacturing;
- Satellite Communication Services; and
- Emergency Services Interface and Operator Services

Depending on the application and use of these services, they are critical for Public Safety, Public Health, Economic Security, Homeland Security, and National Security.

Communications Sector Pandemic Planning

The communications companies that own, operate, and supply the nation's communications infrastructure have historically factored natural disasters and accidental disruptions into network resiliency architecture, business continuity plans, and disaster recovery strategies. The interconnected and interdependent nature of these networks fostered crucial information sharing and cooperative response and recovery relationships for decades. Even in today's highly competitive business environment, the Communications community boasts a long-standing tradition of cooperation and trust because one service provider's network problem nearly always affects the networks owned and operated by other network providers. This long tradition of responding to natural disasters and other events within the sector's individual companies and collectively as a sector will continue as the sector plans for the pandemic response.

Communication sector owners and operators focus on ensuring overall reliability of the networks, maintaining "always on" capabilities for certain critical customers, and quickly restoring capabilities following a disruption. The sector mitigates cascading effects of incidents, including a pandemic, by designing and building resilient and redundant communications systems and networks to ensure disruptions remain largely localized and do not affect the national communication backbone.

Communications services are fundamental to serving the needs of fully functioning communities. They also represent the principal channel of interaction, which does not pose an increased risk of spreading the disease, between Americans. As a result, the Communications sector expended great effort to augment existing business continuity plans to address the threats resulting from a pandemic influenza.

Communications companies have participated with DHS, HHS, and CDC, as well as with public health officials at all levels of government to assess the implications of a pandemic on the work environments within these companies. Communications companies have also assessed the potential impacts on employees working in these environments. Initiatives to educate employees on issues associated with a pandemic and the activities employees can take to minimize the chance of infection are in progress. Plans to minimize exposure in the workplace are also being prepared. However, despite all the efforts to minimize the impact of a pandemic influenza outbreak on Communications sector workers, the sector expects a high degree of absenteeism will exist because sick workers or workers who choose to stay home to care for ill family members. One template the sector used in its workforce displacement assessment comes from some member companies' experience with work stoppage preparation and response over the years.

Sector Essential Workers/Tiering

The Communications sector believes the use of communications services will increase during a pandemic influenza outbreak. This will result from the substitution of communications service capability for normal social interaction as individuals attempt to minimize contact with others. Further, businesses have included telecommuting as an element of business continuity plans. It is therefore imperative the communications network remains fully functional through ongoing network management operations and maintenance and any disruption in the network be repaired as quickly as possible. In addition, the Communications sector must maintain the capacity to install a limited number of new services and to repair existing services where the customer represents a priority for the community.

Tier 1 workers include these functions and number 396,097 for the sector. This represents approximately 22 percent of the total Communications sector workforce. **Tier 2 includes an additional 400,097 critical workers, which represents 22 percent of the total sector workforce.** Tier 2 workers represent those workers necessary to expand installation and repair capability, including meeting the needs additional customers who may not be deemed priority in the first tier but whose services to the community are necessary for it to function and might be impaired without adequate communications services. In other words, **the Communications sector identified 796,194 critical workers sector-wide**, or about 44 percent of its total sector workforce.

In closing, the Communications sector realizes communications will be critical to pandemic response activities, and the sector stands ready to meet that challenge. In addition to protecting core infrastructure and responding to the pandemic within the sector, it is also very important to address how customers, business, and government will utilize available communications services to support their critical missions and processes. Customers must understand how infrastructure operates and associated risk levels for a given design solution. This information allows customers to determine what is required to sustain critical functions during a crisis, in this case, a pandemic. Additional facilities, modified business processes, or alternative solutions may be required to provide the level of assurance needed for operational continuity.

Emergency Services Sector Profile

Overview

> *Emergency services disciplines form the nucleus of a system of response elements that act as America's fist line of response toward any terrorist attack or natural hazard event. The ESS consists of hundreds of thousands of career and volunteer men and women who serve in every community in the United States, saving lives, preparing for and managing response operations, protecting residents and property, and ensuring order in communities in times of disaster, natural or otherwise. These personnel are referred to as first responders. The destruction or disabling of this sector would have not only a debilitating impact on protecting and restoring our nations' critical infrastructure/key assets, but also would potentially affect the morale and welfare of all organizations, including the morale and trust of the public.*
>
> - Emergency Services Sector-Specific Plan

The Emergency Services sector includes the following sub-sectors: fire, emergency medical services, emergency management, law enforcement, local jail/corrections, and emergency communications, although studies often exclude emergency communications personnel. Approximately 1.9 million personnel work in the emergency services sector.

Preparedness Efforts

Examples of planning, training, education, and exercises are common in the Emergency Services sector. The emergency medical services, fire, and public health sub-sectors traditionally lead the way on biological preparedness with most training based on infection control management and the techniques of practicing universal precautions. Some of the exercises conducted in the sector have also included the private sector. County level planning groups are tasked with developing a local pandemic plan including training, exercises, and education for the community. Federal grants paid for the purchase of response equipment and antiviral stockpiles, and local authorities have already pre-positioned these caches. The level of pandemic preparedness, however, is limited with smaller or volunteer agencies. In all sub-sectors, volunteer or part-time directors are less likely to have robust preparedness programs. Additionally, recent National Incident Management System (NIMS) mandates aided command preparedness experience significant progress.

Findings

Sustainment

Sustained response capabilities are highly dependent on the availability of the workforce, equipment, and supplies, as well as the uninterrupted provision of electricity, water, utilities, and fuel. Emergency Services agencies are unable to fund and store an adequate stockpile of equipment and supplies that would be crucial in a pandemic event of duration. They are dependent on a "just in time" delivery of supplies. Emergency Services agencies are dependent on numerous suppliers being able to maintain inventory and deliveries of essential goods (e.g., fuel, medical gases (O2), food, basic supplies) to the sector during a pandemic.

Health and Welfare
Emergency services workers should be among the first to receive vaccines if a pandemic outbreak strikes. The Federal government should give responders priority when it comes to vaccines and/or prophylaxis. The ability to deliver services during a pandemic event directly depends on the health and welfare of the Emergency Services workforce, especially in the area of Emergency Medical Services. Pandemic-related workforce absenteeism will likely occur at a time when the number of requests for services may increase five-fold. In addition, these workers are at higher risk for absenteeism given their increased exposure to the ill. Helping to prepare workers' families for an outbreak is important in reducing absentee rates.

Communications
While there are some good examples of communications in the Emergency Services sector (e.g., Regional Information Communication System, ISACs) there are opportunities to improve communication technologies and processes between responders and other inter-dependent entities in a biological event. There also needs to be technology in place for the dissemination of information in a timely manner from a single source. Coordination of communications to improve effectiveness and efficiency is needed.

Caveats

Workforce Numbers
The accuracy of the numbers of workforce in the Emergency Services sub-sectors is questionable given the methods of counting the workforce within the sectors. For example, the Public Health and Healthcare sector might count emergency medical technicians (EMTs), as well. The Communications sector might count emergency communications officers in their list of critical workers. Meanwhile, State corrections officers may be an example of a sub-sector workforce not counted at all, including this sector.

Sector Preparedness
The level of actual preparedness in the Emergency Services sector is difficult to assess. In almost all cases, these preparedness efforts have gone untested in real-world incidents.

Tiering Criteria

The Emergency Services sector adopted the recommendations presented to the NIAC by Ben Schwartz, M.D., Senior Service Advisor, National Vaccine Program Office, U.S. Department of Health and Human Services.

Critical Service Priority 1 are functions that are essential to preserve national security, health and safety, essential societal function, or required to support other sectors' critical functions over the course of a three-month pandemic disease wave. **Critical Service Priority 2** are functions that contribute substantially to preserving national security, health and safety, essential societal function, economic stability, or supports other sectors' critical functions over the course of a three-month pandemic disease wave.

Critical Workforce Tier 1 are workers possessing specialized training, knowledge, experience, or licensure status, and thus cannot easily be replaced or substituted for during a pandemic outbreak. Moreover, peak absenteeism of greater than 30 percent within this tier over the course

of several weeks would degrade the ability of a sector to fulfill a priority function. **Critical Workforce Tier 2** are workers less clearly defined by specialized knowledge or skills but would be difficult to replace and where peak absenteeism of greater than 30 percent for a several week period would degrade the ability of a sector to fulfill a priority function.

The sector defines tiers by the priority of the function and the criticality of the workforce performing the function. The strategy for tiering workforces using the definitions above is as follows: Employees who meet the qualifications of Critical Workforce 2 and Priority 2 are in Tier 2. Those who meet the definitions in any other combination are in Tier 1.

Rationale

It is very likely a high percentage of the workforce in this sector meets the definition of Tier 1. Typically, an emergency services sector agency has a workforce comprised of 90-95 percent responders. The Partnership for Critical Infrastructure Security (PCIS) or Emergency Services Sector Coordinating Council (SCC) should study the tiering question as it pertains to the ESS workforce.

Estimates of Critical Workforce Nationally and Sources of Data

Fire

Sources: International Association of Fire Chiefs (IAFC) and the U.S. Fire Administration (USFA)

- **1,100,750 total firefighters (est. 2004): 305,150 career, and 795,600 volunteer**
  - Estimated number of fire departments in 2004: 30,400
  - Estimated number of stations in the United States for 2002-2004: 51,450
  - Fire department types: Career (6.3 percent), Mostly Career (4.1 percent), Mostly Volunteer (17.3 percent), All Volunteer (76.2 percent)
  - 10 percent of all departments are career or mostly career and protect 61 percent of the U.S. population
  - 43 percent of departments provide EMS Service
  - 13.6 percent provide EMS service and ALS
  - Number of Departments providing Hazmat response: 77 percent

EMS (Pre-Hospital Care)

Sources: IAFC and USFA

- **15,276 total EMS systems (all types):** (Note: in 2004, 10 states/territories did not collect data in this area.)
  - Fire based: 44.89 percent
  - Hospital based: 6.51 percent
  - Private or other type of non-fire, non-hospital based: 48.6 percent
  - EMTs, including basic, intermediate, and paramedics: 875,000

Law Enforcement
Source: U.S. Department of Justice (DOJ)

- 436,182 Full-Time Sworn Local Officers
- 185,859 Full-Time Sworn Sheriff Officers
- 55,892 Sworn State Troopers:

Emergency Management
Source: National Emergency Management Association (NEMA)

- 3,500 Local Emergency Managers
- 4,577 State Emergency Management Personnel

Local Jail/Corrections Officers
Source: American Correctional Association (ACA)

- 145,547 Adult Corrections (jails) total personnel

Communications Officers
Source: Association of Public-Safety Communications Officials (APCO)

APCO said the industry average generally used is 50,000 though this has never been scientifically qualified. Meanwhile, the Bureau of Labor statistics website cited approximately 95,760 for police, fire, and ambulance dispatch (about 36 percent of the total 266,000 total dispatchers in the country).

Recommendations

The Emergency Services sector recommends the following critical worker numbers for the NIAC Report:

- **Tier 1** **1,977,583 critical employees**

Total Estimated Sector Employees **2,257,419 critical employees**

Energy Sector, Electricity Sub-sector Profile

The Electricity sector recommends the following critical worker numbers for the NIAC Report.

- **Tier 1**: **50,000 critical employees**
  The job classifications included in tier 1 are:

  1. Highly-skilled positions required to keep the electric infrastructure operational;
  2. Very difficult to replace; and
  3. Jeopardized by a 40 percent absentee rate that would likely cause serious deterioration of electric power stability.

  Tier 1 job titles include:

  - Transmission System Operators
  - Distribution System Operators
  - Power Plant Operators
  - Outage Response Line Mechanics
  - Substation Operators
  - Substation Technicians
  - SCADA Technicians

- **Tier 2: 75,000 critical employees**
  The job classifications included in tier 2 are:

  1. Highly skilled positions related to "keeping the lights on;"
  2. Difficult to replace; and
  3. Jeopardized by a 40 percent absentee rate that would limit the ability to supply electricity but not prevent it.

  Tier 2 job titles include:

  - Maintenance Line Mechanics
  - Power Plant Maintenance Mechanics
  - Customer Service Representatives
  - Substation Maintenance Mechanics
  - Material Handlers, Management, Finance and Accounting
  - Regulatory Affairs, Engineers

- **Tier 3**: **250,000 critical employees**
  Tier 3 job classifications include the remaining positions required to sustain the operation of the electric power generation, transmission, and distribution infrastructure. It also includes positions critical for customer contact, regulatory, contract, and vital corporate functions.

  Tier 3 job titles include:

- ❑ all remaining power plant personnel
- ❑ line mechanics
- ❑ substation mechanics
- ❑ dispatchers
- ❑ supply chain
- ❑ customer service
- ❑ finance
- ❑ accounting

Energy-Oil and Natural Gas Sector Profile

Background

A healthy energy infrastructure is one of the defining characteristics of a modern global economy. Any prolonged interruption of the supply of basic energy – petroleum, or natural gas – would do considerable harm to the U.S. economy and the American people.

Energy infrastructure assets and systems are dispersed geographically. There are thousands of miles of oil and natural gas pipelines and many other energy assets in all 50 states and territories. There are also numerous owners and operators within the energy sector, both public and private. In addition, the energy sector is heavily subject to regulation in various forms.

Both the oil and natural gas segments of the energy industry require a unique set of supporting activities and assets. Petroleum and natural gas share similarities in methods of extraction, fuel cycles, and transport, but the facilities and commodities are regulated separately and have multiple stakeholders and trade associations. All sectors of the economy, including private, Federal, State, and local entities own energy assets and critical energy infrastructure components.

Segments of the Oil and Natural Gas Sector

Petroleum	***Natural Gas***
• Crude Oil – On-shore fields – Off-shore fields – Terminals – Transport (pipelines) – Storage • Petroleum Processing Facilities – Refineries – Terminals – Transport (pipelines) – Storage • Control Systems • Petroleum Markets	• Production – On-shore fields – Off-shore fields • Processing • Transport (pipelines) • Distribution (pipelines) • Storage • Liquefied Natural Gas Facilities • Control Systems • Gas Markets

Petroleum

The petroleum portion of the energy sector includes the production, transportation, and storage of crude oil; the processing of crude oil into petroleum products; the transmission, distribution,

and storage of petroleum products. U.S. crude oil production is concentrated onshore, and offshore along the Texas Louisiana Gulf Coast, extending inland through west Texas, Oklahoma, and eastern Kansas. There are also significant oil fields in Alaska along the central North Slope. The upstream sector of the petroleum industry includes a large number of facilities, such as wellheads, gas and oil separation plants, oil/gas dehydration units, emulsion breaker units, oil/gas sweetening units, compressor stations, water treatment units, etc., for both onshore and offshore areas. Import terminals receive crude oil into the United States. These terminals usually consist of a berth or port facility for the tankers, unloading facilities, storage facilities, and a system of pipelines to move the crude. Privately owned pipelines transport most of the crude oil in the United States. Waterborne transportation modes, including ocean tankers and barges, are also used. Refineries process crude oil into petroleum products such as gasoline, diesel fuel, jet fuel, and home heating oil. Petroleum products are transported mainly by pipeline, tanker, or barge, but railroad tank cars or trucks are also used.

Natural Gas

The natural gas portion of the energy sector includes the production, processing, transportation, distribution, and storage of natural gas; and liquefied natural gas facilities. The natural gas extracted from a well travels to a processing plant through a network of gathering pipelines. The interstate natural gas pipeline network transports natural gas from processing plants in producing regions to areas with high natural gas requirements, particularly large urban areas. Local distribution companies (utilities) typically transport natural gas from interstate pipeline delivery points to end-users through thousands of miles of distribution pipe. Delivery points to local distribution companies are often termed city gates, especially for large municipal areas, and are important market centers for the pricing of natural gas.

Sector Interdependencies

During the last half of the 20th Century, technical innovations and developments in digital information and telecommunications dramatically increased interdependencies among the nation's critical infrastructures. Disruptions in a single infrastructure can generate disturbances within other infrastructures and over long distances, and the pattern of interconnections can extend or amplify the effects of a disruption. The energy infrastructure provides essential fuel to all of the other critical infrastructures, and in turn depends on the nation's transportation, communications, finance, and government infrastructures. There are also interdependencies within the energy infrastructure itself, in particular, the dependence of petroleum refineries and pipeline pumping stations on a reliable electricity supply and the need for backup generators and utility maintenance vehicles to be supplied with diesel and gasoline fuel.

Energy infrastructure interdependencies also cross international borders. Oil and natural gas pipelines and electric transmission lines have helped integrate the energy systems of North America. Moreover, increasing imports of petroleum products continue to highlight the dependency of the United States on foreign oil.

Oil and Natural Gas Sector Pandemic Planning

Business continuity planning for the oil and natural gas industry requires preparing for the full range of situations posing a threat to owners and operators of the nation's oil and natural gas systems. America's oil and natural gas industry have ample experience in planning for

significant events including Y2K, adverse weather, vandalism, equipment failure, terrorism, and other threats. A new threat challenges the sector with some familiar characteristics along with some new dimensions – the threat of a possible influenza pandemic caused by the H5N1 virus.

Planning and preparation are underway in the oil and natural gas industry to address the possible outbreak of the pandemic flu. Most companies have been or are in the process of developing pandemic flu plans or enhancing current business continuity plans to address a possible pandemic outbreak. In those plans, some of the key questions are:

- How will we maintain operations when 10-25 percent of the workforce falls ill at one time?
- How can we adapt its existing continuity of operations plans to reflect this kind of human resources impact?
- How will we cope when the other businesses and suppliers we rely on experience the same absentee rates?
- How will we communicate and interact with our customers, stakeholders, media, and the government?
- How can existing return-to-work and travel policies be adapted to control the spread of the virus among employees?
- How will we limit the negative economic impact of a pandemic flu on our business?

The Oil and Natural Gas Sector Coordinating Council (created to support Homeland Security Presidential Directive 7) are currently working closely with officials at the Federal and State level to develop and strengthen pandemic preparation and preparedness plans. Further, the ONGSCC developed and finalized the "Oil and Natural Gas Sector Influenza Pandemic Planning, Preparation, and Response Reference Guide" which they distributed throughout the sector and used as a model to help companies develop their own pandemic plans. Workshops, audio conferences, and focused Council discussions on the pandemic have been conducted in the sector for the past year. Representatives from the ONGSCC are also serving on the National Infrastructure Advisory Council task group that is developing recommendations on pandemic countermeasures and prioritization of vaccines/antiviral medication distribution to critical infrastructure. Since this issue focuses on business continuity and is cross-functional in nature, the participating trade associations in the sector have identified and established "single-points-of-contact" within its membership for this issue.

Approach to Tiering

Below are the employment totals for the segments comprising the Oil and Natural Gas sector. The largest segment is clearly gasoline stations with the smallest being oil pipeline transportation. With the exception of the natural gas transmission segment, all the other segments have employment totals that do not vary significantly.

Total Sector Segments

Oil and Natural Gas Extraction:	220,000
Petroleum Manufacturing	112,500
Petroleum Merchant Wholesalers	101,060
Gasoline Stations	871,700

Pipeline Transportation (Oil)	7,180
Pipeline Transportation (Natural Gas)	24,710
Natural Gas Distribution (Utilities)	107,600
Total Employment	**1,444,740**

Tier 1

Each segment of the Oil and Natural Gas sector developed criteria to identify their business essential employees. Generally, those employees in Tier 1 are performing mission critical functions within their companies necessarily to keep the nation's energy infrastructure functioning during a pandemic. Examples of employees in this tier include those who schedule and dispatch gas and petroleum, operate key energy facilities, etc. Estimates are that it would require approximately 223,934 employees, roughly 15.5 percent of the employee base.

Tier 2

The employees in this tier are performing business essential functions within the sector, but they are deemed a slightly lower priority than those in Tier 1. However, these employees are still performing essential functions or providing critical support to the energy infrastructure. Examples, of employees who fall into this tier are those who provide SCADA and system control support, maintain, or repair critical system components, etc. Estimates are that it would require approximately 104,740 employees or slightly more than 7 percent of the sector's employee base.

It is difficult to determine the precise number of employees within each tier. Some segments are able to estimate the number of employees required more easily than other segments. Those segments capable of making determinations that are more precise have been used to benchmark the numbers estimated to be needed in other segments.

Information Sources

1. Individual firm data collected through the Pandemic Assessment Template
2. Bureau of Labor Statistics (2005)

Food and Agriculture Sector Profile

Overview

The U.S. Food and Agriculture sector, composed of complex production, processing, and delivery systems, feeds individuals well beyond the geographic and political boundaries of the United States. Comprised of more than 2 million farms, approximately 880,587 private firms, and 1,086,793 facilities, the sector, which is almost entirely under private ownership, employs more than 20 million workers. Moreover, the sector operates in highly competitive global markets, and provides economic opportunities and improved quality of life for rural and urban Americans. This sector accounts for roughly one-fifth of the nation's economic activity.

The U.S. Department of Agriculture (USDA) along with U.S. Department of Health and Human Services' Food and Drug Administration (FDA) share Sector-Specific Agency (SSA) responsibility for food safety and defense. FDA is responsible for the safety of 80 percent of all food consumed in the United States, including the entire domestic and imported food supply, except for meat, poultry, and frozen, dried, and liquid eggs, which are under the authority of USDA.

In order to function and produce food, the sector is dependent upon resources and services based in other sectors including the Energy, Water, Chemical, Banking and Finance, Transportation, IT, and Government Facilities sectors. The Food and Agriculture sector relies upon its own and these resources and services and cannot operate without them.

Significant progress in the sector on homeland security goals can be accomplished only through a partnership effort between all levels of government and those who own the critical infrastructure. The sector's main coordination mechanism for security partners are the Government Coordinating Council (GCC) and Sector Coordinating Council (SCC). SCC membership consists of agriculture and food industry representatives from "farm-to-table," including individual owner-operators and trade association officials. Due to the great diversity in interests represented on the SCC, the sector subdivided itself into seven sub-councils to address issues relevant to the membership. These sub-councils include:

- Producers/Plant Sub-council;
- Producers/Animals Sub-council;
- Processors/Manufacturers Sub-council;
- Restaurants/Food Service Sub-council;
- Retail Sub-council;
- Warehousing/Logistics Sub-council; and
- Agricultural Production Inputs and Services Sub-council

The SCC asserted avian flu might potentially affect the sector in multiple ways. First, because avian flu could dramatically affect the poultry industry, it is imperative for the sector to consider how an outbreak in the United States would affect the poultry industry and what response an outbreak would necessitate. Second, if a pandemic outbreak strikes the United States, production capacity could be severely limited due to an unavailable workforce. Therefore, the SCC, and the

private sector in general, have initiated an industry examination of existing plans and planning recommendations. Many entities have already established Pandemic Flu Continuity of Operation Plans and many more are in various stages of development. Given a pandemic influenza vaccine will likely not be readily available until many months after the onset of the pandemic, it is imperative to minimize the virus' spread and impact by ensuring these plans, and any government-generated situational information mechanisms, are in place and functional prior to such onset.

Recommendations

After extensive discussions, the Food and Agriculture sector determined that few, if any, critical food or agriculture facilities exist that would warrant a pre-determined finite set of select employees from those facilities to be included in a pandemic influenza vaccine/antiviral prioritization scheme.

At the same time, the sector applauds the effort of the government and private sector to rethink conventional practices and provide for continuity of critical operations. Further, the sector does believe an amount of vaccine and antiviral medications should be set aside and/or reserved to assist food and agriculture entities in a post event situation where there is *prima facie* evidence that certain employees are functioning in a critical capacity that would warrant prioritization or intervention. Therefore, the Food and Agriculture sector proposes the government reserve enough vaccine doses to cover 500,000 critical workers during a Tier 1 release as circumstances warrant at the time the vaccine/antiviral medication becomes available. Additionally, the government should stockpile an additional allotment that would cover 250,000 workers during a Tier 2 release. At the time of incident, the Food and Agriculture sector is able to meet the needs of the public without intervention; the government should transfer this reserve to where it is otherwise needed. The combined amount of this proposed reserve, though admittedly contrived, represents an amount to cover less than 4 percent of the entire sector workforce. If desired, a government/private sector food and agriculture prioritization panel empowered to make decisions of this nature can be composed for the next several months and activated as needed.

Rationale

The complexity within the sector does not lend itself to pre-event identification of critical facilities or critical employees (within those facilities) which would support earmarking of vaccine or antiviral medications for a group of critical employees. There are isolated examples, including the requirement for "certified" operators (approximately 21,000) of specialized equipment to be onsite at low-acid canning operations or the fact that at least five states require a licensed pasteurization equipment operator (approximately 10,000 nationwide) to be onsite at dairies, which might indicate a means to identify a group of critical employees. However, the fact is that it is completely unknown, at this time, whether the facilities in which those employees work are essential to national security or provide an essential societal function, or in the event of a pandemic whether those facilities will even be affected.

The Food and Agriculture sector also possesses many factors that will likely bode well for operations continuity during adverse situations without intervention. For example, the sheer numbers of entities (e.g. 925,000 restaurants, 47,000 grocery stores, 140,000 convenience stores, approximately 2 million farms, and 160,000 food processing/manufacturing/holding facilities)

and experience dealing with past natural disasters and strikes will be beneficial to keeping operations running. Moreover, American ingenuity will help the industries/entities adapt and continue operating during and after a pandemic outbreak. It is critical to embrace this concept, as the development of vaccine is likely to require four to six months from the time a pandemic materializes.

Unfortunately, a lot of the future needs will depend on variables (i.e., timing, location, preparedness efforts) that are yet unknown. In addition to these known unknowns, there are likely many things (the "*unknown unknowns*") that we do not even know that we do not know at this stage. As a pandemic situation develops and materializes, the unknowns will become known and the needs of the sector will become more apparent. Once this happens, the Food and Agriculture sector will be able to take the appropriate actions. In the interim, it is in the Food and Agriculture sector's best interest to prepare for the worst while continuing to explore its options.

Healthcare Sector Profile

Overview

The Healthcare sector encompasses all private facilities, services, and staff that provide healthcare services. For the purposes of the NIAC Study, the sector does not include public health professionals or providers engaged in emergency response services (e.g. EMS). The Emergency Services sector section of this Report includes healthcare providers engaged in non-hospital-based emergency services. The sector overview is largely derived from HHS' "*2006 Sector-Specific Plan for Critical Infrastructure Protection in the Healthcare and Public Health Sector*," version 0.2, October 10, 2006.

The private Healthcare sector constitutes more than 12 percent of the U.S. GDP, and as assessed by the BLS in 2004, the sector was the largest U.S. industry with 13.5 million employees.[58] [59] Of these 13.5 million employees, the private Healthcare sector includes the following personnel:

- Medical treatment providers and suppliers;
- Hospital workers and medical treatment facilities workers;
- Occupational health providers;
- Medical materiel manufacturers and distributors;
- Clinical laboratories;
- Home healthcare workers;
- Transplant and blood product providers;
- Health insurers and third-party payer groups;
- Healthcare information technologies and systems employees;
- Healthcare professionals; and
- Fatality service professionals.

About 545,000 establishments make up the healthcare industry; they vary greatly in terms of size, staffing patterns, and organizational structures. About 76 percent of healthcare facilities are offices of physicians, dentists, or other health practitioners. Although hospitals and medical centers constitute only 2 percent of all healthcare establishments, they employ 40 percent of workers sector-wide.[60]

Elements of the sector are present, though at varying levels of capability, in virtually all communities across the United States. The most visible elements of the Healthcare sector are the medical providers and support staff in hospitals, clinics, and offices. That said, there is a vast network of essential medical goods and service providers at the manufacturer-, distributor-, wholesale-, and retail-levels are included in the provision of care, as well. Privately owned and operated organizations dominate the sector. During 2006, the private healthcare sector included:

[58] U.S. Bureau of Economic Analysis, National Economic Accounts, 3rd Quarter 2006, Gross Domestic Product, Seasonally Adjusted at Current Dollars, www.bea.gov/bea/newsrelarchive/2006/gdp306p.xls

[59] Bureau of Labor Statistics, www.bls.gov/oco/cg/cgs035.htm

[60] Ibid

- Approximately 6,000 hospitals of varying sizes;[61]
- More than 492,000 ambulatory healthcare facilities;
- Nearly 70,000 nursing and residential care facilities;
- Nearly 175,000 individual or group medical practices;
- Nearly 100 health insurance companies;
- More than 40,000 pharmacies;[62]
- Approximately 2,500 pharmaceutical manufacturers, some international in scope;
- An extremely large medical devices and supplies industry;
- More than 500 blood and organ bank establishments; and
- More than 30,000 funeral directors/morticians.[63]

Healthcare Sector Interdependencies

Sector organizations at the Federal, State, and local level interact with each other, with public safety organizations, with emergency response agencies, with private enterprises, and with volunteer organizations at all levels of society. Healthcare delivery and its supporting operations require physical buildings, supply chain movement, and other business functions. The Healthcare sector relies on the same type of basic support from municipal infrastructure, community emergency teams, and other private sector infrastructure businesses as any other type of business. More specifically, the Healthcare sector depends on several other critical sectors, including:

- **Transportation** for the movement of critical supplies, pharmaceuticals, workforce members, emergency response units, and patients;
- **Telecommunications** to support direct patient care, consultations, and virtual triage, as well as third-party reimbursements and other business processes;
- **Electricity** to power essential facility functions of all kinds including facility protection programs;[64]
- **Water and Wastewater Management** for healthcare, pharmaceutical operations, and sanitization services;
- **Emergency Services** for coordination with first responders;
- **Information Technology** for business, clinical, and security information systems;
- **Postal and Shipping** for the movement of equipment and supplies;
- **Chemical** for support to pharmaceutical industry and healthcare operations; and
- **Banking and Finance** to ensure the flow of goods and services.

All other sectors in the U.S. economy are dependent on this sector in both disaster and non-disaster situations involving threats to human life.

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[61] American Hospital Association, www.ahadata.com

[62] National Council for Prescription Drug Programs, www.ncpdp.org

[63] Bureau of Labor Statistics, www.bls.gov/oco/ocos011.htm

[64] In-patient healthcare facilities are required to have emergency power backup generation systems; however these systems only support 10-20 percent of the facility's total electrical requirements in the most critical patient areas, and after a few days demand continuous support for generator fuel and maintenance.

Operations during a Pandemic

To manage emergency and trauma care within a disaster zone during all disaster scenarios (manmade and natural), the Healthcare sector will play a vital role in providing surge capacity while sustaining the basic healthcare delivery needs for all Americans. In a pandemic influenza scenario, however, the Healthcare sector's critical role becomes much more challenging. According to HHS estimates, during a pandemic wave of any severity, 45 million Americans will seek outpatient medical care. As many as 10 million patients, with varying degrees of complications, may seek hospitalization and up to two million may die because of the disease.[65] Under normal circumstances, hospitals and medical centers generally function with little to no excess care giving capacity or operational funds. Any additional increase in demand may have dramatic consequences on operational capabilities, and a pandemic may cause extreme, or even potentially catastrophic, consequences throughout the Healthcare sector. Of note, the ways in which these direct pandemic health impacts and indirect business operational implications affect the Healthcare sector will have an immediate influence on the availability of critical healthcare services and the identification of its most critical workers. These issues are introduced below:

- ***Healthcare Delivery:*** "The overall goal of hospital and acute care response to a mass casualty event is to maximize care across the greatest number of people while meeting at least minimal obligations for care to all who are in need." [66] Every healthcare delivery site will be a precious commodity during a pandemic, thus sustaining operations will be among the most critical and highest priority actions for the nation. Hospitals will face a number of major challenges in a mass casualty event. These challenges include surge capacity issues, existing capacity concerns for emergency and trauma services, lack of on-call specialists and nurses, coordination between competing healthcare systems, incompatible communications systems, and security and protection requirements. The impact of a mass casualty event, such as a pandemic outbreak, has the potential to overwhelm hospitals and other traditional venues for healthcare services, thus necessitating the establishment of alternative care sites for the provision of care. "Facilities of opportunity, which are defined as non-medical buildings, which, because of their size or proximity to a medical center, can be adapted into surge hospitals."[67] However, to be effective, these alternative care sites require portable medical equipment, supplies and, most importantly, sufficient medical providers and ancillary staff members to function. If hospitals are already overwhelmed and there are no safe areas from which to deploy surge capacity, how will the Healthcare sector provide enough essential goods and services to sustain the hospital, as well as the alternative care sites?

- ***Medical Providers:*** The availability of critical medical providers is perhaps the most critical element in the support of healthcare delivery during a crisis. No matter the severity of the virus, those medical providers specifically trained to confront medical challenges associated with pandemic influenza will be in very short supply in traditional and alternative care settings. One of the potential mitigation options is to alter the standards of care temporarily during an emergency to allow other types of medical

[65] Health and Human Services Pandemic Plan, www.hhs.gov/pandemicflu/implementationplan/intro.htm
[66] Health and Human Services, Agency for Healthcare Research and Quality, "Providing Mass Medical Care with Scarce Resources: A Community Planning Guide", www.ahrq.gov/research/mce/mceguide.pdf
[67] Ibid

providers and non-medical responders to take a direct care role. This may be accomplished through a number of different strategies proposed by HHS, including:[68]

- Temporarily modifying State regulations to broaden scope of practice standards among various trained providers;
- Reallocating providers from non-emergency care and non-emergency sites to emergency response assignments and from unaffected communities/regions to affected communities/regions (this will involve identifying skill sets of each practitioner group [e.g., paramedics, nurse midwives, etc.], so as to optimize reassignment potential); and
- Creating and training a pool of non-medical responders to support health and medical care operations.

The potential exists for nearly all types of healthcare providers (including such non-typical influenza treatment providers as psychiatrists, dentists, and occupational health nurses) to take on influenza directly or to play essential supporting roles for patients. Essentially, public officials may ask these other healthcare providers to serve as the local surge support for hospitals and alternative care sites during a pandemic. Regardless of training or specialty, every provider and medical support worker may prove a critical pandemic healthcare worker.

- ***Home Healthcare:*** Given the percentage of those individuals who become ill that will not, or should not, be treated in a hospital or alternative care site setting, there will be tens of millions of Americans requiring care and support at home. Therefore, due to the likely overcrowding in hospitals, the acuity level and care requirements for those managed at home may be higher than for seasonal influenza. The Healthcare sector must develop a better means of providing home healthcare support. To accomplish this, the sector may consider instituting a strategy to exploit and focus existing home healthcare business operations on pandemic influenza support. Moreover, the sector might consider developing new and improved virtual support mechanisms, which take advantage of the latest communications- and computer-based home triage and monitoring capabilities.

- ***Residential Care:*** With millions of elderly, infirmed, and other at-risk individuals living in thousands of nursing and residential care facilities across the nation, ensuring their well-being during a pandemic will be a challenge. One option under consideration is to assign nursing home staff priority access to vaccine or antiviral medications while holding residents in a facility and thus shielding them within a protected environment.

- ***Retail and Outpatient Care Sites:*** The network of medical retail and outpatient care sites in every community is significant. The amount of essential care and supplies provided at these sites is often greater than the provisions at traditional hospitals. Moreover, this type of care is often as important, if not more so, to the overall health of the population. For example, pharmacists who work in community pharmacies that are either independently owned or part of a drugstore chain, grocery store, department store, or mass merchandiser

[68] Health and Human Services, Agency for Healthcare Research and Quality, "Altered Standards of Care in Mass Casualty Events", www.ahrq.gov/research/altstand/altstand4.htm#Protection

account for approximately 61 percent of all medications dispensed in the United States. Additionally, freestanding healthcare facilities, including kidney dialysis centers, outpatient surgical center, urgent care centers, and outpatient mental health and substance abuse centers provide critical healthcare services. Sustaining these services and facilities for an extended pandemic wave will demand extensive planning and preparedness, planning that addresses all of the Healthcare sector's missions and assets in traditional healthcare delivery settings and across all retail and outpatients sites.

- ***Support Supply Chain, Infrastructure and Community Emergency:*** To ensure healthcare providers can deliver care effectively to the patient, the complex and interdependent support system must sustain the continuous availability of adequate quantities of the proper medical equipment, materials, and supplies. Additionally, it must sustain the essential operations of the physical plant, whether for a hospital, alternative care site, outpatient clinic, or necessary retail location. To accomplish this, the Healthcare sector must fully integrate the critical medical supply chain, the municipal and private sector infrastructure support, and the community emergency management and response teams into its pandemic planning. In addition, the Healthcare and other CI/KR sectors should consider the critical workers in those other businesses, where appropriate, for priority vaccine allocation.

- ***Death Care Services:*** A severe pandemic affords the potential for an additional two million deaths in the United States in a relatively short period. The death care services industry will find it extremely difficult to provide adequate support for these fatalities, not to mention their surviving family members. From the critical services carried out at a healthcare facility to critical services accomplished at a funeral home to the supply chain support for critical goods (e.g., caskets and mobile refrigeration units), the death care services sub-sector must be reviewed further. Because of that further study, certain worker types may be identified as critical.

Sector Numbers

The healthcare industry includes establishments ranging from small-town doctor's offices that employ only one medical assistant to busy downtown hospitals that account for thousands of diverse jobs. In 2004, more than 85 percent of non-hospital health service establishments employed fewer than 20 health workers. By contrast, seven out of 10 hospital employees worked in establishments with more than 1,000 workers.[69]

As the largest U.S. industry in 2004, healthcare accounted for 13.5 million jobs—13.1 million jobs for wage and salary workers and about 411,000 jobs for self-employed and unpaid family workers. Of the 13.1 million wage and salary jobs, 41 percent were in hospitals; another 22 percent were in nursing and residential care facilities, and 16 percent were in doctor's offices. While about 92 percent of wage and salary jobs were in private industry, the remaining 8 percent were in State and local government hospitals.[70] Critical sector employment sites and employees for a pandemic include:

[69] Bureau of Labor Statistics, www.bls.gov/oco/cg/cgs035.htm
[70] Ibid

- ***Hospitals.*** 5,535,000 total employees.
  Hospital-based care may be on an inpatient (overnight) or outpatient basis. The mix of workers needed varies, depending on the size, geographic location, goals, philosophy, funding, organization, and management style of the institution.

- ***Nursing and Residential Care Facilities.*** 2,970,000 total employees.
  Nursing care facilities provide inpatient nursing, rehabilitation, and health-related personal care to those who need continuous nursing care, but who do not require hospital services. Residential care facilities provide around-the-clock social and personal care to children, the elderly, and others who have limited ability to care for themselves. Workers care for residents of assisted-living facilities, alcohol and drug rehabilitation centers, group homes, and halfway houses.

- ***Offices of Physicians.*** 2,079,650 total employees.
  About 37 percent of all healthcare establishments fall into this industry segment. Physicians and surgeons practice privately or in groups of practitioners who have the same or different specialties. Physicians conduct the majority of non-emergency outpatient care visits in their offices rather than in hospital clinics.

- ***Offices of Dentists.*** 768,790 total employees.
  About one of every five healthcare establishments is a dentist's office. Most dental work is preventative or elective and could be deferred during a pandemic; however, there is substantial emergent and follow-up care that cannot.

- ***Home Healthcare Services.*** 806,460 total employees.
  Skilled nursing or medical care is sometimes provided in the home, under a physician's supervision. Primarily, existing home healthcare services are provided to the elderly. However, the development of in-home medical technologies, substantial cost savings, and patients' preference for care in the home has helped change this once-small segment of the industry into one of the fastest growing parts of the economy.

- ***Pharmacists and Pharmacy Technicians*** 230,000 pharmacist and 226,140 technician total employees.
  About 61 percent of pharmacists and technicians work in community pharmacies. About 24 percent of salaried pharmacists work in hospitals. Others work in clinics, mail-order pharmacies, pharmaceutical wholesalers, home health care agencies, or for the Federal government.[71]

- ***Medical and Diagnostic Laboratories.*** 257,000 total employees.
  Medical and diagnostic laboratories provide analytic or diagnostic services to the medical profession or directly to patients following a physician's prescription.[72] In 1999, the CDC established the Laboratory Response Network (LRN). The purpose of the LRN is to run a network of labs that can respond to biological and chemical terrorism, and other public

[71] Bureau of Labor Statistics, www.bls.gov/oco/pdf/ocos079.pdf
[72] American Society for Clinical Laboratory Science, www.ascls.org/position/bioterrorism.asp

health emergencies including pandemic influenza. The LRN includes 150 public and private clinical labs in the United States and around the world.[73]

- ***Outpatient Care Centers.*** 465,560 total employees.
  The diverse establishments in this group include kidney dialysis centers, outpatient mental health and substance abuse centers, health maintenance organization medical centers, and freestanding ambulatory surgical and emergency centers. Not only are these critical healthcare delivery sites, but besides the physicians and nurses they also employ critical skilled technicians that may prove necessary as pandemic surge support such as for radiology and laboratory.

- ***Pharmaceutical and Medicine Manufacturing.*** 291,000 total employees.
  Nearly 60 percent of this industry's jobs in 2004 were in establishments that employed more than 500 workers. Most plants are in California, Illinois, Texas, Indiana, New Jersey, New York, North Carolina, and Pennsylvania. The total includes 40,000 critical employees in vaccine production activities. About 29 percent of all jobs in the pharmaceutical and medicine manufacturing industry are in professional and related occupations, mostly scientists and science technicians. About one of four jobs in the industry is in production occupations, including both low skilled and high skilled jobs.[74]

- ***Medical Equipment and Supply Manufacturers and Distributors.*** 304,100 total employees.
  Providing "just-in-time" and on a stocked basis for the manufacture and distribution of critical medical goods and services ranging from IV solutions, bandages, and surgical needles to medical gases, sterilization tools, and cleaning chemicals.

- ***Death Care Services***. 138,100 total employees.
  Most funeral homes are small, family-run businesses, and the funeral directors are either owner-operators or employees of the operation. All 50 states license funeral directors. [75]

- ***Specific Critical Workers by type include:***
  - 650,000 physicians.[76]
  - 95,000 dentists[77]
  - 2,909,467 registered nurses[78]
  - 586,000 licensed practical and vocational nurses[79]

[73] Centers for Disease Control, www.bt.cdc.gov/lrn/factsheet.asp
[74] Bureau of Labor Statistics, www.bls.gov/oco/cg/cgs009.htm
[75] Bureau of Labor Statistics, ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_812200.pdf and www.bls.gov/oco/ocos011.htm
[76] American Medical Association, www.ama-assn.org/ama/pub/category/2670.html
[77] Bureau of Labor Statistics, ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_621-30.pdf
[78] Health and Human Services, Health Resources and Services Administration, www.bhpr.hrsa.gov/healthworkforce/reports/rnpopulation/preliminaryfindings.htm
[79] Bureau of Labor Statistics, www.bls.gov/oco/cg/cgs035.htm

Tiering Criteria

The Healthcare sector used the following criteria for prioritization of both services and workforce:

- Essential elements of national security and homeland security
- Components of systems, assets, and industries upon which our economy depends
- Components of systems, assets, and industries upon which public health depends

Recommendations

The Healthcare sector recommends the following numbers for the NIAC Report, and it has provided this narrative detailing how it derived these numbers. Due to its complexity and scale the Sector strongly recommends that there be an extensive follow-on study conducted to further explore and adequately refine the Healthcare sector's critical goods and services and worker numbers. There is a great probability that Americans will have similarly extreme pandemic-related demands for the entire Healthcare sector's critical goods and services at virtually the same time. As a result, the Healthcare sector is likely to employ all appropriate medical and non-medical personal regardless of specialty to provide critical internal or local surge capacity. Given these variables, the Healthcare sector recommends **6,999,725 Tier 1 critical workers** in its sector, or **51.8 percent** of the total sector workforce.

- **650,000** or 100 percent of physicians and surgeons
- **95,000** or 100 percent of dentists (assumes those dentists not necessary for emergency dental care will provide other direct medical pandemic influenza support)
- **2,909,467** or 100 percent of registered nurses
- **586,000** or 100 percent of licensed/practical nurses
- **1,600,000** most critical hospital-based employees or 42.6 percent of all remaining hospital-based employees who are necessary to sustaining essential hospital operations and/or may be pressed into service as influenza care support providers (assumes all physicians, dentists, registered and licensed/practical nurses, pharmacists, pharmacy technicians and clinical laboratory employees are already included in the critical numbers)
- **0 percent** of nursing and residential care employees for vaccine priority (assumes all physicians, dentists, pharmacists/technicians, and registered and licensed/practical nurses are already included in the critical vaccine numbers), however to fully shield non-protected residents all remaining critical/non-critical personnel should be considered for prophylactic antiviral medications
- **0 percent** of remaining office of physicians and dentists (assumes all physicians, dentists and nurses are already included, although some small number of radiology and laboratory technicians working in large physician offices may prove essential)
- **201,500** or 25 percent of the most critical home healthcare employees (assumes all physicians and nurses are already included)
- **456,140** or 100 percent of pharmacists and pharmacy technicians
- **152,200** or 60 percent of the most critical first-line medical and diagnostic laboratory employees

- **139,668** or 30 percent of the most critical outpatient care center employees to sustain essential outpatient chronic and trauma care and to potentially serve as alternate influenza triage or treatment sites (assumes all physicians and nurses are already included)
- **72,750** or 25 percent of the pharmaceutical and medicine manufacturing employees (= 100 percent of first-line plant operators)
- **101,000** or 33 percent of the most critical medical equipment and supplies manufacturer and distributor employees.
- **36,000** or 26 percent of death care service employees (=100 percent of funeral directors/morticians)

Information Technology (IT) Sector Profile

Overview

The IT sector is composed of entities—owner-operators and their respective associations—who produce and provide hardware, software, and IT systems and services, including development, integration, operations, communications, and security. In addition, Federal, State, and local governments participate in the IT sector as providers of government IT services designed to meet the needs of citizens, businesses, and employees. The IT sector includes but is not limited to, the following:

- Domain Name System (DNS) root and Generic Top Level Domain (GTLD) operators;
- Internet Service Providers (ISPs);
- Internet backbone providers;
- Internet portal and email providers;
- Networking hardware companies (e.g., fiber-optics makers and hardware manufacturers) and other hardware manufacturers (e.g., PC and server manufacturers);
- Software companies;
- Security services vendors;
- Communications companies characterizing themselves as having an IT role;
- IT edge and core service providers; and
- IT System integrators[80]

The Internet, a key component of the IT sector, encompasses packet-based networks and databases that use a common set of protocols to communicate through various transports. The availability of the network and its services is the collective responsibility of the IT and Telecommunications sectors. Recognizing a technological and industry trend toward convergence and given the interdependent nature of IT and telecommunications, IT sector efforts are being closely coordinated with the activities of the Communications sector.

Differentiator between IT Sector and Communications Sector Staff

In most companies, IT services share the same network infrastructure as communications services, and many of the same staff. For purposes of this study, staff involved in Wide Area Network (WAN) activities, which are outside of a given enterprise, are considered to be Communications staff. Staff members involved in all other IT activities, including managing Local Area Networks (LANs), are considered to be IT staff.

IT Staffing Considerations for Other Sectors

The study uses statistical data from the IT Worldwide Benchmark 2005 courtesy of Gartner Consulting.) Below is the breakout of IT staff as percentage of total employees by industry/sector. Other sectors can utilize this information to calculate baseline IT staff support requirements for their entities. Then, by taking into account the additional data that only 56 percent of IT is dedicated to maintaining operations versus transforming or growing the

[80] Operating Charter of the Information Technology Sector Coordinating Council, January 24, 2006, https://www.it-isac.org/documents/itscc/index.php

operation (such as special projects), sectors can then further calculate the "mission critical" portion of IT required to sustain operations during a pandemic.

Sector/Industry	Percent IT Staff[1]
Education	1.3 %
Food/Beverage Processing	1.7 %
Manufacturing	2.1 %
Retail	2.1 %
Consumer Products	2.2 %
Metals/Natural Resources	2.3 %
Chemicals	2.3 %
Electronics	2.4 %
Construction and Engineering	2.5 %
Hospitality and Travel	3.5 %
Professional Services	3.6 %
Information Technology	3.7 %
Pharmaceuticals	4.0 %
Energy	4.1 %
Government	4.4 %
Media	5.2 %
Utilities	5.9 %
Transportation	5.9 %
Telecommunications	6.7 %
Banking and Financial	7.4 %
Healthcare	7.8 %
Insurance	10.7 %

Information Technology Sector Pandemic Planning

In the event of a pandemic, reliance on IT will increase substantially depending on the extent of social distancing measures employed. As a result, information technology is critical to the response strategy of all sectors during a pandemic. Private-sector technology staffing focus will increase for those employees who provide technical support to clients and decrease for those employees involved in marketing and selling new products or services.

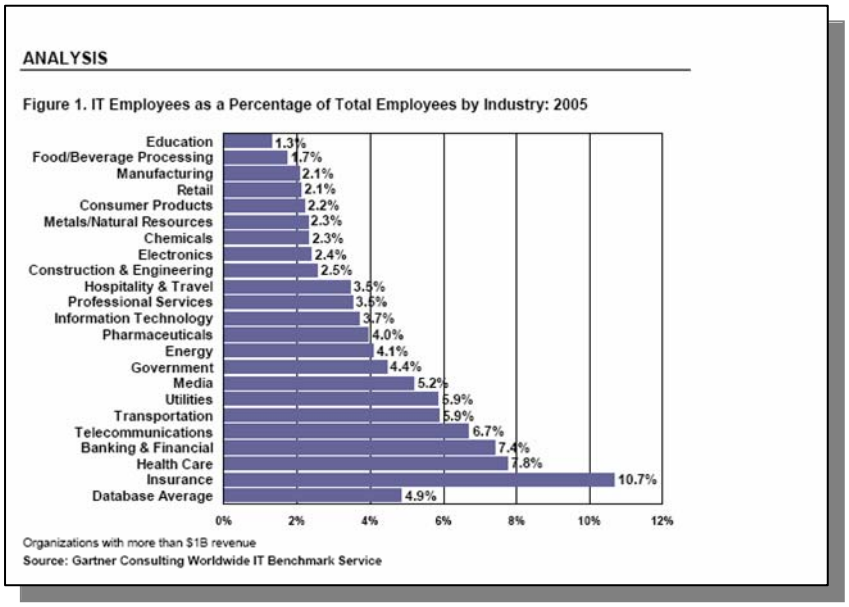
Approach to Tiering for a Pandemic Scenario

The guideline for tiering staff skill-sets during a pandemic is to prioritize customer support services over all other activities. Technical support requiring on-site presence will be prioritized over technical support staffs capable of working remotely. A remote work staff achieves social distancing and, therefore, it is not as critical to vaccinate this group, as it is to vaccinate on-site employees.

Tier 1 692,800 critical workers
Specialized technical support skill-sets requiring on-site presence to provide customer support (additionally due to no depth/alternate resourcing) and specialized technical support skill-sets critical to support Tier 1 staff availability (such as internal IT).

Tier 3 1,666,000 critical workers
Staff neither involved in technical support activities for customer support nor critical to supporting that group directly.

Additional Information – Gartner Figures[81]



[81] Gartner Consulting Worldwide IT Benchmark Service Study – 2005

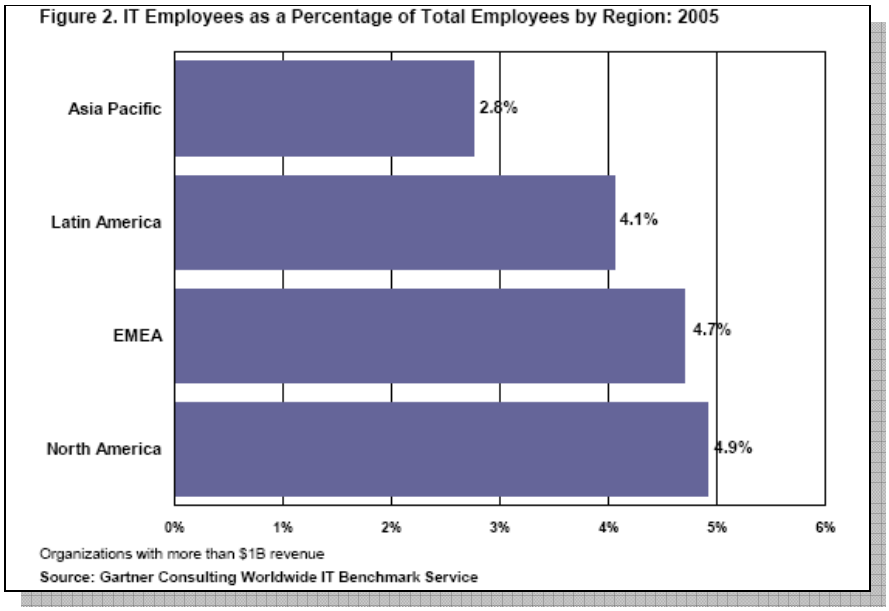


Figure 2. IT Employees as a Percentage of Total Employees by Region: 2005
Asia Pacific
2.8%
Latin America
4.1%
EMEA
4.7%
North America
4.9%
0%
1%
2%
3%
4%
5%
6%
Organizations with more than $1B revenue
Source: Gartner Consulting Worldwide IT Benchmark Service

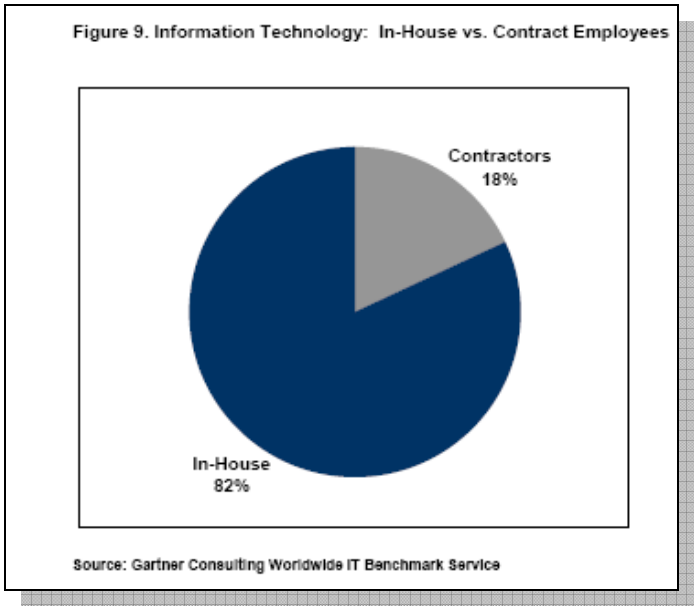
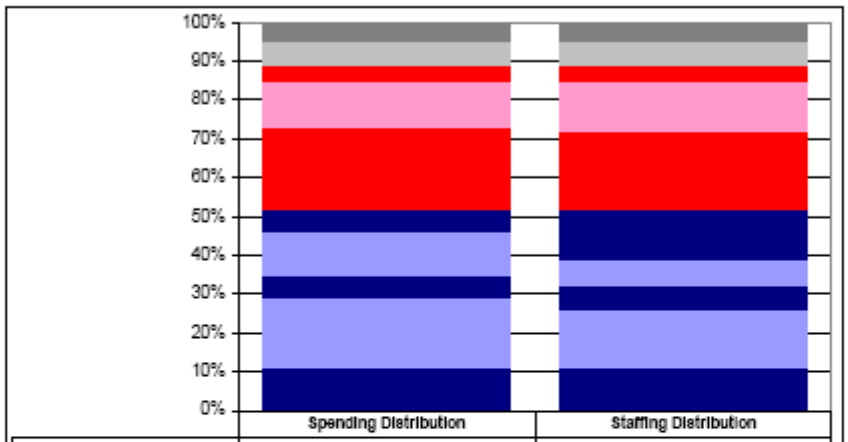


Figure 9. Information Technology: In-House vs. Contract Employees
Contractors
18%
In-House
82%
Source: Gartner Consulting Worldwide IT Benchmark Service

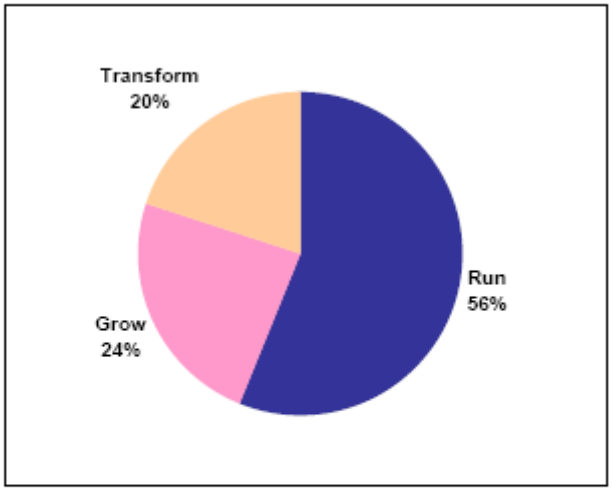
Figure 11. Information Technology: Distribution of Spending & Staffing by IT Domain



	Spending Distribution	Staffing Distribution
Other	5%	5%
Finance and Administration	6%	6%
Application, Other	4%	4%
Application Maintenance	12%	13%
Application Development	21%	20%
Help Desk	6%	13%
Data Network	11%	7%
Voice Network	6%	6%
Desktop/LAN Server	18%	15%
Data Center	11%	11%

Source: Gartner Consulting Worldwide IT Benchmark Service

Figure 10. Information Technology: IT Spend to Run, Grow, and Transform the Business



Source: Gartner Consulting Worldwide IT Benchmark Service

The distribution of IT spending to "run", "grow", and "transform the business" provides a view of the investment profile in business terms. In some industries, it is not uncommon to see high "run" focus – typically because organizations in the industry are not planning strong changes in business model or high organic growth - so this often times translates into a more "cost center" role of IT in the industry.

Nuclear Sector Profile

Overview

The Nuclear sector is responsible for the following responsibilities and activities.

- **Electric Generation Using Nuclear Reactors**

Nuclear energy produces approximately 20 percent of the energy on the Electrical Grid in the United States. There are 26 companies, operating 104 nuclear reactors on 64 sites in 31 states. Nuclear Energy plays a crucial and mission critical sector in powering the American economy for a number of reasons.

Electricity is an essential commodity and service touching every aspect of the American economy. None of the other CI/KR sectors can function without electricity. Industrial, Commercial, and Residential customer markets for electricity touch every American in many ways on a daily basis. Many of the systems and components of Chemical, Commercial Facilities, Food and Agriculture, Healthcare, IT, Transportation, Telecommunications, and Water sectors cannot function even for a few hours without stable and reliable electricity.

Electricity is a commodity that cannot be stored or imported and operators must generate it in real time, on demand. Given some unique elements, nuclear power plays a crucial role in the energy supply chain. For example, some of the advantages of nuclear generation include; no need to provide fuel at a constant rate as is the case with other generation methods. Nuclear reactors are refueled only once every 18 or 24 months, and maintenance of a continuous supply chain for fuel is unnecessary. Nuclear energy also distinguished itself in its ability not to pollute the air. Additionally, having the lowest unit generation cost, it remains the preferred nationwide base load generator on the grid.

The low cost of generation, the base load nature of the generation, and the physical location of nuclear plants on the transmission grid makes nuclear energy a very important tool in managing the entire energy grid. This reactive power management capability is critical to transmission grid reliability, and grid operators use nuclear plants nationwide for this purpose. Loss of nuclear plants can jeopardize the stable operation of the grid, even when other sources of generation are available in most parts of the country. Conversely, the loss of the transmission grid often results in the tripping of nuclear plants because there is no place for the generated output to go. Further, the loss of an alternate emergency power supply source from the external grid to the reactor safety systems will result in the shutdown of nuclear plants for safety and regulatory reasons.

Production and Distribution of Medical and Industrial Radioisotopes

The production and distribution of medical radioisotopes is an essential part of the Healthcare sector of the economy. Health professionals use these radioisotopes for medical diagnostics, cancer treatment, and other medical applications. Industrial radioisotopes are also used for non-destructive examination and diagnostics at fabricator's shops and factories, but they may be somewhat less critical than medical radioisotopes during a pandemic. In terms of their shelf life, radioisotopes are time sensitive because of half-life considerations. There are also security

implications related to the diverting of radioisotopes for non-intended uses. Therefore, adequate staffing throughout the course of a pandemic is important to maintain the flow of these radioisotopes to their regular customers.

The safe and secure storage of spent nuclear fuel at various civilian storage sites in the United States is part of this sector's scope. There are more than a dozen such sites nationwide, and while they do not generate any electric power, their secure storage remains important to national security. For these reasons, permanent around-the-clock staffing of site management and security officer is critical through a pandemic.

Other sub-sectors within the nuclear sector include the radioactive shipments and storage, university research and test reactors, as well as the functioning of design companies of new reactor technologies. The vast majority of employee groups in these sub-sectors have not been included for the purposes of 'essential employees' during a pandemic because employers have greater flexibility in deferring or rescheduling many of their activities from an "essential or critical services" point of view. Only that subset of employees needed to support reactor operations and refueling outages and maintaining the flow of radioisotopes to the Healthcare sector has been included.

Sector Essential Workers

The Nuclear sector is a highly regulated sector – the Nuclear Regulatory Commission (NRC) regulates every phase or element of operation. It is also a continually operating 24x7 business and not flexible in terms of stopping and starting at will or even modulating the output. Finally, the sector consists of technologically complex businesses with large numbers of activities requiring highly trained and specialized employees for safety and regulatory reasons. Even with some flexibility shown by NRC to provide some amount of regulatory relief on a short-term deferral basis, the baseline of essential activities is quite high. Consequently, the staffing level of essential employees does not yield itself to much flexibility in terms of tiering. Essential workers include:

- **Control Room and Plant Operators** – These workers monitor and operate the entire nuclear plant, its systems, and component equipment in teams work around-the-clock, seven days a week. They include Control Room operators as well as plant operators.
- **Maintenance and I&C Technicians** – On call around-the-clock, these workers repair/maintain mechanical, electrical and control systems equipment, and practice preventive and predictive maintenance in the plant, etc.
- **Engineers –** These workers ensure the production process runs efficiently and that equipment operates as designed. They include reactor engineers, system engineers, component engineers, design engineers, maintenance engineers, etc. They resolve technical issues raised by the operators and perform other diagnostics, tests, and verifications required for safe operation and by regulator requirements. They are also on call 24x7.
- **Health Physics, Radiation Protection, and Chemistry Technicians** – These workers monitor and manage the health physics and chemistry parameters in the plant and work to reduce radiation exposure to other employees in the course of their work.

- **Plant Security Officers** – They guard the security of the Plant area and equipment on a 24x7 basis. At Spent Fuel Storage Facilities, they perform a similar function to secure the ISFSI sites.
- **Other Site Management Support Functions** – To coordinate and manage the activities of all employees on sites and to conduct other oversight activities such as quality assurance, maintain information technology systems, procurement and warehouse management, emergency preparedness, and mandatory training, etc.
- **Technical Experts and Consultants** – Many workers are located offsite in company headquarters or at a vendor location. They have a higher level of knowledge and skill needed to address technical issues beyond the expertise level of existing site staff. They have a much bigger role in planning for and during refueling outage activities. Some of them are also required for specialized inspections and tests.
- **Outage Workers** – These are seasonal and contract essential workers, who companies bring into plants in large numbers, during refueling outages to repair, build temporary structures, disassemble and reassemble equipment, construct plant modifications, etc.
- **Radioisotope Workers** – They are production workers at radioisotope manufacturing facilities, radio pharmacists, and essential support staff.

Operations during a Disaster

Preparedness for public health safety, security, and environmental management have long been cornerstones of the Nuclear sector. The sector is accustomed to dealing with a variety of natural disasters, such as hurricanes, ice storms, and floods. Pandemic preparedness, as a part of plant safety and security, is one more challenge with some unique elements facility owner/operators are addressing in an industry-coordinated manner.

The Nuclear Sector Coordinating Council (NSCC) established a Pandemic Working Group in 2005 with representation from across the industry. The NSCC developed industry guidelines to manage nuclear plants during a pandemic. In addition, the NSCC organized industry-wide workshops, conducted numerous planning meetings, and has periodically monitored the state of pandemic preparedness in the industry. They engaged with the DHS, CDC, PCIS, NIAC, NRC, and other groups to mitigate, to the maximum extent possible, the adverse conditions during a pandemic. Currently, industry is working with the NRC to evaluate the regulatory infrastructure in its effort to look for opportunities to seek regulatory relief from administrative burden without compromising safety. Through the NSCC, owner-operators are constantly evaluating opportunities for further organization against a pandemic. Every nuclear site in the country provided numbers of critical employees needed to keep the critical infrastructure operational during a pandemic outbreak, and they have assisted the NIAC through NSCC representatives.

Tiering Overview

To keep the sector operational during the first four to six months after the onset of a pandemic, it has established it needs the following three tiers of critical workforce employees. It is essential to operate nuclear power plants safely and securely to maintain the electrical grid reliability and stability, the security of spent fuel storage sites and the flow of medical radioisotopes.

TIER 1A
This tier is essential for the Mission Critical core function of the sector, the absence of which would result in plant shutdown and would reduce electric generation capacity. Ultimately, it would threaten the stability of the entire grid. The estimate is based on discussions with representatives from each of the 64 nuclear plant sites who indicated they would need this tier, at a minimum, to continue functioning for one month to two months. The underlying assumption is also that they would require some amount of regulatory relief from administrative NRC requirements. It also includes security officers and essential management of stand-alone Nuclear Interim Spent Fuel Sites (ISFSIs). While these sites do not produce electricity, they do store spent fuel on an interim basis, and thus security needs to be maintained 24x7. In order not to disrupt the medical service and healthcare infrastructure, this tier also includes personnel required to run the radioisotopes businesses for medical non-invasive diagnostics and radiotherapy for cancers, industrial radiography, etc.

TIER 1B
This tier includes essential offsite technical support from critical vendors and specialized technical headquarters staff necessary to keep the nuclear generation sites running for a longer duration (two to six months). They would be required to resolve emergent technical and other mission critical issues for longer operational runs that come up from time to time.

TIER 1C
This tier is contingent on the pandemic arriving in the United States during the spring or fall season. These are the annual timeframes when 25 percent of the U.S. nuclear fleet shuts down for refueling outages and major repair. This refueling, repair, and upgrade activity occurs once every 18 top 24 months. This amounts to about 26 nuclear plants shutting down each spring and then again another 26 plants every fall. There is no more than about one month of schedule flexibility in these shutdown schedules given the nuclear fuel in the core is fairly depleted and the amount of electric generation is decreases each day toward the end of the fuel load cycle. In addition, critical major equipment has requirements (e.g., maintenance and surveillance) owner-operators cannot defer indefinitely because of safety considerations.

If a pandemic arrives in the United States in early winter (December) or early summer (May), theoretically, Tier 1A and 1B would keep the nuclear industry running for four to six months while vaccine production is ramped up nationally. However if it strikes in the spring or fall, 26 nuclear plants (which would be routinely shut down) would not be able to be put back together and restarted without Tier 1C employees. This would compromise 25 percent of the nation's nuclear capacity. During this time, about 1,500 contractors, specialized vendors, inspection technicians, skilled construction workers, technical experts, and consultants are on each site to perform the increasing upsurge in work. Additional headquarters staff is also at hand to make this happen and manage this massive effort.

It would be imprudent to exclude this tier from Tier 1 generally, as it could jeopardize the output of 26 plants and endanger grid reliability. The unpredictable nature of virus mutation would make this an unknown risk to critical infrastructure and the sector recommends strongly that this number be included in the Tier 1 category. If the pandemic arrived in the United States in early winter or early summer, Tier 1C may not be needed and that vaccine quota could potentially be releasable in part or full from the Nuclear sector to other CI sectors or other critical needs.

Recommendations

The Nuclear sector recommends the following critical worker numbers for the NIAC Report:

- **Tier 1A 37,000 critical employees**
- **Tier 1B 10,000 critical employees**
- **Tier 1C 39,000 critical employees (See discussion on sensitivity to season)**

Total Tier 1 86,000 critical employees (49 percent of total estimated population supporting the sector)

Estimated Total Sector Employee Population

175,000 employees – This figure includes an estimate of utility personnel and personnel at consulting firms, reactor design companies, contractors, construction unions (nuclear experienced), and other specialized vendors (full-time and seasonal), as well as radioisotope businesses, ISFSI sites, RTR, radioactive waste, transportation, and other ancillary businesses comprising the Nuclear sector.

Postal and Shipping Sector Profile

Sector Essential Goods/Services and Workers

Businesses within the Postal and Shipping (P&S) sector provide essential services to nearly all CI/KR sectors, government, private-sector businesses, as well as the public. These businesses play an integral role in sustaining the health and economic well-being of the nation. They perform a host of critical functions, including receiving, warehousing, tracking, moving, and delivering essential documents, equipment, goods, materials, and supplies. These deliveries can include materials such as daily deliveries of "just-in-time" vital medical supplies and vaccine to healthcare facilities, mail order pharmaceuticals to individuals, and time sensitive delivery of essential repair parts and critical documents to businesses as well as federal and state/local governments. For example, P&S businesses are primary shippers for immediate and express movement of equipment, supplies and material worldwide for the Department of Defense (DoD). Private-sector P&S businesses also provide such additional services as consultation and management support to other businesses for logistical and material management processes.

In sustaining their essential functions, P&S businesses rely on critical workers to perform a number of tasks on a daily basis. The tasks, which all relate to the daily delivery of hundreds of millions of packages and documents (shipments), include:

- Managing the efficient and effective receipt of its daily shipments;
- Tracking the end-to-end movement of its shipments;
- Controlling the warehousing of shipments;
- Monitoring the physical storage of shipments;
- Supervising the movement of shipments within warehouses; and
- Facilitating the intercity transfer of shipments between regional control centers and the customer sites.

The loss of key critical worker types anywhere along this chain from initial receipt to final delivery would result in a major disruption to the entire process. While most workers involved in receipt, tracking, warehouse management, and ground delivery may not require special certification, their training is extensive and their experience invaluable. However, for aviation movement and certain specialty ground transportation types, extensive training, certification and licensure for critical workers is necessary and/or mandated.[82]

Operations during a Disaster

The U.S. Postal Service (USPS) mail delivery operationally differs greatly from the other P&S shippers in that USPS is responsible under normal circumstances for delivery and pickup six days a week at every personal and commercial mail drop in the nation – more than 140 million locations.[83] Thus, under normal circumstances the sheer scope of this endeavor makes it nearly

[82] For example, P&S businesses transport with their dedicated aviation assets the greatest amount of air cargo of any U.S. air carrier; in fact either of the two largest P&S businesses transports more tonnage than all other U.S. air cargo businesses combined. http://en.wikipedia.org/wiki/Cargo_airline

[83] Unites States Postal Service, http://www.usps.com/history/anrpt05/

impossible to accomplish with much less than 100 percent of career staff. To function with less than 100 percent of staff during a pandemic two things must happen. First, the type of mail delivered must be regulated carefully. Second, the number of days in a week for delivery and or the number/types of personal versus commercial delivery sites may need to be reduced and regulated.

Along with the daily shipment of essential goods, P&S private-sector businesses also receive, manage, and deliver a significant volume of less than critical goods. While these goods may be fundamental to sustain businesses and the basic national economy, they may be less important during a severe crisis, such as a pandemic influenza outbreak. If required by the situation, the P&S sector could reduce the total volume of its receipts and deliveries. If the Federal government were to purposefully regulate or the private sector voluntarily manage the type of material P&S businesses handle and deliver during a pandemic, businesses in the sector could maximize the number of available employees in a concerted effort to sustain essential operations.

Of note, however, during a pandemic there may also be an increased requirement for P&S services beyond the typical day-to-day operations and functions. For instance, the Federal government and/or private-sector businesses may call on the P&S sector to manage surge levels of emergency and express deliveries for equipment (i.e., pharmaceuticals, masks, and gloves) and supplies (i.e., basic consumables). Moreover, with the high likelihood that the public may avoid large gathering places (e.g.., grocery stores, malls, and retail centers), many experts believe the use of online shopping vendors with home delivery options may increase dramatically.

Additionally, in a severe pandemic planning scenario defining the most critical workers and their total numbers assumes:

- There will be a baseline of all worker types (50-60 percent) available that, even without vaccine, will not become ill or will not be absent from work to care for ill family members. This baseline will be able to perform less technical functions while still supporting the sector's most critical tasks.
- Those workers who will be available can be expected to perform at greater than normal levels; for example being asked to work on extended/double shifts, under strict infection control and social distancing strategies, and where legal to cross-train and perform duties other than those they would normally conduct.
- Businesses will be expected to take whatever emergency measures are necessary to consolidate, curtail and otherwise adapt their normal business practices, their operating hours/days, worker and customer interactions, shift functions and others to maximize worker and customer protection while optimizing productivity levels for critical goods and services.
- The government will define the most critical end-goods/products and services to sustain the national social and economic welfare such that the commercial goods and services that are, or support the manufacture of, these most critical end-goods can be identified, and from the commercial sites providing these most critical products identified.

Numbers Overview

For this Report, the numbers of critical workers in the P&S sector are based on a comparative analysis of Bureau of Labor Statistics (BLS), Economic Census (EC), Department of Transportation (DOT) and other national data, open source information on private-sector P&S total workers and operational particulars provided in surveys as well as discussions with expert representatives. Of note, estimates are that the USPS and the three largest private-sector businesses employ about 95 percent of the entire P&S workforce. From this analysis, the extrapolated total P&S sector's U.S. worker number is approximately 1,720,000; with around 800,000 employed by the USPS and the remainder spread across the private-sector P&S businesses.

Due to important differences in how Postal-USPS and the Shipping-private sector businesses operate, the sector has recommended two different priority assessments and assignments, and it has highlighted some differences in critical worker categories below:

- For USPS, only career personnel are included as a baseline (704,716). Additionally, the sector assumes some percentage substantially less than 100 percent of all mail handlers and other field personnel (693,443) are critical to sustain essential operations with greatly reduced volume and delivery schedules for non-essential mail, including personal mail.

- For private-sector businesses, the Tier 1 priority aviation workers are also included in the total BLS numbers for the overall Transportation sector aviation numbers. Vehicle drivers however are split between those who perform specialized and long-haul general freight trucking (and should also be in the Transportation sector trucking numbers) and those who provide local inter and intra-city delivery (which will be the much larger number for P&S businesses) that may be included in the BLS 492100 and 492200 categories. However, the BLS definition for "couriers" and "local messengers" seems to indicate they are intra-city only and not inter-city shipping types, thus these BLS numbers may be off the mark for P&S type workers. Tier 2 is similar in that a portion of "sorters and warehouse employees" and "operations and management" may be in the 493100 category and others may appear elsewhere in the BLS warehouse worker categories. Some percentage of warehouse operations should be included as an essential Tier 1 category, otherwise there may be little for the pilots and drivers to deliver. For these reasons, the P&S totals are based mostly on a broad estimate from the actual business worker data available through open sources rather than the BLS numbers; although compared for an order of magnitude to the BLS.

Recommendations

For the NIAC Report, the P&S sector recommends using the following numbers of critical worker by tier. Sector experts have provided this narrative detailing how it derived these numbers. The sector also recommends there is a real need for conducting an extensive follow-on study to take this baseline information and further refine all the worker numbers for this sector. The following percentages assume there will be a baseline of workers (50-60 percent) available that, even without vaccine, will not become ill or will not be absent from work for such as to care for ill family members, and thus will be able to perform less technical functions while still supporting the sector's critical tasks. Due to specific differences in how Postal (USPS with

37,000 post offices and 144 million mailbox delivery locations) and Shipping (private sector-businesses) conduct operations, the Report presents two priority assessments and assignments.

- **Postal Service:**
  - **Tier 1: 69,344 total critical employees**
    (10 percent of key career employees only in critical field processing, movement and delivery operations who by virtue of their technical skills and/or possessing low density critical occupational skills at a location, the sector believes cannot be readily substituted and/or replaced)
  - **Tier 2: 211,400 total critical employees**
    (20 percent of key career employees only to sustain critical operations for an extended period and to expedite recovery)

- **Private Sector-P&S:**
  - **Tier 1**: **46,000 total critical employees**
    (5 percent of essential employees who by virtue of their technical skills, experience and/or licensure the sector believes cannot be readily substituted and/or replaced; to include aviation direct and aviation support, specialty delivery/trucking and key regional warehouse shipping order and material management operations)
  - **Tier 2: 138,000 total critical employees**
    (15 percent of key warehouse and management operations to backfill Tier 1 workers to sustain critical operations over time and to expedite inter-wave recovery)

Transportation Sector Profile

Sector Essential Goods/Services

The Transportation sector is an interconnected network that moves, distributes, and delivers millions of passengers and goods each year. The sector organizes itself into six key sub-sectors, or modes, which operate independently yet are also interdependent, including Aviation; Highway, Maritime; Mass Transit, Rail; and Pipelines.

The nation's oil and gas pipeline infrastructure is an essential national transportation asset moving 64 percent of the energy commodities consumed in the United States.[84] For purposes of the NIAC Report, the pipeline narrative and critical worker numbers is included in the Oil and Gas sub-sector of the Energy sector narrative. All five remaining sub-sectors contribute similarly to the transport of people, food, water, medicines, fuel, and other commodities. The divergence in their functions occurs when discriminating each sub-sector's critical goods, services, and workers for a pandemic. There are significant differences in how and what each mode transports, and that make a difference in what service functions and workers are identified as critical and what workers are essential to support these functions in a pandemic.

In identifying their critical goods and services, transportation is primarily a service sector whose chief function is the movement of others' goods. In general, the Transportation sector, with the exception of those vertically integrated manufacturing and retail businesses that own their transportation assets, neither identifies nor defines the criticality or priority of the goods it transports. However, if the government identifies and prioritizes these critical goods, then the Transportation sector can rapidly identify their corresponding critical transportation service functions and the workers needed to move those critical goods during a pandemic.

- Thus, the Transportation sector believes the most effective way for it to help prepare for a pandemic is for the government to determine what goods are most critical to the nation's best interests. Once this prioritization list is established, the Transportation sub-sectors can then develop their prioritized list of the most critical services they must provide. However, even without a national priority list for critical goods and services, the Transportation sector can offer some assumed levels of critical effort and identify those critical workers necessary to sustain what it believes may be a national priority.

Sector Essential Workers

All Transportation sector workers are to varying degrees important and may be critical in sustaining both the normal and crisis flow of goods and services. During a pandemic, however, the Transportation sector will have to balance protecting its workers with sustaining the flow of critical goods and services given the likely changes in demand for transportation services. The critical workers types in each sub-sector include:

[84] Pipeline and Hazardous Materials Safety Administration, http://www.phmsa.dot.gov/about/index.html

- **Aviation:** Pilots and flight attendants make up 33 percent of the air transportation workforce and are the most visible occupations in this industry.[85]
  - ***Airline pilots, copilots, and flight engineers*** are highly trained professionals who fly and navigate jet and turboprop airplanes. Pilots must be licensed (certified) and rated for the specific type aircraft they fly, these licenses are not interchangeable.[86]
  - Airline flights must have at least one ***flight attendant*** on board, and attendants' most important function is assisting passengers in the event of an emergency.
  - ***Aircraft mechanics and service technicians*** maintain, inspect, and repair planes. Mechanics and technicians are not required to be certified, however if they do not possess a certificate they must be supervised by someone who does, thus every repair crew must have at least one certified worker.[87]
  - Other members of ground crew include: ***reservation and transportation ticket agent, airplane cargo agents, baggage handlers***, *and* ***aircraft cleaners*****.**
  - ***Air Traffic Controllers:*** The Federal Aviation Administration (FAA) employs nearly all air traffic controllers today.[88] There are more than 15,000 trained air traffic controllers in the United States; the workforce includes ***tower controllers***, **t*erminal radar approach controllers*** located at airports, and ***en route center controllers*** who work in 24 centers located across the country.[89]

- **Maritime:** The movement of huge amounts of cargo, as well as passengers, between nations and within the United States depends on workers in water transportation occupations who operate deep-sea merchant ships, tugboats, towboats, ferries, dredges, excursion vessels, and other waterborne craft on all types of waterways.[90] The U.S. Coast Guard (USCG) establishes and regulates entry, training, and educational requirements for most maritime occupations. All officers and operators of commercially operated vessels must be "licensed" by the USCG, which confers specific licenses dependant on the occupational position. Licensed ship officers can operate any size or class vessel within the limits of their technical license and certificate; the only addition being an international license for those who operate vessels over an explicit tonnage in deep-sea.[91]
  - ***Captains or masters*** command the operation of a vessel, and supervise the work of all other officers and crew.
  - ***Deck officers or mates*** direct the routine operation of the vessel for the captain during the shifts when they are on watch.
  - ***Pilots*** guide ships in and out of confined waterways and require a familiarity with local water depths, winds, tides, currents, and hazards.
  - ***Ship engineers*** operate, maintain, and repair propulsion engines, boilers, generators, pumps, and other machinery.
  - ***Marine oilers*** and ***qualified members of the engine department*** **(**QMEDs) maintain the vessel in the engine spaces below decks.

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[85] Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs016.htm
[86] Federal Aviation Administration, http://www.faa.gov/pilots/lic_cert/
[87] Federal Aviation Administration, http://www.faa.gov/mechanics/become/faq/
[88] Bureau of Labor Statistics, http://www.bls.gov/oco/ocos108.htm
[89] National Air Traffic Controllers Association, http://www.natca.org/about/whatatc.msp
[90] Bureau of Labor Statistics, http://www.bls.gov/oco/ocos247.htm
[91] U.S. Coast Guard, http://www.uscg.mil/stcw/

- ***Sailors*** operate the vessel and its deck equipment under the direction of the ship's officers and keep the non-engineering areas in good condition.
- ***Passenger hotel, traveler, and administrative support personnel*** operate all necessary onboard passenger support activities.

- ***Port operations*** are an essential part of the maritime transportation and overall critical supply chain. Ocean, lake and river ports serve as the key inter-modal transit point where goods and materials are loaded and offloaded from cargo ships, handled, sorted, warehoused, as necessary, and then loaded to trucks, rail cars, or other ships for the next leg of the journey. Notably, not all ports are active at all times of the year. Certain ports are highly specialized in the types of material they handle. For some ports, such as grain operation ports, are much more active at certain times of the year. However, ports are not typically interchangeable as to the type of vessels or cargo they can efficiently manage. Within the diverse port operations, port workers run the gamut from highly skilled, certified and nearly irreplaceable container and specialty crane operators to food and fuel supply workers and unskilled laborers.

- **Public Transportation:** All public transportation drivers/operators are required to be licensed (certified) for the type and size conveyance they operate. For many who do not or cannot drive, public transportation, especially in large urban areas, is a necessity to go to work, obtain food, take children to school, go to the doctor, etc.
  - ***Transit and Intercity bus drivers***
  - ***School bus drivers***
  - ***Taxi drivers and chauffeurs***
  - ***Subway operators***
  - ***Maintenance and repair workers***
  - ***Passenger and vehicle scheduling and administration***

- **Railroad:** A railroad worker's technical and occupational classification and rank is based on professional experience. Employers usually fill locomotive engineer positions with workers who have experience in other railroad-operating occupations. Federal regulations require beginning engineers to complete a formal engineer training program, including classroom, simulator, and hands-on instruction in locomotive operation.[92]
  - ***Locomotive engineers*** are among the most experienced and skilled workers on the railroad.
  - ***Rail yard engineers*** operate engines within the rail yard.
  - ***Dinkey operators*** drive smaller engines, mainly within industrial plants, mines, and quarries, or construction projects.
  - ***Railroad conductors*** coordinate the activities of freight and passenger train crews.
  - ***Yardmasters*** coordinate workers engaged in railroad traffic operations.
  - ***Railroad brake operators*** act as assistants to engineers, handling the coupling and uncoupling of cars as well as operating some switches.
  - ***Signal operators*** install, maintain, and repair the signals on tracks and in yards.
  - ***Switch operators*** control the track switches within a rail yard.[93]

[92] Bureau of Labor Statistics, http://www.bls.gov/oco/ocos244.htm
[93] Ibid

- ***Other administrative workers*** manage other aspects including passenger and freight coordination, ticketing, maintenance and information technology.

- **Trucking:** In 2004, the Trucking sub-sector employed 8.6 million people including 3.28 million truck drivers across all sectors employed. Currently, the critical long-haul truckload industry is short more than 20,000 truck drivers with this shortage expected to worsen dramatically over the next eight years.[94]
  - ***Truck drivers and driver/sales workers*** hold 45 percent of all trucking and warehousing jobs. States issue licenses based upon the size/weight of vehicles, Class A, B and C, with endorsements for the type trailer and cargo.[95]
  - ***Laborers and hand freight, stock, and material movers*** help load, freight unload freight, and move freight around warehouses and terminals.
  - ***Dispatchers*** coordinate the movement of freight and trucks, and inform truck drivers of their assignments, schedules, and routes.
  - ***Shipping, receiving, and traffic clerks*** record inbound and outbound shipments.
  - ***Vehicle and mobile equipment mechanics, installers, and repairers*** sustain trucks and other vehicles and generally require special vocational training and experience.[96]

Operations during a Disaster

Given the extended duration and extreme scope of a pandemic, the demand for critical goods and services and the neediest locations will differ greatly. Geography and time constraints bound most "typical" disasters so responders from unaffected zones can support the affected communities in disaster areas more swiftly. In a typical disaster, demand on all transportation modes to support rapidly surging disaster relief goods and people into the disaster zone may be drawn from "excess" capacity elsewhere with only minimal disruption to their operations. In a pandemic, however, if authorities attempt to sustain near normal movement of goods *everywhere*, there will be no "excess" transportation capacity available *anywhere*.

If a pandemic reduces worker availability across the board by as much as 40 percent over a pandemic wave, then there will be no transportation surge support available. The major difference for a pandemic over other disasters will be determining what the sector cannot deliver. In other words, if a pandemic affects all regions equally and all are engaged in response, all transportation modes are impacted equally by worker absenteeism, and all transportation modes have little existing excess capacity, then the available transportation hauling capacity may be nominally reduced by a percentage roughly equal to the percentage loss of drivers and support personnel. Thus, with around 40 percent absent, what 40 percent of goods will not be delivered?

As previously stated, the Transportation sector recommends the best way for it to prepare for a pandemic is for the government experts to first identify and prioritize what goods and services are most critical to the nation's interests. Once identified, the Transportation sector and its sub-sectors will be in a good position to develop a prioritized list of the sector's most critical goods, services, and workers necessary to ensure the nation's transportation needs. The NIAC Study does not provide a national list of critical goods and services, only a business sector-based one.

[94] American Trucking Association, Trends 2005-2006, http://www.truckline.com/index
[95] Federal Motor Carrier Safety Administration, http://www.fmcsa.dot.gov/registration-licensing/cdl/cdl.htm
[96] Bureau of Labor Statistics, http://www.bls.gov/oco/cg/cgs021.htm

However, it does provide an excellent base from which to launch a study to derive a government prioritization of national critical goods and services.

Numbers Overview

For the NIAC Report, the number of critical workers in the Transportation sector is based on a comparative analysis of Bureau of Labor Statistics (BLS), [97] Economic Census (EC) [98] and other national data, open source information on private-sector chemical total workers and operational particulars provided in surveys and discussions with expert representatives. In 2004, the Transportation sector's total U.S. workforce was approximately **3,012,000,** with the following breakdown by the five sub-sectors addressed in this narrative:[99]

1. **Aviation, BLS 2004 Total: 656,200, to include[100]**
   - *Scheduled air transportation: 470,300, to include:*
     - Aircraft pilots and flight engineers 65,011
     - Airline pilots, copilots, and flight engineers 63,804
     - Commercial pilots 1,207
     - Airfield operations specialists 871
     - Transportation and material moving occupations 111,349
     - Aircraft mechanics and service technicians 35,303
   - *Unscheduled air transportation: 44,500, to include:*
     - Aircraft pilots and flight engineers 12,364
     - Airline pilots, copilots, and flight engineers 6,430
     - Commercial pilots 5,934
     - Airfield operations specialists 485
     - Aircraft mechanics and service technicians 6,290

   Air Transportation Support Activities: 141,400
   Air Traffic Controller Workforce: 16,683

2. **Maritime, BLS,2004 Total: 149,600 [101]**
   - *Deep-Sea- Total: 36,600, to include:*102
     - Sailors and marine oilers 4,741
     - Ship and boat captains and operators 3,574
     - Ship engineers 3,302
   - *Inland Waterways- Total: 20,500, to include:*
     - Sailors and marine oilers 5,141
     - Ship and boat captains and operators 4,757

[97] Bureau of Labor Statistics National Employment Matrix 2004-14, http://www.bls.gov/emp/empiols.htm
[98] U.S. Census Bureau 2002 Economic Census, http://www.census.gov/econ/census02/
[99] The retail sub-sector totals do not match those of the trade association noted earlier due to differences in how the two groups define the businesses. The numbers used for the final analysis are from the BLS.
[100] Bureau of Labor Statistics, 2004, ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_481000.pdf
[101] Bureau of Labor Statistics, 2004, ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_483000.pdf and ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_488300.pdf
[102] "U.S. Coast Guard data reflects that there are approximately 16,000 mariners who are fully qualified to sail the current U.S. commercial fleet and crew the government's vessels in a national emergency," the report said. "Despite overall numbers that reflect adequate mariners to crew our nation's sealift assets, unlicensed mariner ranks are thin, and there are potentially critical shortages in unlicensed mariner availability to support a prolonged crisis that necessitates crew rotations." http://www.amo-union.org/newspaper/morgue/9-2005/Sections/News/mariners.htm

- Motorboat operators 215
- Ship engineers 2,047

- *Water Transportation Support Operations- Total: 92,500, to include:*
  - Sailors and marine oilers 7,291
  - Ship and boat captains and operators 8,351
  - Motorboat operators 475
  - Ship engineers 2,330
  - Crane and tower operators 2,291
  - Hoist and winch operators 259

3. Public Transportation, BLS 2004 Total: 385,600, to include:

- *Bus drivers, transit and intercity 63,698*
- *Bus drivers, school 140,819*
- *Taxi drivers and chauffeurs 57,692*
- *Railroad brake, signal, and switch operators 139*
- *Railroad conductors and yardmasters 287*
- *Subway and streetcar operators 189*
- *Vehicle and mobile equipment mechanics, installers, and repairers 14,653*

4. Railroad, BLS 2004 Total: 224,100, to include:

- *Locomotive engineers and operators 36,109*
- *Railroad brake, signal, and switch operators 15,521*
- *Railroad conductors and yardmasters 33,552*
- *Heavy vehicle and mobile equipment service technicians and mechanics 10,721*
- *Rail car repairers 10,652*

5. Trucking, BLS 2004 Total: 1,596,500, to include:

- *Truck drivers, heavy and tractor-trailer 741,819*
- *Truck drivers, light or delivery services 69,833*
- *Vehicle and mobile equipment mechanics, installers, and repairers 49,865*
- *Road transportation support services 76,200*
- *Freight transportation arrangement 169,600*

Due to the Transportation sector's integration within nearly every other sector, the number of truck drivers identified in the trucking sub-sector is well under the total number of licensed truck drivers. As highlighted earlier, the American Trucking Association calculates 8.6 million people employed throughout the economy in jobs related to trucking, and a total 3,280,000 truck drivers.[103] With only 811,652 truck drivers listed in the trucking sub-sector report for the Transportation sector, there are then an additional 2,468,348 truck drivers spread across all other industry categories and critical sectors. Additionally, this NIAC Report assumes transportation-manufacturing businesses for all sub-sectors will operate without vaccine prioritization given the reduced demand levels.

For purposes of providing an initial placeholder estimate on vaccine prioritization for the most critical workers, the Transportation sector assumes for the five key sub-sectors that their most critical worker types for prioritization in vaccine allocation include:

[103] American Trucking Association, Trends 2005-2006, http://www.truckline.com/index

1. **Aviation:** 36,983 critical workers (5.6 percent total aviation). Given the likely dramatic decrease in passenger air travel, a similar though less dramatic decrease in air freight operations, and a major shift in the types of critical goods being transported based on the government's national priorities, the available aviation workforce should be sufficient even at assumed reduced levels to sustain the most critical operations. However, specific critical aviation assets (e.g. pilots and support essential to sustain jumbo cargo jet operations) may prove necessary to include for vaccine following the release of a national priority for goods and additional study to refine aviation requirements. At this time, however, the only aviation assets that should be included in a critical priority for vaccine are high value low-density skill sets like air ambulance and law enforcement pilots, and those air traffic controllers who are critical to sustaining the operations of all type airlines.

2. **Maritime:** 44,774 critical workers (29.2 percent of total maritime). Given that only U.S. maritime workers operate in Jones Act coastal and inland waterways and these domestic waterway operations typically support the movement of critical bulk goods (e.g., coal) other modes cannot reasonably transport, the government must make some prioritization considerations to ensure these critical operations are sustained. Most critical international cargos—89 percent of total cargos by weight are coal, petroleum products or chemicals—are shipped on foreign-flagged deep-sea vessels, thus removing their shipboard workers from consideration. However, those shipboard workers on U.S. flagged deep-sea ships (such as those in the U.S. Maritime Security Program) and those operating the nation's strategic port operations should be included in a prioritization.[104]

3. **Public Transportation:** 5,000 critical workers (1.2 percent of total public transportation). On the one hand, public transportation is essential in most urban areas to transport workers and others who have no other means of transportation. On the other hand, crowded buses and subways can significantly increase the spread of a virus. With an anticipated dramatic decrease in general public ridership by concentrating available workers on supporting the most critical rider requirements there should be sufficient workers without additional prioritization. However, a placeholder priority for the most critical low-density skills, like metro/subway engine maintenance and safety, should be considered.

4. **Railroad:** 61,630 critical workers (27.5 percent of total railroad). Railroads perform a critical function for which no other transportation mode over land is as well suited—hauling critical bulky goods and material long distances. Coal, chemicals, and petroleum products make up more than 60 percent of all freight by weight. Given the critical nature of such goods to other sector's operations, the most experienced critical railroad workers, like locomotive engineers, should be included in the prioritization.[105]

5. **Trucking:** 50,000 critical workers (3.1 percent of total trucking). Less than one-third of all truck drivers are directly identified in the sector's general commercial truck movement and delivery operations, with more than two-thirds employed elsewhere across the nation's industries. For this narrative, only those truck drivers and their supporting maintenance and

[104] U.S. Domestic Ocean Trades b y Vessel Type and Commodity Group, 2000 and 2004.
[105] Association of American Railroads, http://www.aar.org/PubCommon/Documents/AboutTheIndustry/Overview.pdf

warehouse operations workers identified with the sector's direct operations are being considered. Even with this greatly reduced total, assuming the government provides a directed priority list for the most critical goods, the number of licensed commercial truck drivers and warehouse personnel seems adequate to sustain these most critical goods deliveries even with pandemic-related absenteeism. Where there are challenges though are in those drivers licensed to haul specialized materials and/or with specialized vehicles and trailers, like hazardous materials and tank vehicles. Officials should consider adding these critical drivers and the most critical warehouse personnel to a vaccine prioritization list.

Recommendations

The Transportation sector recommends the following numbers for the NIAC Report, and it has provided this narrative detailing how it derived these numbers. The sector strongly recommends that there be an extensive follow-on study conducted to further explore and adequately refine the Transportation sector's critical goods and services and worker numbers based on a government-prioritized list of the most critical end-goods/products and services to sustain the national social and economic welfare. Of the total **3,012,000** workers in the Transportation sector, the following are this report's recommendations for pandemic vaccine prioritization:

- **Tier 1: 100,185 critical workers (3.3 percent of all workers)**
  - 16,983 aviation air traffic controllers and critical specialty commercial pilots;
  - 22,387 (50 percent) of maritime crew members and the most critical port workers, such as crane operators;
  - 5,000 of the most critical public transportation skilled maintenance workers;
  - 30,815 (50 percent) of the most critical railroad locomotive engineers, operators, and maintenance workers;
  - 25,000 (50 percent) of total drivers and support personnel for critical specialty cargos and vehicle types.
  - The sector believes all these workers are critical due to their expertise, experience, and licensure. The sector cannot readily substitute or replace them during a pandemic, and their absence would severely jeopardize the sector's ability to sustain their most critical functions at the most critical sites.

- **Tier 2: 98,202 critical workers (3.2 percent of all workers)**
  - 20,000 critical aviation specialty workers (e.g., jumbo/cargo jet pilots);
  - 22,387 maritime, 30,815 railroad, and 25,000 trucking workers or the remaining 50 percent of these most critical workers to provide relief for the first 50 percent of critical workers. These workers would aid in sustaining critical operations for an extended period, and they would expedite recovery.

Water and Wastewater Management Sector Profile

Sector Profile

Drinking Water

- There are more than 52,000 community water systems in the United States. Almost 9,000 of them serve 3,300 people or more. Overall, there are 160,000 public water systems, which include "systems" as small as a highway rest stop.
- Publicly owned water systems account for approximately 91 percent of the drinking water produced in the United States each year.
- There are approximately 2.3 million miles of distribution system pipes in the United States.

The major physical components of drinking water systems include water sources (ground or surface), raw water conveyances, pumps, raw water storage, treatment plants, finished water storage, distribution systems, monitoring systems, and Supervisory Control and Data Acquisition Systems (SCADA).

Wastewater

- There are more than 16,000 publicly owned treatment works (POTWs) in the United States.
- An estimated 75 percent of the total U.S. population is served by POTWs; the remainder is served by decentralized or private septic systems.
- There are approximately 600,000 miles of publicly owned collection lines in the United States.

The major physical components of wastewater systems include the wastewater collection pipes, pumps, untreated wastewater storage, treatment plants, treated wastewater storage, discharge systems, monitoring systems, and SCADA.

Critical Services

Electricity, chemicals, and fuel were ranked highest among services needed by drinking water and wastewater systems surveyed in 2006 by the Association of Metropolitan Water Agencies (AMWA). The survey was disseminated to AMWA members and the association with members on the Water Sector Coordinating Council, namely the National Association of Clean Water Agencies, American Water Works Association, the Water Environment Federation, the National Rural Water Association, the National Association of Water Companies and the Association of State Drinking Water Administrators.

Electricity ranked highest in priority for wastewater systems, as consumers, while treatment chemicals ranked highest among drinking water systems. Other top needs for the utilities included communications; parts, pipe and equipment repair; removal of biosolids (wastewater systems); natural gas (wastewater systems); safe wholesale water (drinking water systems); retail drinking water (wastewater systems); and transportation.

Key interdependencies necessary to providing drinking water and collecting and treating wastewater exist with power suppliers, chemical (particularly chlorine) producers and distributors, and gasoline and diesel producers and distributors. Distribution of chemicals and fuel will depend on transportation networks, namely rail and trucking. The interdependencies with telecommunications providers (landlines, mobile service and Internet connections) ranked high as well.

A very significant interdependency exists between wholesale water suppliers and water systems only distributing water to homes and businesses. Depending on the length of a pandemic, key interdependencies could also exist between the water sector and suppliers of parts, equipment and pipe material, as could interdependencies with banks, the U.S. Postal Service and third-party billing services to collect fees.

Critical Employees

In September 2006, AMWA and the Water Information Sharing and Analysis Center (Water ISAC) surveyed about 600 drinking water and wastewater systems nationwide about their critical worker needs in the event of a pandemic. The survey asked utilities how many workers in the sector would need to be vaccinated in a worst-case scenario. Put another way, the survey sought the minimum number of workers who cannot be absent without jeopardizing the delivery of safe drinking water and the removal and treatment of wastewater.

The job functions covered by the survey include: plant operations; distribution systems; maintenance specialists; lab; SCADA; business support (HR, accounting, admin, etc.); executive management; all other. Drinking water systems reported about 458,000 critical workers in these job functions, and wastewater systems reported about 150,000 critical workers, for approximately 608,000 across the entire sector. The survey also asked utilities representatives to provide their total number of workers. Based on the results, there are an estimated 1.22 million drinking water utility employees and approximately 261,000 wastewater system employees, for approximately 1.48 million employees in the sector. These numbers account for employees working in both drinking water and wastewater functions.

Pandemic Preparedness

Most drinking water and wastewater systems would respond to a pandemic by relying on pandemic preparedness plans developed in conjunction with local emergency planning or public health agencies or on plans developed for natural disasters and similar emergencies. Most or nearly all utilities in the water sector have emergency response plans, developed under the Bioterrorism Act of 2002, the Clean Air Act's Risk Management Plan program, state law or other initiatives. In recent months, utilities and local governments have developed plans specifically to address a pandemic.

Appendix D: Reports Influencing the Study

Previous Efforts

For more than a year, the Federal government has worked to optimize its response to a potential pandemic influenza event. The White House, DHS, and HHS released important documents articulating the threat and response to a pandemic. These publications provided guidance for the Council when it began formulating its recommendations.

The National Strategy for Pandemic Influenza

In November 2005, the Homeland Security Council (HSC) released the *National Strategy for the Pandemic Influenza*. This overview of the entire national strategy clearly establishes the Federal government's overarching position on a potential pandemic. The document articulates planning and preparation for a pandemic requires:

- Utilizing all resources at the government's disposal;
- Understanding a pandemic does not discriminate by race, sex, age, or nationality;
- Realizing a pandemic comes in waves lasting months affecting communities across the nation and, as the NIAC addresses and
- Threatens critical infrastructure by impacting its workforce.[106]

The National Strategy asserts a pandemic event exceeds a health emergency; it affects all aspects of society. At its highest level, the National Strategy identifies three crucial pillars for successfully combating a pandemic:

- **Preparedness and Communication** addresses pre-pandemic activities ensuring preparedness and communicating roles and responsibilities to all government levels, segments of society and individuals;
- **Surveillance and Detection** speaks to domestic and international systems providing continuous situational awareness allowing the earliest possible warning to protect the population and
- **Response and Containment** include actions limiting an outbreak's spread and mitigating the health, social and economic impacts of a pandemic.[107]

The Implementation Plan for the National Strategy for Pandemic Influenza

At the late June 2006 kickoff meeting between Pandemic Working and Study Group members and HHS representatives, the *Implementation Plan for the National Strategy for Pandemic Influenza* formed the backbone of the discussion. The Homeland Security Council released the Plan in May 2006 to address nine issues, only one of which concentrates directly on protecting CI/KR for economic and social stability:

- The Pandemic Threat;
- U.S. Government Planning for a Pandemic;

[106] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza. 2005. 2.*
[107] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza. 2005. 3.*

- Federal government Response to a Pandemic;
- International Efforts;
- Transportation and Borders;
- Protecting Human Health;
- Protecting Animal Health;
- Law Enforcement, Public Safety And Health and
- Institutions Protecting Personnel and Ensuring Continuity of Operations.[108]

The Implementation Plan defines the multi-sector pandemic response strategy and identifies more than 300 action items and performance measures to gauge the response's effectiveness. Chapter 6, *Protecting Human Health,* clearly relates most to the NIAC's task. Chapter 9 also relates specifically to the NIAC charge of defining critical infrastructure. These chapters reassert the three strategic goals of the *National Strategy* as:

- Stopping, slowing or limiting the spread of the disease;
- Mitigating disease, suffering and death and
- Sustaining infrastructure and mitigating economic and social impacts.[109]

The *Implementation Plan* focuses on key considerations[110], roles and responsibilities[111] as well as actions and expectations.[112] The fourth expected result, Establishing Distribution Plans for Medical Countermeasures, Including Vaccines and Antiviral Medications also addresses pandemic vaccine prioritization. The second proposed action under Establishing Distribution Plans, calls for prioritizing countermeasure allocation before an outbreak and updating it immediately after an outbreak based on the at-risk populations, available supplies and virus characteristics.[113] In coordination with DHS and Sector-Specific Agencies,[114] HHS shall develop objectives for allocating vaccine and antiviral drugs within three months. HHS and these other agencies shall also develop lists of personnel and other groups for priority access within nine months.[115]

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[108] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza Implementation Plan. 2006. v.*

[109] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza Implementation Plan. 2006.* 100.

[110] These include epidemiology, the importance of initial conditions, maintaining situational awareness, the role of diagnostic tests, countermeasures development, disease transmission reduction, geographic quarantine (cordon sanitaire), expanding medical surge capacity, risk communication and regulatory/financial/legal matters.

[111] Including the Federal government; State, local, and tribal entities; private sector and critical infrastructure entities; as well as individuals and families.

[112] The Plan divides the actions and expectations into subcategories classified under the aforementioned three pillars. Within the first pillar, Preparedness and Communication , alone there are five classifications and 17 different actions: 1) Planning for a Pandemic, 2) Communicating Expectations and Responsibilities, 3) Producing and Stockpiling Vaccines, Antiviral Medications and Medical Material, 4) Establishing Distribution Plans for Medical Countermeasures, Including Vaccines and Antiviral Medications and 5) Advancing Scientific Knowledge and Accelerating Development.

[14] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza Implementation Plan. 2006.* 122-123.

[114] Departments of State, Defense, Justice, Labor, Veterans' Affairs, Treasury and State/local governments

[115] The White House. The Homeland Security Council. *The National Strategy for Pandemic Influenza Implementation Plan. 2006.* 123-124.

Pandemic Influenza Preparedness, Response, and Recovery Guide for Critical Infrastructure and Key Resources

DHS also formally released the *Pandemic Influenza Preparedness, Response, and Recovery Guide for Critical Infrastructure and Key Resources* in September 2005. DHS developed the guide for business owners, operators and contingency planners to aid pandemic preparedness. The Guide collects the primary government and pandemic influenza-specific background material, references and contacts in one cohesive document. DHS published this document in the hope of complementing and enhancing ongoing private-sector contingency planning.

> Eighty-five percent of critical infrastructure resources reside in the private sector, which generally lacks individual and system-wide business continuity plans specifically for catastrophic health emergencies such as pandemic influenza. Many businesses have extensive contingency plans in response to threats from diverse natural and manmade disasters. While useful for their intended purpose, these plans may prove ineffective given they do not account for the extreme health impact assumptions and containment strategies projected for a severe pandemic influenza.[116]

The Guide clearly defines one of the key activities the Council used in its approach to the original task—pandemic preparedness requires the complete engagement of the private sector. Only the actual businesses and organizations fully know what they define as essential activities and personnel to sustaining service. Pandemic planning truly tests the public-private-sector partnership.[117]

HHS Pandemic Influenza Plan

HHS released its Pandemic Influenza Plan in November 2005. HHS designed this document as its operational guide for all pandemic influenza preparedness and response planning. The Plan addresses two crucial operational facets of a potentials pandemic influenza event:

- The Strategic Plan and
- Public Health Guidance for State and Local Partners

The Strategic Plan articulates the cohesive public health and medical strategy driving preparedness and response to an influenza pandemic. Public Health Guidance for State and Local Partners offers direction on specific pandemic influenza planning and response aspects for generating state and local preparedness plans.

- The Pandemic Influenza Threat;
- Planning Assumptions;
- Pandemic Response Doctrine;
- Key Pandemic Influenza Response Actions and Key Capabilities for Effective Implementation;
- HHS Agencies and Officers Roles and Responsibilities; and
- HHS Pandemic Influenza Preparedness and Response Actions.[118]

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[116] *Pandemic Influenza Preparedness, Response, and Recovery Guide for Critical Infrastructure and Key Resources,* Executive Summary, page ii, http://www.pandemicflu.gov/plan/pdf/CIKRpandemicInfluenzaGuide.pdf

[117] Department of Homeland Security. Pandemic Influenza Preparedness, Response, and Recovery Guide. November 2005. ii.

[118] Department of Health and Human Services. HHS Pandemic Influenza Plan. November 2005. 4.

This part of the Plan establishes definitions and provides hard background data to drive many activities that followed it. By succinctly depicting the threat from the H5N1 virus and laying out all assumptions inherent in a pandemic, HHS establishes a foundation from which both the public and private sectors can adjust or even develop their contingency plans.

ACIP and NVAC Recommendations

Within the HHS Pandemic Influenza Plan, Appendix D, both the Advisory Committee on Immunization Practices (ACIP) and the National Vaccine Advisory Committee (NVAC), provided recommendations to HHS on vaccines and antiviral drugs in an influenza pandemic.

These two groups weighed prioritizing potential vaccine recipients but generally adhered to health and public health discussion with the objective of decreasing a pandemic's health impact. The advisory committees produced recommendations around prioritizing vaccine groups. The report presents these recommendations in Table 5.

Table5

			(in millions)	
Tier	**Priority groups**		**Pop.**	**Cm pop**
1	A.	Essential HCW; vaccine & antiviral mfrs.	9	9
	B.	Highest risk persons (age & underlying dis.)	26	35
	C.	Household contacts of <6 mo & severely immunocompromised; pregnant women	11	46
	D.	Key govt. leaders & pandemic responders	<1	47
2	A.	Other high risk persons	59	106
	B.	Critical infrastructure & other pandemic resp.	9	115
3	Key govt. health decision-makers; mortuary		NA	NA
4	Healthy 2-64 yr old not in other groups		186	300

These recommendations added perspective to vaccine prioritization of the normal population.

Federal Resources

- The official Federal pandemic preparedness website is www.pandemicflu.gov.
- The *National Strategy for Pandemic Influenza*, which outlines responsibilities that Federal, State, and local governments, as well as individuals and industry have for preparing for and responding to a pandemic, is available at www.whitehouse.gov/homeland/pandemic-influenza.html.
- The HHS Pandemic Influenza plan can be found at www.hhs.gov/pandemicflu/plan/.
- To reach the 24/7 CDC Hotline, call 800-CDC-INFO or email cdcinfo@cdc.gov.
- HHS Pandemic Influenza Specific Business Continuity Checklists are available at www.pandemicflu.gov/plan/tab4.html.
- HHS Pandemic Influenza Tabletop Exercise Materials are available at www.hhs.gov/nvpo/pandemics/tabletopex.html.

- For a detailed list of what HHS will recommend and do when WHO declares a new phase in the pandemic, visit www.hhs.gov/pandemicflu/plan/part1.html#5.
- The U.S. State Department has information on Avian Influenza at www.state.gov/g/oes/avianflu/. To read how the State Department is working with other countries to combat Avian Flu, visit www.state.gov/r/pa/scp/2005/55972.htm.
- The U.S. Agency for International Development provides information on its work in affected countries at www.usaid.gov/our_work/global_health/home/News/news_items/avian_influenza.html.
- For information on the U.S. Department of Agriculture's efforts to protect the United States against Avian influenza, visit www.usda.gov/wps/portal/usdahome?navtype=SU&navid=AVIAN_INFLUENZA.
- The U.S.G.S. National Wildlife Health Center provides information on avian influenza in migratory birds and the Department of the Interior will protect the health of employees and the 450 million people who visit Department-managed lands each year. For more information, visit: www.nwhc.usgs.gov/research/avian_influenza/avian_influenza.html.
- DHS' National Response Plan contains a comprehensive all-hazards approach to enhance the ability of the United States to manage domestic incidents and is available at www.dhs.gov/dhspublic/interapp/editorial/editorial_0566.xml.
- The National Incident Management Systems (NIMS) Training website is available at http://training.fema.gov/EMIWeb/IS/is700.asp
- A FEMA site for providing disaster assistance materials on all types of natural disasters is available at www.disasterhelp.gov/portal/jhtml/index.jhtml.

International Resources

- For more information and additional online resources about global surveillance and monitoring of the pandemic flu virus, visit http://pandemicflu.gov/global/.
- The pandemic preparedness website for the World Health Organization (WHO) is available at www.who.int/csr/disease/influenza/pandemic/en/.
- The WHO checklist for pandemic influenza preparedness planning is available online at: www.who.int/csr/resources/publications/influenza/FluCheck6web.pdf
- To learn more about the WHO's November 2005 meeting concerning avian and human pandemic flu, visit www.who.int/mediacentre/events/2005/meeting_avian_influenza/en/index.html.
- For the most up-to-the-minute numbers on the pandemic influenza virus, visit www.who.int/csr/disease/avian_influenza/en/index.html.
- To reach the WHO Headquarters in Geneva, Switzerland, call 4122-791-2684 or 4122-791-3982. To contact the WHO Regional Office for the Americas in Washington, D.C., call 202-974-3458.
- The United Nations Food and Agriculture Organization has more information on pandemic preparedness available at www.fao.org/ag/againfo/subjects/en/health/diseases-cards/geneva-docs.html.
- To see more information on the United Nations Foundation on Pandemic Influenza, visit: www.unfoundation.org/features/avian_influenza.asp
- For a more comprehensive list of national pandemic plans from around the world, visit: www.who.int/csr/disease/influenza/nationalpandemic/en/index.html

- The Australian Pandemic website is online at www.pandemic.net.au/newsletters/05Dec20.html.
- For more information related to pandemic preparedness for in Hong Kong, visit: www.info.gov.hk/info/flu/eng/files/checklist-e_flu_eng_20051105.pdf
- The European Union's Public Health and Influenza website is available by visiting: http://europa.eu.int/comm/health/ph_threats/com/Influenza/influenza_en.htm
- For information about the World Bank's plan and investment in pandemic influenza, visit http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/0,,contentMDK:20711283~menuPK:208943~pagePK:146736~piPK:146830~theSitePK:226301,00.html
- Pandemic Influenza Preparedness Plans for Pacific Island Countries are available at www.spc.int/phs/pphsn/Outbreak/Influenza/Pand-Preparedness-plans-Pacific-countries.htm.
- The Canadian Pandemic Plan can be found at www.phac-aspc.gc.ca/cpip-pclcpi/index.html.
- Transcripts from sessions of the Council on Foreign Relations November 2005 Conference on the Global Threat of Pandemic Influenza are available at www.cfr.org/publication/9282/council_on_foreign_relations_conference_on_the_global_threat_of_pandemic_influenza_session_4.html?breadcrumb=default.
- In October 2006, HHS published its "Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic," which can be found at http://www.pandemicflu.gov/plan/maskguidancehc.html.
- The Congressional Budget Office (CBO) released the *A Potential Influenza Pandemic: An Update on Possible Macroeconomic Effects and Policy Issues* in May 2006. It is available at http://www.cbo.gov/ftpdocs/72xx/doc7214/05-22-Avian percent20Flu.pdf.
- CDC posts its document entitled *The Economic Impact of Pandemic Influenza in the United States: Priorities for Intervention* at http://www.cdc.gov/ncidod/EID/vol5no5/meltzer.htm.
- HHS included the NVAC/ACIP Recommendations for Prioritization of Pandemic Influenza Vaccine and NVAC Recommendations on Pandemic Antiviral Drug Use in Appendix D of its Pandemic Flu Plan. It can be found at http://www.hhs.gov/pandemicflu/plan/appendixd.html

State and Local Resources

- For links to state pandemic plans, visit www.pandemicflu.gov/plan/stateplans.html.
- For a complete list of state homeland security advisors, visit: www.dhs.gov/dhspublic/interapp/editorial/editorial_0291.xml
- For a comprehensive link to all State Emergency Management Agencies, visit: www.fema.gov/fema/statedr.shtm
- For a database of state health officials and agencies and public hotlines, as well as a search engine for public health sites, visit www.statepublichealth.org/index.php.
- For a comprehensive list of State and territorial public health officials, visit: www.astho.org/index.php?template=regional_links.php&PHPSESSID=58b56231688358e09f989713c70ede0a.
- For a list of State health departments, visit www.phppo.cdc.gov/phtn/sites.asp#state.

- The National Association of Counties has information on pandemic influenza available at www.naco.org/Template.cfm?Section=Publications&template=/ContentManagement/ContentDisplay.cfm&ContentID=18621.
- For a list of United States Fire Administration State Points of Contact, visit: www.usfa.fema.gov/pocs/
- FEMA has 10 regional offices, and two area offices. For a contact list of all FEMA offices, see: www.fema.gov/regions/
- For more information on HHS offices and services available in each region, and how to contact HHS regional offices, please visit: www.hhs.gov/about/regions/.
- The National Governors Association (NGA) released its *Preparing for a Pandemic Influenza: a Primer for Governors and Senior State Officials* in 2006. It is available at www.nga.org/Files/pdf/0607PANDEMICPRIMER.PDF.

Private-Sector Resources

- For an overview of the roles and responsibilities for all public and private-sector partners, visit www.whitehouse.gov/homeland/pandemic-influenza.html#section9 and www.hhs.gov/pandemicflu/plan/part2.html#overview.
- The Financial Services Roundtable released its *Preparing for Pandemic Flu: A Call To Action* in November 2006 and it can be found at http://www.fsround.org/publications/pdfs/PANDEMICFinal.pdf
- For DHS basic preparedness information for businesses and individuals, visit www.ready.gov/.
- For information on pandemic preparedness from the U.S. Chamber of Commerce, visit: www.uschamber.com/issues/index/defense/pandemic_influenza.htm
- For a Congressional Budget Office report on the possible macroeconomic effects of a pandemic, visit www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf.
- "Avian Flu: Preparing for a Pandemic," a report for employees and clients of Marsh on risk related topics is available at www.marsh-asia.com/birca/white_paper.pdf.
- Read an example of a Pandemic Influenza Workplace Plan, based on Shell Oil's plans for operations in Oceana, at www.med.govt.nz/irdev/econ_dev/pandemic-planning/infrastructure/example/example.pdf.
- Pandemic Flu Planning Guide for Infrastructure Providers in New Zealand is available at http://healthcareproviders.org.nz/publication/documents/v9PandemicPlanningGuide.doc
- Download a copy of "Are You Ready? A Guide to Citizen Preparedness" at www.fema.gov/areyouready/.
- The National Fire Protection Association's Guide to Business Continuity Planning for Disaster Scenarios is available for purchase at www.nfpa.org/catalog/product.asp?pid=160004&src=nfpa&order_src=A292.
- FEMA's Emergency Management Guide for Business and Industry, available at www.fema.gov/library/bizindex.shtm, offers a step-by-step approach to emergency planning, response and recovery for companies of all sizes. FEMA's website is also an excellent resource for family disaster preparedness guides.
- The National Organization for Disability on Emergency Preparedness website is available at www.nod.org/emergency/index.cfm and contains information on the needs of the disabled during an emergency. Visit www.nod.org/content.cfm?id=1380d for more on disability emergency preparedness, and www.nod.org/pdffiles/epi2002.pdf to view the

"Guide on the Special Needs of People with Disabilities for Emergency Managers, Planners & Responders."

- The Institute of Medicine pandemic reports are available at www.iom.edu/?id=3783&redirect=0.
- The Occupational Health Disaster Emergency Network's website provides Pandemic-specific planning and preparedness tips for private industry. Visit http://ohden.sph.unc.edu:9002/pandemic for more information.
- Video and transcripts of the September 2005 conference in New York, "Bulls, Bears, and Birds: Preparing the Private Industry for Pandemic Influenza," are available at www.upmc-biosecurity.org/pages/events/birds/index.html.
- Mercer Human Resource Consulting also released a document entitled *Preparing for a pandemic: Easing the Avian flu's impact on employee welfare and productivity*. It can be found at http://www.mercerhr.com/avianflu.
- Booz Allen Hamilton published a document titled *Influenza Pandemic Simulation: Implications for the Public and Private Sectors.* This is located at www.boozallen.com/media/file/Influenza_Pandemic_Simulation.pdf.
- Barry, John M. (2004). The Great Influenza: The Epic Story of the Deadliest Plague in History. New York: Penguin Books, Ltd.
- Kao, Amy and Vidal, David J. (2006, July). The Conference Board Executive Action Series. The Corporate Response to the Avian Flu Crisis: Are Businesses Doing Enough To Prepare for a Pandemic? 204.
- Pandemic Preparedness: Frequently Asked Questions. The Conference Board Executive Action Series. (2006, September) 210.
- 10 Point Framework for Pandemic Influenza Business Contingency Planning. (2006, September). University of Minnesota, Center for Infectious Disease Research and Policy (CIDRAP).

Appendix E: NIAC History

Purpose

The National Infrastructure Advisory Council (NIAC) provides the President, through the Secretary of the Department of Homeland Security (DHS), with critical infrastructure security advice to support the economy. The Council's charter allows it to directly advise other agency heads who share responsibility for critical infrastructure protection. These agencies include Health and Human Services, Transportation and Energy. The President tasked the NIAC with improving the cooperation and partnership between the public and private sectors in securing critical infrastructure and advising on policies and strategies ranging from risk assessment and management to information sharing to protective strategies and clarification on roles and responsibilities between public and private sectors.

Background

Executive Order 13231 (October 16, 2001) as amended by Executive Order 13286 (February 28, 2003) and Executive Order 13385 (September 29, 2005) created the NIAC. The Council is composed of not more than 30 members, appointed by the President and selected from the private sector, academia, and State and local government, representing senior executive leadership expertise from the critical infrastructure and key resource areas as delineated in Homeland Security Presidential Directive-7 (HSPD-7).

Leadership

The positions of NIAC Chair and Vice Chairs are named by the President. Currently, the NIAC Chair position is held by Mr. Erle A. Nye, Chairman Emeritus, TXU Corp. The Vice Chair is Mr. John T. Chambers, President and CEO of Cisco Systems, Inc.

NIAC Secretariat

The Infrastructure Partnerships Division (IPD) within DHS serves as the NIAC Secretariat. IPD is the primary hub for critical infrastructure expertise, coordinates infrastructure situational and operational awareness for DHS, and builds and maintains public-private partnerships and forums to engage and support critical infrastructure sectors, including the responsibility for developing and maintaining information sharing programs with the sectors.

NIAC Operations

The NIAC meets publicly four times each year, twice by teleconference and twice in-person. These meetings, whether in person or by teleconference, take place in Washington, D.C. in a venue open to the public, usually the National Press Club. The Council uses its public meetings as working meetings, focusing on progress reports from its working groups and deliberations producing useful, actionable recommendations in a timely manner. The Council addresses four to six major studies annually, with high performance goals of delivering quality, well-researched reports between 6-12 months from the inception of the selected studies. Its reports have drawn public and private-sector interest with regular requests from Congressional committees for copies. Public meetings are normally attended by several members of the Press. The President

meets with the Council at least once a year and has directed very specific requests to the Council for recommendations on issues of interest. The White House monitors the progress of the Council's studies on a regular basis between meetings through a liaison in the Homeland Security Council.

NIAC Membership

Chair - **MR. ERLE A. NYE** *Chairman Emeritus,* TXU Corp.

MR. EDMUND G. ARCHULETA *General Manager,* El Paso Water Utilities

MR. CRAIG R. BARRETT *Chairman of the Board,* Intel Corporation

MR. ALFRED R. BERKELEY, III *Chairman and Chief Executive Officer,* Pipeline Financial Group LLC (former Vice-Chairman, NASDAQ)

MR. GEORGE H. CONRADES *Executive Chairman,* Akamai Technologies Inc.

CHIEF REBECCA F. DENLINGER *Chief,* Cobb County (Georgia) Fire and Emergency Services

LT. GEN (RET.) ALBERT J. EDMONDS *Chairman,* Edmonds Enterprise Services, Inc.

CHIEF GILBERT G. GALLEGOS *Chief of Police (retired),* City of Albuquerque, New Mexico

MS. MARGARET E. GRAYSON *President,* Grayson and Associates

COMMISSIONER RAYMOND W. KELLY *Police Commissioner,* City of New York

MS. MARTHA H. MARSH *President and Chief Executive Officer,* Stanford Hospital and Clinics

MR. JAMES B. NICHOLSON *President and CEO,* PVS Chemical, Inc.

MR. THOMAS E. NOONAN *Chairman, President and Chief Executive Officer,* Internet Security Systems, Inc.

THE HONORABLE TIM PAWLENTY *Governor,* The State of Minnesota

MR. GREGORY A. PETERS *Managing Partner,* Collective IQ

MR. BRUCE A. ROHDE *Chairman and Chief Executive Officer Emeritus,* ConAgra Foods, Inc.

DR. LINWOOD H. ROSE *President,* James Madison University

MR. JOHN W. THOMPSON *Chairman and Chief Executive Officer,* Symantec Corporation