IBM Center for
The Business of Government

Collaboration Series

Adapting the Incident Command Model for Knowledge-Based Crises

The Case of the Centers for Disease Control and Prevention

Chris Ansell
Ann Keller
University of California, Berkeley

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Adapting the Incident Command Model for Knowledge-Based Crises: The Case of the Centers for Disease Control and Prevention

Chris Ansell
Professor
University of California, Berkeley

Ann Keller
Associate Professor
University of California, Berkeley

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Foreword

On behalf of the IBM Center for The Business of Government, we are pleased to present this report, *Adapting the Incident Command Model for Knowledge-Based Crises: The Case of the Centers for Disease Control and Prevention*, by Christopher Ansell and Ann Keller of the University of California, Berkeley.

Daniel J. Chenok

The federal government has developed increasingly sophisticated approaches to addressing emergencies and crises. One successful management model is the incident command system (ICS), which was initially developed in the 1970s as a command-and-control approach for fighting forest fires, but has since been adapted to other policy domains.

The IBM Center sponsored two case studies on the use of the ICS several years ago: *Leveraging Collaborative Networks in Infrequent Emergency Situations* (2005) and *From Forest Fires to Hurricane Katrina: Case Studies of Incident Command Systems* (2007), both by Dr. Donald Moynihan. During this period, the Department of Homeland Security adopted the ICS model—which it renamed the National Incident Management System (NIMS)—and required its use at all levels of government in emergency and crisis situations.

Giovanna Patterson

This report is a case study of one agency—the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services—which sought to use the standard NIMS model but ultimately developed a significantly revised approach to incident management. The report finds that the transformation happened because the CDC is required to produce authoritative knowledge during a crisis. This calls for a different response structure than might work for direct, frontline operations.

While the CDC experience is but a single case, it demonstrates that the ICS model can be applied as a governance approach outside the context in which it was originally developed—direct operational control of an emergency situation. As a result, the CDC experience in using, and successfully adapting, the ICS model may be useful in other "knowledge-based" agencies such as the National Weather Service, the Securities and Exchange Commission, or the Environmental Protection Agency. Indeed, the report concludes with a set of recommendations to consider in applying the model to other agency settings, including that agencies should determine whether their core function is operations or knowledge production, and should assess how widely dispersed subject-matter expertise is in their organization's core emergency-related business functions.

We hope federal executives in the Department of Homeland Security and in other knowledge-based agencies find the lessons and recommendations in this report useful as they consider their approaches to emergency and crisis management initiatives in the future.

Daniel J. Chenok
Executive Director
IBM Center for The Business of Government
chenokd@us.ibm.com

Giovanna Patterson
VP, Federal Healthcare Industry Leader
IBM Global Business Services
gio.patterson@us.ibm.com

Introduction

Even six months after the onset of the 2009 H1N1 influenza outbreak, the Emergency Operations Center at the U.S. Centers for Disease Control and Prevention (CDC) conveyed a sense of urgency. Banks of computers with seats designated for certain agencies or task forces—some of them occupied—dominated the center of the room, while the 24/7 response desk watched over the operations center through a Plexiglas window. A gigantic video screen on the front wall simultaneously displayed 24-hour news feeds, the daily schedule, the director's "information needs," and maps of the outbreak. A local film crew taped a segment for the nightly news in front of the screen. Men and women, some in military uniform, scurried through on their way to task force meetings held in a warren of breakout rooms. The walls were garlanded with pictures of notable visitors including the Duchess of York and actor Will Smith, along with "ribbons" representing previous mobilizations (SARS, Katrina, etc.)—giving the Operations Center a sense of purpose and history.

The layout and operation of the center reflect a central challenge the CDC faces in responding to public health crises. Effective response requires both speed and accurate knowledge. Medical treatment and public health measures must be rapidly deployed, but the choice of when and how to deploy depends on accurate identification, analysis, and tracking of the disease.

In early April of 2009, the twin challenges of speed and accurate knowledge were very much evident at the CDC. Within two weeks of discovering the first two cases of the novel H1N1 influenza, the CDC had:

- Published a public report on those cases
- Dispatched epidemiologic support teams to two states
- Moved from routine to fully activated emergency operations

In addition, the CDC continued to analyze suspected cases in an effort to ascertain the virus's severity. This pace of activity might give the impression that the agency was working from complete and reliable information. In fact, the agency faced significant uncertainty about the virus's spread and severity, the most effective protective measures, and the most vulnerable populations. In spite of this, the agency was under enormous pressure to orchestrate a response that was neither too timid nor over-zealous.

In meeting these challenges, the CDC and other government agencies adopted a distinctive organizational governance strategy for handling crises and emergencies. Following the attacks on September 11, 2001, and the anthrax attacks that same year, the federal government recognized the need to think systematically about emergency response. The subsequent, heavily publicized failures associated with Hurricane Katrina in 2005 reinforced this concern about organizational performance in the face of an emergency. Increasingly, public officials turned to an organizational governance strategy known as the incident command system (ICS) model.

This report is organized as follows:

- An introduction to the traditional ICS model explains how it is intended to integrate the resources necessary to carry out a first response during an emergency or crisis.
- The CDC case study. This section describes CDC's routine operations and briefly looks at what CDC's crisis response looked like before its adoption of ICS. We describe how CDC reconfigured ICS during the 2009 influenza pandemic.
- Findings and recommendations are presented for how other knowledge-based organizations might incorporate tailored versions of ICS to support critical agency functions in response to an emergency or crisis.

Emergence of the Incident Command System Model

The ICS governance model was initially developed by firefighters in California in the late 1970s after a summer of severe fires that overwhelmed the resources of any single firefighting company. During these large events, firefighters struggled to integrate personnel and resources from multiple jurisdictions into one, coordinated response organization (Annelli 2006; Bigley and Roberts 2001; Buck, Trainor, and Aguirre 2006; Lindell, Perry and Prater 2005).

The emergence of the ICS model within the firefighting community was meant to resolve coordination problems by creating a flexible, adaptable response structure—ICS allows for responses to be scaled up or scaled down as necessary—while remaining sufficiently robust in command and communication functions.

Successful application of ICS in firefighting popularized the approach and led government agencies facing any number of potential emergencies—natural disasters, multi-casualty accidents, hazardous chemical releases, or terrorist attacks—to incorporate the ICS model as their central organizing strategy (Moynihan 2009). Adoption of ICS at the federal level began under James Lee Witt, director of the Federal Emergency Management Agency (FEMA) in the 1990s. Though initially shelved by President George W. Bush's FEMA appointees, its use was reinstated after the attacks of September 11th and it was renamed the National Incident Management System (NIMS).[1] Its use was expanded to the extent that, today, the application of the ICS model is required for all federal agencies and for any state, local, tribal, or private agency accepting federal preparedness funding (Buck, Trainor, and Aguirre 2006; Lindell, Perry and Prater 2005).[2]

While ICS has demonstrated its value for firefighting, there have been lingering concerns in the public health community about whether the incident command model is appropriate for responding to infectious disease outbreaks. Indicating a view that there are consequential differences between public health and firefighting responses, one public health official asked us rhetorically: "Are we firemen now?"

This report is a case study of the CDC's use of the ICS model (which it now calls the Incident Management System) during the 2009 H1N1 pandemic. Though critics of ICS worry that it will fail to perform outside the first responder context, the CDC case tells a slightly different story.

1. The federal government adopted a slightly different label that also entails subtle changes in form. Instead of incident "command," the federal government refers to incident "management" (Annelli 2006; Lindell, Perry and Prater 2005).
2. Both the public and elected officials, concerned with the capacity of the public health system, considered it necessary to allocate resources for increasing that capacity. While some of this effort has been devoted to an "all hazards" approach, the George W. Bush administration also allocated specific resources to prepare for novel influenza pandemics. See Homeland Security Council (2005).

Study Methodology

This report draws from data collected during the authors' study of the international response to the 2009 H1N1 pandemic. This study sought to understand how national and international public health organizations respond to uncertain risks demanding rapid response. Initially, we planned to gather real-time data on organizational response by surveying responders working at multiple institutional locations during an infectious disease outbreak. However, when the 2009 pandemic broke out, we learned a valuable, and in hindsight, totally predictable lesson: responders are simply too busy in the early phases of the response to engage with academics. This lesson shaped the subsequent strategy developed to understand the response.

Our second step was to assemble a group of public health officials from several national and international institutions to discuss the Spring 2009 pandemic response. This meeting was held at the University of California, Berkeley, in the summer of 2009. Public officials were no longer in full-blown emergency response mode (the H1N1 moved to the southern hemisphere in the summer of 2009). The meeting was attended by public health officials representing the local and national levels in the United States, the national level in France, the European Union, the World Health Organization's European and Western Pacific regions, the Global Outbreak Alert and Response Network (GOARN), and Fluwiki. The purpose of the meeting was to compare the organizing and sense-making response as it unfolded in April, 2009. While we do not report on the results of this meeting here (Keller, Ansell, Reingold et al 2012), it did provide critical background knowledge about the response and directly shaped our subsequent research strategy.

The public officials attending this meeting suggested that we could profitably study organizational response by observing their activities firsthand during the expected "second wave" of the H1N1 pandemic in the fall of 2009. As a result, we placed an observer with the European CDC in Stockholm, the United Nations System Influenza Coordination (UNSIC) group in Geneva, and the French Institut de Vieille Sanitaire (InVS) in Paris. We also placed two researchers with the U.S. CDC in Atlanta. The CDC was the lead organization of the U.S. national response to H1N1 and our researchers were embedded with two units—the global disease detection unit (October to December 2009) and the policy unit (November 2009). Both of these units were part of the CDC's H1N1 incident command organization. Our analysis of the CDC's experience with ICS draws on observations, interviews, and information gathered by both CDC observers, but primarily by the researcher embedded with the policy unit.

In addition to participating in the life of the policy unit, one of the embedded researchers was able to interview and observe other ICS units and came to focus on the performance of the CDC's incident command system. This observer sat in on or listened to daily executive meetings on the response (the director's and the morning reports) and also listened in on various conference calls (a key CDC communication strategy). This researcher was also given access to the system of documents related to the response, including Joint Information Center media reports, incident action plans, plan decision unit reports, and minutes of previous morning reports.

Both researchers embedded at the CDC (as well as those embedded elsewhere) posted daily field notes to a secure common website. These observations, interviews, documents, and field notes form the basis of our analysis of the CDC's ICS operation during the 2009 H1N1 pandemic.

The CDC is not a first responder organization in the traditional sense. Some of its tasks are operational and it must be prepared to provide additional capacity to overwhelmed local or state public health agencies, but its central mission is best described as the "rapid mobilization of authoritative knowledge." When CDC employees are deployed to outbreak sites, they are primarily charged with collecting and analyzing information and with advising a vast network of first responders across the public and private sectors.

Existing research suggests that the ICS model may be less effective in situations that differ from those faced by frontline first responders such as firefighters. However, our research finds that the CDC successfully adapted the ICS model to the rapid mobilization of authoritative knowledge. The CDC case, therefore, suggests that the ICS model can be adapted to work effectively in situations other than the first responder model. Nevertheless, it is important to understand how and why the CDC was able to adapt this governance model designed for an operationally focused mission to its own knowledge and expertise-based context and mission.

Our research leads us to observe that ICS was originally created with a set of assumptions about what constitute critical agency mission functions during a crisis. Since many organizations have been asked to adopt the ICS governance model, they need to first assess how their critical agency mission functions differ from those of first responders. We conclude that there is a need for organizations to adapt the ICS model in ways that meet their own core agency mission functions.

What Is the Incident Command System and How Does It Work?

The most fundamental element of the ICS model is the rapid establishment of a single chain of command. In the firefighting context, the senior officer arriving at a fire assumes the role of incident commander. A basic organization is then put in place and responders trained in ICS are assigned to pre-established organizational functions that include operations, planning, logistics, and finance/administration. As both requested and unrequested personnel and resources arrive on scene, they will be integrated into this basic organizational structure. As more high-ranking responders arrive, the incident command may be shifted to those with greater experience and authority. But the principle of unity of command will always be followed. When working in its "natural habitat," ICS provides responders with a strategy for coordinating and scaling up response efforts. In the most successful cases of incident command, this process happens relatively smoothly.[3]

Bigley and Roberts (2001) vividly describe the ICS in action during an "immense California wildfire." Their description (see *California Wildlands on Fire*) provides a sense of the magnitude and diversity of resources that can be at stake during an emergency.

In the face of such a challenge, it is clear that there is a great potential for people and institutions to work at cross-purposes. Relatively simple administrative tasks of sharing personnel or equipment can become major bottlenecks to decisive action. Turf battles can stymie efforts to coordinate effectively. Stress and time constraints can turn small coordinating problems into major disputes. The basic logic of incident command is to avoid these frictions by rapidly integrating different people and institutions into a single, integrated response organization.

3. Buck, Trainor, and Aguirre (2006) review several cases where multiple jurisdictions were integrated into a single ICS—including the attacks on the Pentagon, the Oklahoma City bombing, and the Northridge earthquake. They also review examples where unified command was never established, such as the attacks on the World Trade Center and the Columbia Space Shuttle accident and Hurricane Floyd. They argue that unified command is more likely to emerge in situations where responders have trained in ICS and when the perimeter of the event is circumscribed.

California Wildlands on Fire

In 1970, this event spanned 13 days and the fire was fought under volatile conditions, both over treacherous or difficult-to-access wildlands and in various residential areas. From the outset, resource deployment proceeded at a torrid pace. Three minutes after the first call was received, approximately 65 people, seven engine companies, two water-dropping helicopters, and one bulldozer were dispatched to the scene.

Within 80 minutes, the deployment had escalated to over 950 people and several hundred pieces of equipment. In the end, approximately 839 engines and 44 aerial units (consisting of both helicopters and fixed-wing aircraft) were called into service. Firefighters responded from 458 fire agencies across 12 states and ultimately numbered more than 7000.

Furthermore, as the incident evolved, the dimensionality and uncertainty of the task environment increased substantially. Although fire suppression was the original focus, other operational imperatives rapidly emerged, including search and rescue, medical aid, residential evacuation, and hazardous materials containment.

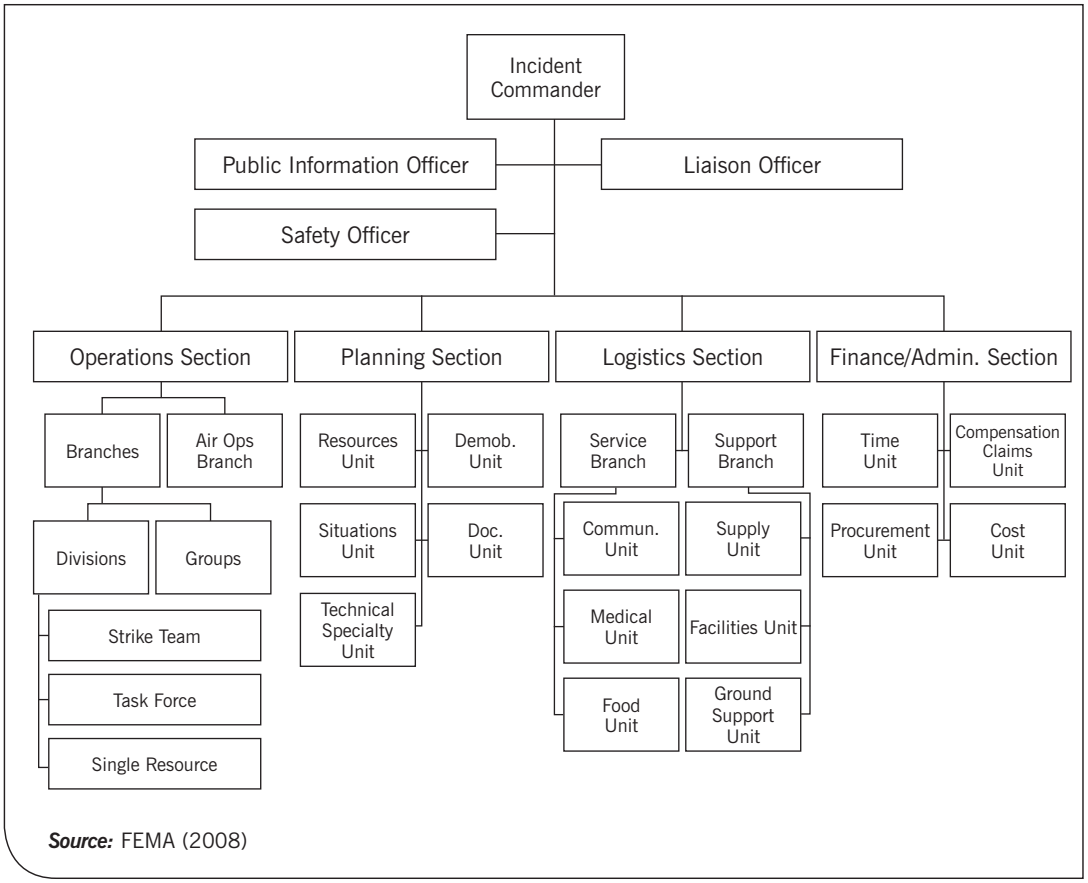
Moreover, personnel from many other types of agencies (for instance, law enforcement, Red Cross, city and county governments, National Guard, the Federal Aviation Administration, and the Federal Emergency Management Agency) became involved with the emergency management effort, and their diverse contributions were coordinated through the ICS (2001: 1283–4).

Figure 1 shows the organizational structure of the standard ICS model, as defined by FEMA. As this organization chart makes clear, the ICS model is organized around four basic components:

- Operations
- Planning
- Logistics
- Finance/administration

These four components report directly to the incident commander, preserving the unity of command. The sections are, in turn, divided into branches and units following the basic hierarchical structure of incident command. Most of the ICS governance structure exists within this basic line organization. However, several roles (public information, liaison, and safety officers) provide "staff" support directly to the incident commander. These roles are referred to collectively as the "command staff."

Figure 1: Standard Incident Command Structure



Source: FEMA (2008)

The CDC Experience: Adaptation of the Incident Command System to Knowledge-Based Crises

The CDC is one of the premier public health agencies in the world and often serves as an exemplar for other countries. It has a capacity to engage in public health missions internationally as well as domestically. A highly professional organization with a commitment to science-based practice, it has deep expertise in infectious diseases and significant laboratory and analytical capacity. The CDC is a highly respected agency and enjoys bipartisan support.

To better understand the pressures faced by the agency during a crisis, we begin with a description of CDC's routine operations. Though this brief description cannot capture the variation in activities this complex agency performs, it does provide a useful baseline. In its first incarnation—controlling malaria in the South during World War 2—the CDC tackled the operational mission of filling in swamps and marshes where mosquitoes bred. Over the course of the 20th century, its mission has evolved. It now centers on the production of authoritative scientific information that can be used as the basis of public health campaigns and its ongoing efforts to bolster public health capacity at the state and local level. The agency also maintains systems for disease surveillance and acts as a clearinghouse for health information collected by health care providers and public health officials at the state and local level. The agency's mission includes infectious diseases, chronic diseases, environmentally produced diseases, and injury and violence, both within the United States and globally.

Much of the agency's work involves the long, painstaking process of establishing a scientific understanding of the epidemiology associated with any given disease or threat to human health. Some of this research is conducted in house, but the agency also allocates federal dollars to support outside researchers. Equally important, the agency reviews and disseminates evidence-based approaches to mitigate health threats in the population. By focusing on both science and interventions, the agency works to turn advances in knowledge into concrete actions that can improve public health.[4]

This portrait of the CDC as an agency that links science to public health interventions—a process that can take 10 to 15 years—contrasts markedly with popular images of the agency as a rapid responder to contagious disease outbreaks. Outbreak response is an ongoing but only occasionally all-consuming part of the agency's work. In order to maintain outbreak response capacity, the CDC maintains a cadre of specially trained experts—epidemic intelligence service officers—who can be dispatched as needed for outbreak investigations. This allows the CDC to support outbreak investigations without disrupting the agency's routine operations. In fact, most outbreaks are local events that fail to make national headlines and demand few resources from the CDC beyond its advice and, occasionally, the handful of epidemic intelligence service officers sent to the outbreak site. However, when outbreaks—especially novel ones—reach

4. For example, the CDC's Division of HIV/AIDS Prevention systematically reviews the scientific literature to find effective behavioral interventions and, where it can replicate those findings, disseminates information explaining the details of the proven programs to community-level actors working to lower risky sexual behavior among targeted groups.

epidemic or even pandemic proportions, the agency shifts resources away from its routine public health work to the crisis. Depending on the nature of the crisis, emergency operations might be sustained for months. Based on interviews, participant observation, and internal documents, this report examines the CDC's experience as it shifted from routine to emergency operations during the 2009 H1N1 pandemic.

Shifting from Routine Operations to Crisis Response

Prior to its adoption of the ICS model, the CDC structured emergency response around subject matter expertise by assembling teams of experts that would fulfill core public health functions including surveillance, disease control, and laboratory work (Papagiotis, Frank, Bruce, and Posid 2012; Posid, Bruce, Guarnizo, Taylor, and Garza 2005). During the 2000s, the CDC mounted a full-scale emergency response for the:

- 2001 anthrax attacks
- 2002 outbreak of West Nile virus
- 2003 outbreak of Severe Acute Respiratory Syndrome (SARS)

Owing to difficulties with coordination and communication during the anthrax attacks and the spread of West Nile, the CDC developed an emergency operations center and brought in staff specifically to help conduct emergency operations. The SARS outbreak was the first time the new operations center was used. However, the presence of the operations center did not change the agency's team-based approach.

The director of the National Center for Infectious Diseases (NCID) was appointed to lead the CDC's SARS response in what came to be called the NCID leadership team. This team drew on technical support from CDC staff within NCID's Division of Viral and Rickettsial Disease. The response effort was initially structured into nine teams:

- NCID Leadership
- Epidemiology/Surveillance
- Clinical/Infection Control
- Laboratory
- Quarantine
- International/WHO
- Information technology
- Communications
- Operations

Additional teams, including ones for hotel investigations and community health, were added as new issues arose (Posid, Bruce, Guarnizo, Taylor, and Garza 2005). Thus, the CDC response included the capacity to restructure and adapt to the dynamics of the emergency at hand.

In terms of hierarchy, each team reported to the NCID leadership team, and team leaders met twice daily during the crisis to keep abreast of unfolding events. Unlike the ICS model, this approach was not concerned with the "span of control"—the number of units or personnel supervised by a manager. Thus, as teams were added, the leadership's management scope increased until it was overseeing 15 teams, as well as several ad hoc groups. Field assignments—where

What Is CDC's Routine Response to Localized Outbreaks?

The CDC's response to the 2009 H1N1 pandemic is placed in stronger comparative perspective by understanding what CDC's routine outbreak response looks like. This typically means serving in an advisory capacity to state or local agencies, or the use of a temporary taskforce, if an outbreak is larger.

Popular conceptions of the CDC during an outbreak may include expert scientists dressed in elaborate white barrier suits to allow them to minimize their personal risk while collecting specimens of deadly infectious agents like Ebola or monkey pox. While this image is not incorrect, it does not represent CDC's normal mode of outbreak response. In fact, the CDC—as an agency that produces authoritative and often cutting-edge information about disease—often acts in only an advisory capacity for domestic outbreaks.

Most outbreaks occur locally and are locally managed. State and local health departments have their own capacity to study outbreaks, determine their sources, and set in motion plans to mitigate their effects. CDC staff note that only a small proportion of the outbreaks in the United States in a given year are even brought to the CDC's attention. In the cases where local authorities do contact CDC staff, they are often seeking consultations that can be conducted over a few e-mails or even a single phone call. Local authorities might call on the CDC because they lack sufficient capacity, staff, or expertise to proceed comfortably on their own. Local authorities also contact the CDC simply to keep them informed of local events. In such situations, the CDC acts as a hub or clearinghouse for expertise generated at the local level.

CDC staff who work on outbreak response strive to be at the frontier of outbreak dynamics in order to signal to state and local health departments what capacities are needed to meet emerging challenges. For example, as vaccines have decreased the number of infectious diseases, food-borne and medical-setting outbreaks have increased as a percentage of the outbreaks currently under investigation. Thus, the CDC capacity in these areas has grown over time, along with efforts to encourage state and local health departments to develop similar capacities.

CDC's Epidemic Intelligence Service. Though the CDC is consulted on a small subset of domestically occurring outbreaks, only a fraction of those cases result in the CDC sending personnel to a given location to support outbreak control. The CDC maintains an ongoing capacity to provide such support via the Epidemic Intelligence Service—a highly sought-after two-year postgraduate training program in applied epidemiology. The program admits 70 to 75 trainees per year. About two-thirds of these work from CDC offices in Atlanta and will be dispatched when local officials request CDC assistance. The rest are placed in local and state health departments and conduct outbreak investigations in real time. This typically involves reporting back to CDC for consultation as part of the traineeship. In cases where the CDC is invited to formally participate in a localized outbreak investigation—a so-called EpiAid—only a handful of trainees are dispatched. Thus, in most routine cases, the resources required to mount an EpiAid have minimal impact on the organization's larger function.

What triggers a different approach? Outbreak response can begin to involve the larger CDC organization in cases where any of the following are present, especially in combination:

- Severity
- Potential to become widespread
- Novelty

In such cases, the likelihood of wider CDC involvement goes up. Still, even in cases of pandemic, the CDC first must be invited by local or state governments to become involved in any operational sense—i.e., boots on the ground. Also, when the CDC moves into emergency operations, the number of personnel dispatched through EpiAids may still only be a small proportion of the personnel actively working on the emergency response.

CDC staff are sent to provide assistance at outbreak locations—were not managed by the operations team. Instead, they were managed by expert teams:

- Domestic field assignments were overseen by the epidemiology/surveillance team.
- International assignments were overseen by the international/WHO team (Posid, Bruce, Guarnizo, Taylor, and Garza 2005).

In this sense, what might be called in ICS language the operational arm of CDC's response reported to subject matter experts rather than directly to the leadership team. It is also notable that the agency created a liaison function between its operations team—tasked with finding staff, equipment, funds, and space–and the emergency operations staff (Posid, Bruce, Guarnizo, Taylor, and Garza 2005). This might suggest that the agency viewed its emergency operations staff as filling an advisory rather than leadership role during the crisis. Moreover, the operations team had an average of five staff, well below the team average staff level of 18 during the agency's SARS response effort.

The scale of the 2002 SARS outbreak led the CDC to experiment with other organizing strategies, including the ICS model (Papagiotis, Frank, Bruce, and Posid 2012). CDC attempted to use ICS in its response to Hurricane Katrina, but the agency was not adept at using it and the experiment fostered organizational confusion (U.S. Centers for Disease Control and Prevention 2006). In the summer of 2009, a senior CDC official told us, "We have learned to do it [ICS], but it wasn't easy."

Even outside of crises, the CDC's incident management system is maintained in a "ready" status on an ongoing basis within its Office of Public Health Preparedness and Response. It is continuously supported by a small staff who are also responsible for providing training on the incident management concept to CDC employees. A number of these staffers have military backgrounds and were recruited by the CDC to help the agency master its incident management system. When a serious event like H1N1 occurs, however, the incident management system is activated and staffed with personnel from all parts of the CDC. The staffers from the Office of Public Health Preparedness and Response who maintain the incident management system between incidents may then assume a secondary role.

CDC's Use of Incident Management during the H1N1 Crisis

The traditional ICS model has proven to be an effective organizational strategy for firefighting and other emergency response activities. But is responding to a pandemic analogous to fighting a fire? Not necessarily. During the first wave of the 2009 H1N1 pandemic, the CDC IMS followed the traditional ICS represented in Figure 1. After the first wave of the pandemic, however, the CDC adapted ICS in seven important ways to reflect its knowledge-based, rather than operationally based, role in the crisis (see Figure 2):

- **Operations.** The adaptation of ICS relegated the operations aspect of a traditional ICS to being a support function within the IMS, so that operations, planning, logistics, and finance/administration reported to a chief of staff rather than directly to the incident manager.
- **Task forces.** The adaptation was the elevation of the technical specialty unit (now called task forces) from a peripheral advisory role to the core of the CDC's incident management system. CDC recast its technical specialty unit into five task forces reporting directly to the incident manager:
  - Epidemiology/lab
  - Community mitigation

  - Medical care and countermeasures
  - Vaccine
  - State coordination
- **Plans decision unit.** This adaptation transformed the plans decision unit to better fit CDC's culture of careful information vetting.
- **Joint information center.** This adaptation expanded and elevated the role of the joint information center.
- **Team B.** This adaptation added a "Team B" to aid in vetting CDC decisions.
- **Policy unit.** This adaptation added a policy unit to facilitate and shepherd draft policies through the clearance process within the agency.
- **Deputy incident manager.** This adaptation created a new role—the deputy incident manager—to oversee the plans decision unit, the joint information center, Team B, and the policy unit.

The standard ICS structure assumes that the central problem of emergency response is the coordination of a large operational mission that extends beyond the boundaries of a single organization. In reviewing the 2009 pandemic, three central features of CDC's pandemic response challenged this logic:

- An emphasis on producing authoritative knowledge rather than carrying out an operational mission
- The need to draw on specialized and often isolated knowledge from a dispersed network of actors
- The use of significant resources for managing external perceptions about the CDC's response in anticipation of confusion or controversy among those whose cooperation the agency needed in order to be effective

Each of the seven adaptations CDC made to its 2009 IMS stem from the need to adapt to one or more of the three above features. In the following section, we describe each adaptation and discuss why it was implemented.

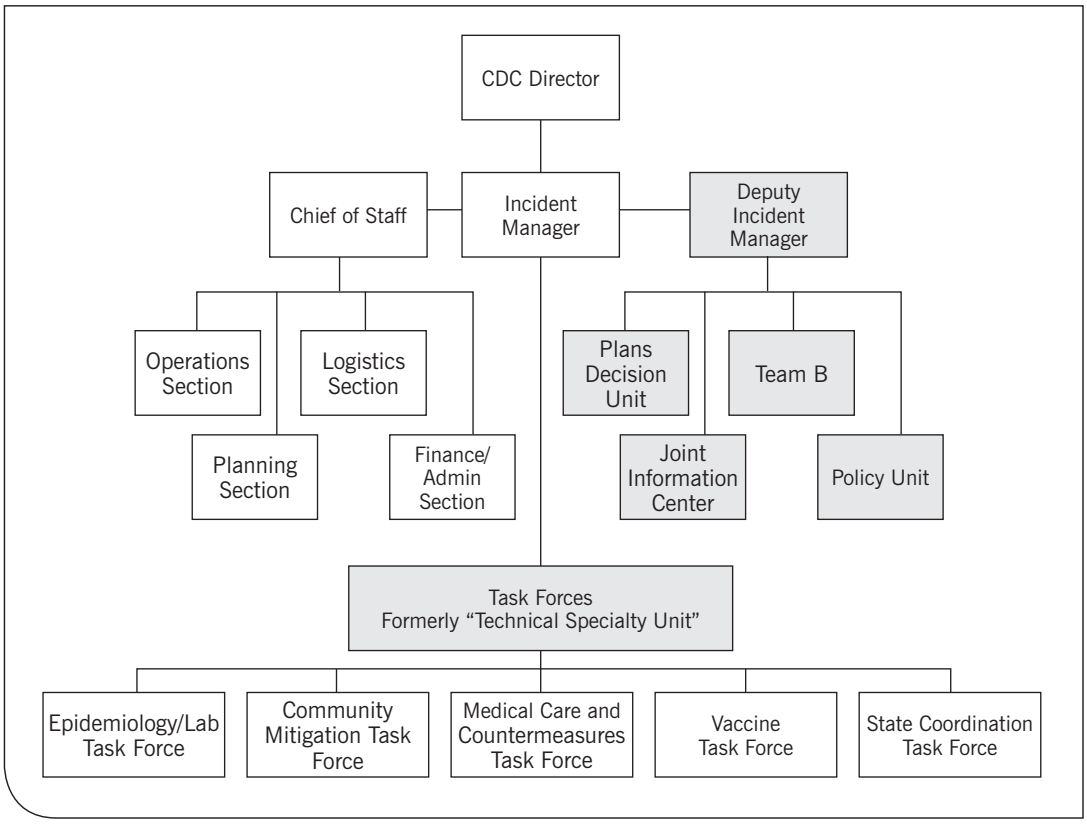
Recasting Roles from the Incident Command Structure to Incident Management Structure

While the CDC does have operational objectives—rapid deployment of people and resources—the priority given to operations by the standard ICS model does not fully match the character of a CDC response. As a result, CDC adapted the ICS model by elevating some units and de-emphasizing others. The seven adaptations are discussed below.

Operations: Relegation of Roles

The CDC adapted the ICS model during its response to the H1N1 influenza because the CDC's chief role is knowledge management, not operations. Many of the frontline operational functions during an infectious disease outbreak (quarantine, vaccine production, vaccination, drug stockpiling, medical care) are carried out by non-federal government entities: local and state public health departments, hospitals, and private health care institutions. Emphasis on producing authoritative knowledge led to the creation and elevation of the technical support unit (renamed task forces).

Figure 2: The CDC's Incident Management System (as of November 2009)



The Task Forces: A Shift from Periphery to Core

When the IMS was activated for the H1N1 response ("stood up" in emergency managers' parlance), the key leadership came from the CDC unit responsible for pandemic preparedness—the influenza coordination unit. The director, deputy director, and program manager of the influenza unit became the incident manager, the deputy incident manager, and the chief of staff of the H1N1 IMS.[5] This activation of the standing IMS and the inclusion of the influenza coordination unit were a first step in aligning the use of the incident management system model with the CDC's traditional science-based approach to public health events. The incident manager, Rear Admiral Stephen Redd, was a senior officer in the U.S. Public Health Service, a medical doctor by training, and a former CDC epidemic intelligence officer. Deputy Incident Manager Toby Merlin was a medical doctor with a background in pathology.

To rapidly mobilize authoritative knowledge, the CDC relies heavily on subject-matter experts. The CDC's major adaptation of the ICS was to place subject-matter experts at the center of its H1N1 response.[6] In its initial structure, subject-matter experts were organized into a set of

5. The deputy incident manager does not appear formally in the incident command structure until August 2009. The structure of the ICU has some parallels with the prototypical structure of incident command. It has an operations/plans, resources, and logistics unit which are approximately equivalent to the ICS structure of operation, plans, logistics, and finance/administration. However, the influenza coordination unit also has a science, communications, and policy unit, which reflect the importance in the CDC of mobilizing authoritative knowledge.

6. We can trace the evolving structure of the response through the incident action plans produced during the response. The first action plan (April 22–24, 2009) reflects an organizational structure that was directly modeled on FEMA's standard ICS model. The key sections of this initial incident command structure created by CDC mirrors the operations, planning, logistics, and finance/administration sections illustrated in Figure 1.

teams reporting to a technical specialty unit (now called task forces) which reports in turn to the planning section, which is the traditional incident command structure. The CDC elevated the technical specialty unit from a support group reporting to the planning section to become the dominant core of the IMS as a set of five task forces. The formal transition to this new structure was rolled out in the summer of 2009 after the intense spring response (Incident Action Plan, August 27, 2009).

One of the military personnel detailed to the CDC to aid them in using incident command described some of the pressures that led the subject-matter experts to become the core of the response organization. He observed that the vaccine task force drove this transformation, since it had to begin planning immediately. The large size of the epidemiology group was also a major factor. It was organized into 68 regional teams, with three epidemiologists assigned to each region. The large amount of information handled by the surveillance/diagnostics unit also drove this adaptation. The sheer volume of information flowing into the agency and the need to quickly process it increased the prominence of subject-matter experts in the CDC IMS.

A notable feature of the ICS model is that it anticipates the need to adapt to changing circumstances. ICS philosophy stresses the "modular" character of incident command, which means that units can be "plugged in" or "unplugged" as needed. The CDC's adaptation of ICS is a tribute to the success of this flexible "plug and play" strategy. However, celebrating the adaptability of the ICS should not lead us to miss what was distinctive about elevating the technical support unit's role. It was not simply elevated to an equal status with the other sections (operations, plans, logistics, and finance/administration), but instead became the core of the IMS.

This new operational core was itself transformed into five task forces:

- Epidemiology/lab
- Community mitigation
- Medical care and countermeasures
- Vaccine
- State coordination

Each of these task forces was further subdivided into a number of units. The epidemiology/lab task force and the medical care and countermeasures task force had an extensive number of subunits. The complexity of these task forces probably gave rise to the comment by one permanent ICS staffer that the CDC stretches the incident command principle of maintaining a low "span of control"—e.g., keeping the number of units supervised low.

The task forces did not—at least explicitly—use the hierarchical logic of organizing subunits into branches and divisions and groups in order to reduce the span of control. The central role of the task forces in the CDC IMS reflects both the need to produce authoritative knowledge and the fact that specialized knowledge needed for pandemic response is expected to be highly dispersed.

The central role of these task forces was seen in our observations of the morning report, a daily meeting where different sections and units apprise the incident manager of the situation. We observed that the task forces were the most prominent units in these important daily meetings of senior incident leadership. In addition, our interviews with the operations and plans units reinforced our impression that they were not as central as they would have been in a traditional ICS response structure. One reason for their more peripheral status was that the leadership wanted subject-matter experts reporting directly to subject-matter experts. In essence, the CDC stood the typical logic of ICS on its head: The traditional "staff" role of subject-matter experts

was placed at the center of the response, while the traditional "line" role of the four core ICS sections was converted into a supporting "staff" role.[7]

The Plans Decision Unit

The plans decision unit is a standard element of the ICS model, but CDC altered its role. One way in which the CDC's emphasis on knowledge management and its associated organizational culture became evident during the H1N1 response was in tensions that arose around its approach to planning. In agencies like CDC that rely on scientific standards to produce authoritative knowledge, the culture places a premium on knowing before acting. This can come across as not sufficiently valuing the role of planning.

We discovered this tension in conversations with former military planners detailed to the organization to aid in its pandemic response efforts. In essence, they told us that "scientists do not like to plan." In an interview with two former military personnel detailed to the CDC, one observed that planning was not part of the organization's culture. He explained, "They [CDC staff] just do things and they feel like they will work it out as they go." To underscore this point, the second interviewee added: "Even if you have to change your plans on the ground, you want to have a lot of things worked out." Both implied that the CDC, and especially scientists at the CDC, are wary of acting on uncertain information and, thus, do not feel sufficiently comfortable projecting the course of future events—something that is required if one is going to commit to a plan. This finding was reinforced by a (non-military) senior official who told us that "prioritizing" is a challenge for the CDC and that decisions are often driven by events and time pressures.

The lack of a culture that emphasizes the need to commit to a course of action despite uncertainty can be further illustrated by the transformation of the plans decision unit (PDU).[8] Broadly guided by the framework set out by the Department of Homeland Security's Integrated Planning System (U.S. Department of Homeland Security 2009), the planning unit was designed to help make decisions under uncertainty. It is a hybrid of short- and long-term planning. A planning unit staffer (who was former military) said that the unit's role is important because most people are so busy thinking about short-term needs that they can't think about the longer term. The plans decision process is rooted in military planning (and staffed by ex-military planners) and is designed to "force" a decision and to create cross-unit decision-making integration.[9]

To illustrate how the planning unit typically supports operations, consider a story that planners told about the importance of their function. A high-level doctor complained that there were a lot of meetings; everyone agreed that there were too many meetings without resolving issues raised, but then nothing changed. At the next meeting, everyone would again agree about the problem and still nothing would change. And this would happen again and again. The planning staff argued that this is what the role of the planning unit is designed to prevent, by forcing decisions. The planning staffers note that a "scientific" organization like the CDC especially needs this mechanism, because scientists do not like to make decisions under uncertainty.

7. This transformation is explicit in the revised organization charts. Operations, planning, logistics, finance/administration, and situation awareness are represented as staff functions reporting to the chief of staff rather than directly to the incident manager (see Incident Action Plan, August 27, 2009).

8. Recall that the typical ICS prioritizes operations and the other three sections (planning, logistics, and finance/administration) are conceived of in operational terms.

9. One PDU staffer told us he was still not sure of the best place for the unit in the incident command structure, and that having the PDU report to the DIC developed during the 4th pandemic planning exercise.

However, the role of the PDU and its military planners was, to some extent, transformed by the CDC. At the same time that the technical support unit was elevated organizationally to represent its core role in the response, the PDU was removed from the traditional planning section and made to report directly to the newly created position of deputy incident manager. This might appear to be an elevation in status, but we found that this unit, in this new location, came to serve a somewhat different function during H1N1. While the operational planning functions of the unit were no longer central to the response, the CDC still had to make critical decisions and manage the wider information environment. Thus, the PDU, along with the Joint Information Center, Team B (a group of non-agency experts)[10], and the policy unit, were placed directly under the deputy incident manager's portfolio.

By the time we were in residence at the CDC in November 2009, the PDU was relatively inactive, though there is a record of earlier planning guidance provided by the unit. In addition to this record, a planning staffer told us that approximately 90 percent of the topics the unit addressed came from the incident manager or the deputy incident manager. Another 10 percent were "what if" drills initiated by the unit.[11] This pattern suggests that the PDU's role in continuous operational planning was transformed into more of an on-demand advisory function.

By the time we arrived, the planning staff had partly adapted to this new role. A staffer told us that they conceived of the planning process as a "breakout for smart people."[12] The results are written up and presented as "options" for the leadership. Staffers stressed that it is critical to have a lot of interaction with the leadership about the process and to nail down a question that the leadership agrees with. The leadership must be sympathetic to the planning assumptions that get made because, after seeing the results, the leadership may decide that they need to go back to the drawing board. During H1N1, the unit staff learned that the credibility of their planning advice depended on getting the right subject-matter experts to participate. This is especially important, they say, in a scientific culture like the CDC's. They point out that in the military it is not particularly important who the staff planners are; one is as good as another. At the CDC, on the other hand, it is critical to have the "right" scientists involved. Pressure to produce authoritative knowledge drove this transformation in the role and importance of the CDC plans decision unit.

The Joint Information Center

The joint information center is a standard element of the ICS model, but CDC elevated its role. It is one of the CDC's central mechanisms for the "rapid mobilization of authoritative knowledge." Just as subject-matter expertise partially supplanted operational units in the CDC's incident management system, the CDC's joint information center played a greater role than might have been expected on the basis of the standard ICS model.

Such centers are a standard feature of the National Incident Management System, where they play an important supporting role under the guidance of a public information officer (see Figure 1). Broadly speaking, a joint information center is responsible for risk communication and press relations (National Response Team 2000; U.S. Department of Homeland Security 2008). Reflecting the centrality of knowledge management in public health response, the CDC's was a joint information center on steroids. The main leadership of the joint information

10. Both the Joint Information Center and Team B are described more fully on pages 20–22.

11. Earlier in the response, the staffer told us, it might have been closer to a 60%/40% split.

12. Once a topic is assigned, the PDU then gathers relevant subject matter experts. They are presented with the topic and asked to come up with a list of implied tasks related to the topic, to articulate a set of facts (which everyone must agree on) and then a set of explicit planning assumptions (which must be "necessary and valid"). If there is disagreement, the leader of the process may authoritatively set the assumptions. The group then articulates options, which get subjectively ranked quantitatively. PDU staffers stress that the process is not complicated, but it is "hard to deliver."

center comes from the standing emergency risk communications group, which has seven standing teams. When the incident management system for H1N1 was mobilized, an additional eight teams were created. During the H1N1 response, the joint information center was located in a small room off the emergency operations center, which was only large enough for the 15 team leads.

Due to its distinctive role in the response, several staffers recommended that we observe the joint information center. One staffer described it as being like an "iceberg," because it does many things beyond its most apparent tasks. In earlier events and during the H1N1 response, the center's role had evolved and expanded, placing it at the center of information networks within and beyond the CDC.

At a joint information center meeting we observed in November 2009, the CDC info team reported that the CDC had received 151,000 inquiries about H1N1 and many of these inquiries were then fielded by the joint information center. The center was responsible for about 51 percent of all tasks tracked through the operations center tracker system. Early in the response, the operations team, which is in charge of the overall tracking system, handled all these tasks.[13] But the ops team was not good at distinguishing "communication tasks." So the joint information center became centrally involved in the task tracker system, allocating the high volume of communication tasks to the 15 or so teams that fall under its jurisdiction.

A key function of the center is to help the CDC speak with a single voice. Given the volume and complexity of communications, there is always significant potential for sending or contributing to conflicting messages and information. The joint information center not only had to be aware of all the CDC's external communications; it also had to stay on top of how those messages were being received and interpreted. As a result, it carefully monitors—in real time—how the media interpret the event. Through its various teams, it also maintains the capacity to communicate through specific channels and to communicate with key stakeholder groups. It is, as the center lead says, a "network of networks."

Our impressions in observing the joint information center were that its communication strategy was modeled on what the risk communication literature calls a "risk amplification" framework.[14] This framework assumes a tendency for risk to become amplified or attenuated through the social processing of information. The center's risk communication strategy is to engage specialized communication channels to prevent this amplification or attenuation of risk (colloquially called "rumor control").

For example, at one meeting, the center lead opened by talking about the "myths" surrounding the antiviral medicine Tamiflu and the need to combat them. Apparently, these myths were even held by clinicians. The center lead told the teams that they must find out where these myths come from and try to combat them. A discussion ensued about how the center could reach out to clinicians to increase the use of antivirals, especially for those at high risk. One team suggested using non-traditional networks (like "walk-in minute clinics") to reach people. Another team suggested working through credentialing boards. A third suggested working through drug representatives, who visit the doctors regularly.

13. We spoke with a staff person in the operations unit with general responsibility for tasking and sending out tasks that come in to a point of contact in the operations unit. She pointed out that it is actually quite difficult to learn where in the incident management system to send these tasks.

14. On public health risk and crisis communication, see Reynolds and Seeger (2005). Risk communication is a tricky business, because public health authorities want to convey reassurance, prevent panic, and provide guidance and factual information, while providing a realistic sense of the uncertainty involved in an incident. Much is often at stake, both in terms of public health and economic welfare (on risk communication during SARS, see Smith 2006). See Kim and Liu (2012) on CDC crisis communication during H1N1.

The elaborated responsibilities of this "iceberg" reflect the central importance of knowledge management in the CDC's public health mission, as well as the need to manage external perceptions of agency performance and communications. The expansion and evolution of the joint information center's role provides another example of how an agency might adapt ICS if its primary role is the "rapid mobilization of authoritative knowledge."

Team B: The Outside Experts

A Team B is not a standard element of the ICS model. CDC created this unit because of the critical real-time role scientists play in peer-reviewing activities. Science is central to everything the CDC does, but the organization rarely has the leisure to conduct basic research or peer review during a response. It must therefore make decisions under considerable uncertainty and, to do this, it must rely on the experience and judgment of experts. One distinctive mechanism it developed to do this is Team B, designed to get input on critical decisions from the body of experts outside the CDC. The concept of a Team B was first developed by the CIA during the Cold War to develop alternative perspectives on Soviet military threats. CDC first experimented with its version of Team B during its response to Hurricane Katrina.

By mobilizing the knowledge of a wide group of non-CDC experts, Team B helps CDC leadership avoid prematurely locking in to certain ways of interpreting the incident—a significant danger in rapid response situations (Herman and Dayton 2009). During the H1N1 response, Team B was chaired by David Sencer, CDC director during the 1976 swine flu epidemic, whose experience at that time made him particularly aware of the dangers of settling too quickly on an interpretation of outbreak dynamics.

As it developed for the 2009 pandemic, Team B became a virtual team that operated by conference calls. We sat in on one Team B meeting examining the appropriate CDC response to the insufficient vaccine supply. The incident manager began the conference call by describing the different phases of the response and key statistics on the pandemic and on vaccine production. The bottom line was that there would not be enough supply to meet demand at the flu's peak. More would become available after the peak. But a third wave (e.g., in March 2010) was possible and the incident manager thought that the CDC should probably still encourage people to get vaccinated after the first wave. The Team B experts agreed that another wave was possible and that the CDC should continue pushing vaccination. They emphasized that the CDC needed to explain the technical difficulties with producing vaccines to the press, the public and to public officials.

In this Team B meeting, the external experts reinforced the CDC's own interpretation of the situation. Although the Team B experts are not encouraged to develop a consensus position, this mechanism does allow for the wider vetting of ideas about critical public health decisions. It also permits the mobilization of wide networks of expertise beyond the CDC's own considerable retinue of subject-matter experts.

The concept of a Team B is not unique to the CDC. However, to our knowledge, it is a unique adaptation to the incident command system. Like the joint information center, Team B reflects the importance of the rapid mobilization of authoritative knowledge in the public health context.

The Policy Unit

Another prominent CDC adaptation of the ICS was the development of a policy unit to guide the interpretation, coordination, and adjudication of policy during the response. This is not a standard element of the ICS model.

The policy unit was originally a team within the joint information center. During the response to the H1N1 flu, it was elevated to an independent unit reporting directly to the deputy incident manager. Given its origin, it is perhaps not surprising that the unit is similar to the joint information center in the way it functions.

The policy unit has a matrixed structure—its own internal units roughly mirror the structure of the five task forces. Each of these internal units is staffed by a liaison between the policy unit and the incident command task forces. For example, the policy unit's state coordination lead liaises directly with the state coordination task force's policy and communication group. Several policy unit staffers also liaised with standing policy units in the CDC Centers. These liaisons monitored policy developments and issues and also helped to coordinate policy interactions between units.

The independence of the policy unit and the fact that it reports directly to the deputy incident manager signal the political sensitivity of policy issues and political stakeholders during a major outbreak response. One of the unit's major functions is to shepherd draft policies through a gauntlet of clearances. This function is critical for moving policies in a timely way. Another function of the unit is to help respond to requests from political overseers, such as the parent agency (HHS), congressional committees, and the White House. To fulfill these requests, the policy unit often helped collect information and coordinate a response between several CDC units. The unit attended to the relationship between the CDC and state governments—a critical relationship often framed in policy terms (via grants, programs, official requests for assistance, etc.).

The clearance process—a standard part of the scientific and management culture at the CDC—suggests a logic of coordination that differs from the one prevalent in the traditional ICS model. Incident command creates unity and coordination through structural integration—unity of command, short "spans of control," and formal planning processes. To speak with a single voice, the IMS, on behalf of the rest of CDC, vets policy documents by passing them through a series of institutional checkpoints. This vetting can often be a slow process that may seem like it would be relaxed during a major incident like the H1N1 pandemic. But the policy unit lead suggested that this formal vetting process might be even more important during a major outbreak response. Often, the policies being vetted were guidance documents that translate science into CDC recommendations, which are then followed by first responders, the public, and public and private institutions. As the policy unit lead told us, thorough vetting of these guidance documents is critical because it may be a matter of "life or death."

While the clearance process during an incident is formal, it is also accelerated. The job of the policy unit is to help usher the policy documents from unit to unit, gathering the necessary signatures and negotiating any roadblocks. The CDC centers and the incident command task forces are typically very busy with other matters, so the policy unit must bring these documents to their attention. To follow the policy unit lead on several forays to facilitate these clearances, as we did, is to be impressed by the knowledge and skill it takes to move guidance documents quickly through the clearance process. The independent status of the policy unit and the central importance of the clearance process are both a testament to the way that the rapid mobilization of authoritative knowledge is at the heart of the CDC's incident management system. The policy unit also reflects the need for the CDC to manage its communications externally to ensure that its policies are understood adequately by the agency's stakeholders.

The Deputy Incident Manager

The role of deputy incident manager is not a standard element of the ICS model. The creation of the role is another adaptation of the CDC's incident management system. Typically, incident

command systems do not envision a deputy (see Figure 1). In fact, it might be argued that a deputy manager contradicts the basic principles of incident command, which stress unity of command, narrow spans of control, and direct communications with the sections. From this perspective, a deputy just muddies the waters of command and communication.

Since the incident manager also has a chief of staff who assists in management and operations, the deputy's role is not fundamentally about incident command or management as it is understood by the ICS. However, the deputy's role does reflect the importance the CDC places on mobilizing authoritative knowledge and the efforts it must undertake to ensure that its policies are accurately represented and understood outside the agency

Each of the "knowledge management" units—the plans decision unit, the joint information center, Team B, and the policy unit—reported directly to the deputy incident manager. This reporting relationship stands outside the core chain of command that linked the incident manager directly to the task forces. As described earlier, these task forces are also composed of subject-matter experts, so the key distinction here is not between an operational core and a knowledge management support staff. Both groups are dealing with knowledge management. But the deputy's jurisdiction might be described as encompassing both strategic and political knowledge management. As a public health expert, the deputy incident manager preserved the CDC's basic organizational rule, which is that subject-matter experts should report to subject-matter experts.

While the chief of staff is focused inwardly on the effective management of the incident command system, the deputy's gaze is outward to the strategic and political environment in which the CDC must operate. A good example of this outward orientation occurred during our visit. The impending shortage of vaccine was a central political issue heating up during the period in which we observed the CDC in November 2009. This shortage was the result of technical glitches in the production process, but it was beginning to become a serious political issue for the CDC and HHS. The DIC was dispatched to the Biomedical Advanced Research and Development Authority (BARDA)—the HHS agency responsible for the H1N1 vaccine development—to help the CDC better understand the barriers to timely vaccine production.

Findings and Recommendations

Findings

In adapting the traditional ICS model to reflect its culture and operational context, the CDC moved scientific and technical task forces into the role of core line organizations and shifted the classic operational functions of ICS to a supporting role. It chafed at the traditional planning strategies of incident command, which did not seem to work particularly well in a science-based environment. It created or adapted a number of more networked units to manage the dispersed flows of information and knowledge.

Finding One: The CDC initially found the ICS model more useful than its previous team approach, but the model had to be adapted to account for its knowledge-based mission. Asked about the value of the incident command system model, the policy unit lead told us that its use had improved the CDC's ability to respond to serious events. The policy unit lead characterized the pre-ICS model as "too ad hoc."

The CDC, in effect, produced a hybrid model that combined features of its earlier task force approach with the more structured logic of the incident command system successfully used by other agencies. The CDC adopted the ICS, but had to learn, by experience, to adapt its structure to work effectively for them. Clearly, the CDC staff are not firemen, but like the firefighters that invented the ICS, the CDC needed an institutional governance framework that could coordinate the dispersed mobilization of information and knowledge.

In reflecting on the transformation of the ICS model to the IMS model at CDC during the 2009 H1N1 pandemic, three features of CDC crisis response stand out:

- **The CDC's adaptation of the ICS model heavily emphasizes its need and capacity to produce authoritative knowledge.** During the pandemic, science and expertise had to be rapidly mobilized and deployed and were fundamental to every aspect of the CDC's H1N1 response (Schuchat, Bell, and Redd 2011). Science was used for:
  - Surveillance and detection
  - Providing guidance to clinicians and the public
  - Understanding the transmissibility and spread of the disease
  - Developing a vaccine

  In addition to relying on science to support a response, the CDC sees communicating science to the public as central to its mission during a pandemic.

  This emphasis on science and the production of authoritative knowledge should be understood as the agency's "technical core," i.e., the central mission around which the agency is organized. Thus, the CDC is not primarily carrying out frontline operations during a pandemic. Hospitals, community clinics, other private sector providers, and state and

local public health departments are the pandemic's first responders. Frontline operations include disseminating public health messages regarding prevention, treating ill patients, and delivering vaccinations. Although the CDC may provide direct aid to first responders, its primary role is to provide technical assistance to the states that ultimately have the legal authority to carry out pandemic response. First responders typically answer to state- or county-level authorities and operate separately from the CDC's incident management system.

- **CDC's adaptation of the ICS model stems from the structure of specialized expertise within science-producing organizations.** Deep scientific knowledge is crucial for assessing and predicting the impact of a novel pathogen and hence, specialization is essential. At the same time, deep specialization can produce silos of organizational activity, since the effort and focus required to be on the frontier of one's field create opportunity costs in terms of more generalist knowledge; it can be difficult to keep pace with what is happening outside of one's own domain of expertise.

  Matrix organizational structures are typically used to replace traditional bureaucratic hierarchies for organizations where multiple areas of specialization are necessary to carry out the organization's work. In the traditional ICS framework, the emphasis on a single reporting structure accomplished through a traditional organizational hierarchy leaves unaddressed how organizations that draw on siloed arenas of expertise will cope during an emergency. During a pandemic, the CDC was dependent on specialized knowledge that existed outside the agency. The importance of dispersed knowledge makes the agency dependent on a network of actors, creating organizational pressures not well accounted for in the traditional ICS hierarchy.

- **CDC's adaptation of the ICS model reflects the significant resources the agency devoted to monitoring and managing the external understanding and framing of CDC pandemic decision-making.** Because the CDC is working as the hub of a larger network of frontline actors and receives both its funding and its legitimate authority from elected officials, the agency's most powerful tool in shaping pandemic response is its authority and persuasive power. The agency expends considerable resources trying to create reliable guidance by short-circuiting its normal modes of information vetting. Once it has produced agency consensus around a set of guidance, CDC then manages the messaging around that guidance to ensure that it is well understood by outside actors. If the agency believes it is misunderstood or becoming embroiled in controversy, it will act quickly to dispel myths about its goals and intentions and attempt to manage controversies that may arise. This requirement for a highly developed external focus is not envisioned as part of the traditional ICS.

These three features are sufficiently different from the firefighting events that produced ICS to make the CDC's transformation of ICS unsurprising. Perhaps what is surprising is that the CDC experience with ICS demonstrates that ICS is sufficiently flexible to operate in an agency whose mission is centered on information processing and providing authoritative knowledge. ICS was not designed to create this specific type of capacity during a crisis. And yet, during the 2009 H1N1 pandemic, the CDC found that the balance of functional roles contained within traditional ICS could be adapted to support its mission of rapidly mobilizing authoritative knowledge.

Finding Two: The CDC adapted the ICS model in three ways to accommodate its distinctive mission approach during the H1N1 pandemic.

First, CDC flipped the traditional ICS structure. The task forces became the core of the response effort, while traditional core units (operations, planning, logistics, finance/administration) were converted into support units. This transformation makes sense because the CDC

does not have a major operational role, but is responsible for rapidly mobilizing authoritative knowledge.

Given the centrality of knowledge management in CDC's mission, the traditional logic of operational planning embraced by ICS makes less sense. Although the CDC does not have the leisure to conduct basic science during a major outbreak, the scientific concern about the reliability and validity of information remains critical. This scientific logic sometimes aligns awkwardly with the operational logic of ICS planning. Planning at CDC was therefore converted into a forum for expert advice.

Second, CDC created new roles for various units responsible for the rapid mobilization of authoritative knowledge:

- **The joint information center** played a central role in the response, partly displacing the task tracking responsibilities of the operations group. Its elaborate networks within and outside the CDC were also instrumental in helping the CDC speak with one voice and in preventing a misleading amplification or attenuation of risk.
- **Team B** helped to mobilize advice and information from external experts and provided a check on internal decision-making.
- **The policy unit** managed the elaborate process of clearing policy documents for release and helped to mobilize responses to sensitive political requests and concerns. These units and the transformed plans decision unit reported directly to the deputy incident manager, who was responsible for managing strategic and political knowledge in the CDC's environment.

Third, CDC had to balance the tensions between both hierarchical and networked perspectives. From a hierarchical perspective, the CDC wants to provide unified authoritative knowledge and guidance. The joint information center, for example, was fundamentally concerned about preventing deviations from the CDC's unified, centrally determined message. This concern illustrates a hierarchical style and it fits well within the ICS's emphasis on clear and unitary chains of command.

However, information and expertise are also spread across different scientific disciplines and programs within the CDC and knowledge and decision-making are highly dispersed outside the CDC. Local governments and clinicians, among many others, are a pandemic's first responders. As such, they are a source of critical information as well as the arbiters of CDC guidance. To collect critical information and to manage its distribution, the joint information center must work in a highly networked fashion.

A number of other features of the CDC's adaptation of ICS illustrate that it works in a networked, rather than hierarchical, fashion:

- The number of units established under the task forces during the H1N1 response dispersed expertise, which challenged the ICS concept of keeping narrow spans of control.
- The policy unit managed a clearance process that departed from ICS command by using networks of actors. While these clearances partly operate in a vertical fashion across levels of hierarchy, they also mobilize consent and opinion horizontally among different centers and units. The policy unit's liaison structure enables direct horizontal relationships between units, as opposed to vertical chains of command flowing from the incident manager. We also see that the CDC is uncomfortable with a hierarchical planning logic—one that "forces" decision priorities. Instead, it converts this decision making into an advice forum that mobilizes input from internal experts.

- The operation of Team B suggests that the CDC mobilizes the ideas and opinions of extended networks of external experts, while it avoids making them a distinctive center of power that might dictate decisions.
- The addition of a deputy incident manager potentially weakens the unitary chain of command, but allows the CDC to facilitate strategic decision-making and engage in diplomacy with overseers and other agencies.

The CDC's relationship with a pandemic's first responders only intensifies the networked character of CDC's emergency response role. The CDC provides valuable guidance and information to first responders. It does not dictate how they organize or conduct their responses. It deploys epidemic intelligence service officers and other resources to support state and local response efforts, as requested. It works closely with them to gather information and analyzes dynamic situations.

The relationship with state and local governments is sometimes perceived as hierarchical because the CDC may bring superior resources and analytical capabilities to bear on local issues. But state and local public health departments are legally and institutionally independent of the CDC. Therefore, the mode of interaction with public health institutions outside the CDC is more networked than hierarchical. States do not have to follow CDC recommendations. The CDC's authority rests on its reputation of producing reliable guidance, and the accuracy of its guidance for an emerging pandemic can only be judged in retrospect.

Recommendations

Recommendations to Agency Leaders

Senior leaders in knowledge-based agencies who are considering adopting or adapting the ICS model should review the following recommendations:

Recommendation One: In advance of an emergency situation, an agency should determine whether its core function is operations or knowledge production. If an agency's most important function during an emergency is neither operations nor knowledge production, then agencies need to identify their core function and plan for adapting ICS to make their core function central in the ICS structure.

Recommendation Two: An agency should assess how widely dispersed subject-matter expertise is in their organization's core emergency-related business functions. For some organizations, expertise is broadly shared across actors in the organization (those with more experience tend to have greater expertise). In others, expertise is extremely specialized and even siloed. In organizations with highly siloed or dispersed expertise, simple hierarchies will not be sufficient to manage communications during a crisis. Creating a more matrixed ICS structure, like the one developed by the CDC, will be more appropriate.

Recommendation Three: An agency should assess the extent to which its organization's actions are accepted as legitimate on their face by their stakeholders or how likely they are to be contested or misunderstood. In the latter case, it will be necessary to create a more elaborate external communications function to manage the organization's message during an emergency. This is especially important if a successful response during an emergency depends on other actors understanding and accepting the organization's guidance or recommendations as legitimate.

Transferability of the CDC ICS Model to Other Knowledge-Based Organizations

The CDC's experience with recasting the ICS model may be of use to other knowledge-based agencies that may find themselves charged with the rapid mobilization of authoritative knowledge. For example:

- The National Weather Service (NWS) is charged with providing timely information that helps the nation respond effectively to weather-related emergencies. This role is clearly critical for effective emergency response, but the NWS's mission—like the CDC's—is primarily about managing knowledge.
- In other cases, agencies may have multiple missions, some of which may be operational and some of which may be more about knowledge management. For instance, security agencies like the FBI or CIA certainly have important operational missions. However, their role in many missions—such as in terrorist surveillance—is often more fundamentally about knowledge management. Paralleling the CDC's mission of collecting scientific evidence about the nation's health, such missions may require painstaking data collection over long periods of time. Like the CDC, these security agencies may also be responsible for rapid collection and interpretation of time-sensitive and decision-critical intelligence.
- Similarly, agencies involved in economic regulation—like the Securities and Exchange Commission or the Federal Reserve—are called upon to rapidly provide authoritative information in support of policy decisions.
- Other regulatory agencies—like the Environmental Protection Agency—are often called upon to assess emergency situations and to provide expert guidance to decision-makers. Many institutions, in fact, have some capacity to deploy experts rapidly in the case of emergencies or crises.
- The model can be adapted by international organizations, as well. For example, the UN Development Programme (UNDP) maintains a capacity to deploy experts in the case of humanitarian or other crises. As in the CDC's Epidemiological Intelligence Service, rapid deployment can be partly seen as an operational task. However, experts are deployed in order to rapidly mobilize authoritative knowledge.

Recommendation to Federal Emergency Management Agency (FEMA)

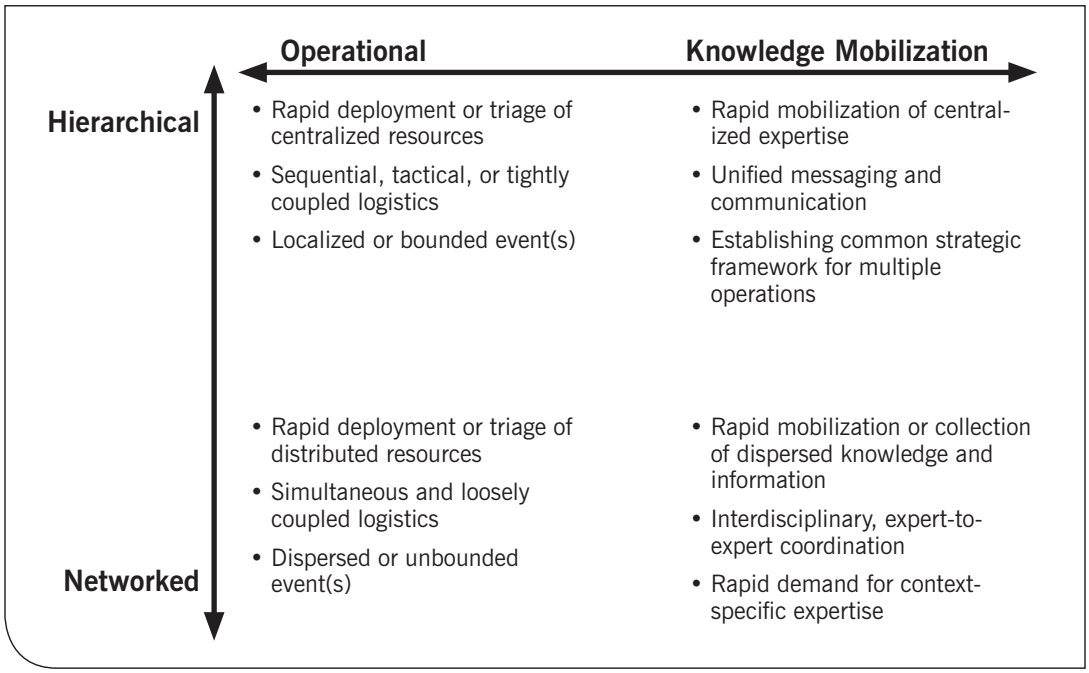
Recommendation 4: FEMA should consider amending its National Incident Management System (NIMS) model to allow a variant for knowledge-based agency emergency responses, not just direct operations-based agency emergency responses.

The Federal Emergency Management Agency oversees government-wide guidance in how agencies organize to respond to emergencies and crises via the National Incident Management System. The CDC case study suggests that there may be alternative models to the one described in FEMA's guidance.

Figure 3 illustrates two dimensions that place distinct demands on an agency's approach to incident command. Along one dimension, we can contrast the operational logic of the traditional ICS model, which rapidly deploys people to tasks and coordinates complex logistics, with a knowledge mobilization logic that focuses on rapid mobilization and delivery of authoritative information and decision-making.

The CDC found that it had to achieve both tasks. It rapidly deploys epidemic intelligence service officers to the field and is capable of creating reliable strategies for meeting threats from novel pathogens. But because CDC is more often providing information and expertise to first responders, its overall role is closer to the knowledge mobilization logic than to the operational

Figure 3: Broadening of the Framework of Incident Command



logic. We have shown how the CDC turned the operational logic of traditional ICS on its head in order to support this knowledge mobilization function.

The second dimension in Figure 3—the tension between hierarchical versus networked organization—is well noted in the literature on crisis management. Crisis situations often create a variety of challenges that call for hierarchical command. For example, difficult triage decisions must be made and centralized resources must be efficiently deployed. However, crisis situations also elicit the need for more horizontal coordination among people or groups with more independence of action. This is particularly true when the response is quite dispersed or when the units involved have specialized expertise.

Moynihan (2008, 2009) has argued that incident command systems usefully combine the advantages of hierarchy and network. We agree with this, but would also note that many structural principles of incident command are hierarchical rather than networked. It is analytically useful to think of hierarchical command and networked coordination as operating along a continuum and suited to different kinds of tasks. This allows us to imagine how incident command might function differently under more or less hierarchical or networked circumstances.

References

Bigley, Gregory and Karlene Roberts. 2001. "The Incident Command System: High Reliability Organizing for Complex and Volatile Task Environments," *Academy of Management Journal*, 44: 1281–1299.

Buck, Dick, Joseph E. Trainor, and Benigno E. Aguirre. 2006. "A Critical Evaluation of the Incident Command System and NIMS," *Journal of Homeland Security and Emergency Management,* 3, 1–27.

FEMA. 2008. Emergency Management Institute ICS Resource Center. ICS Review Document. http://training.fema.gov/EMIWeb/IS/ICSResource/index.htm.

FEMA. 2007. Basic Guidance for Public Information Officers (PIOs). National Incident Management System. FEMA 517/November 2007.

Giles, David W. 2011. "Tennessee Response to the 2009 Novel H1N1 Influenza A Pandemic," Kennedy School of Government Case Number 1941.0.

Hermann, M. G., and B.W. Dayton. 2009. "Transboundary Crises through the Eyes of Policymakers: Sense Making and Crisis Management," *Journal of Contingencies and Crisis Management*, *17*(4), 233–241.

Homeland Security Council. 2005. National Strategy for Pandemic Influenza. Washington, D.C.: The White House.

Keller, Ann, Chris Ansell, Art Reingold, et al. 2012. "Improving Pandemic Response: A Sensemaking Perspective on the Spring 2009 H1N1 Pandemic," *Risks, Hazards, and Crisis in Public Policy* 3 (2): 1–37.

Kim, S., and B.F. Liu. 2012. "Are All Crises Opportunities? A Comparison of How Corporate and Government Organizations Responded to the 2009 Flu Pandemic," *Journal of Public Relations Research*, *24*(1), 69–85.

Moynihan, D. P. 2009. The Network Governance of Crisis Response: Case Studies of Incident Command Systems. *Journal of Public Administration Research and Theory*, *19*(4), 895–915.

Moynihan, D. P. 2008. Combining Structural Forms in the Search for Policy Tools: Incident Command Systems in U.S. Crisis Management. *Governance*, *21*(2), 205–229.

National Response Team. 2000. *Joint Information Center Model: Collaborative Communications During Emergency Response*.

Neustadt, R.E., J.A. Califano, and H.V. Fineberg. 1978. *The Swine Flu Affair*. U.S. Government Printing Office.

Papagiotas, Stephen S., Mark Frank, Sherrie Bruce, and Joseph Posid. 2012. "From SARS to 2009 H1N1 Influenza: The Evolution of a Public Health Incident Management System at CDC." *Public Health Reports*, 127, May–June, 267–274.

Posid, Joseph M., Sherrie M. Bruce, Julie T. Guarnizo, Melissa L. Taylor, and Brenda W. Garza. 2005. SARS: Mobilizing and Maintaining a Public Health Emergency Response. *Journal of Public Health Management Practice* 11(3): 208–215.

Reynolds, B., and M.W. Seeger. 2005. "Crisis and Emergency Risk Communication as an Integrative Model." *Journal of Health Communication*, *10*(1), 43–55.

Schuchat, Anne, Beth P. Bell, and Stephen C. Redd. 2011. "The Science Behind Preparing and Responding to Pandemic Influenza: The Lessons and Limits of Science," *Clinical Infectious Diseases*, 52, S1: S8–S12.

Smith, Richard. 2006. "Responding to Global Infectious Diseases Outbreaks: Lessons from SARS on the Role of Risk Perception, Communication and Management," *Social Science and Medicine*, 63: 3113–3123.

U.S. Centers for Disease Control and Prevention. 2006. Hurricane Katrina: After Action Review. Prepared for Dr. Richard Bessers, Coordinating Office for Terrorism Preparedness and Emergency Response. February 1, 2006.

U.S. Department of Homeland Security. 2009. *Integrated Planning System*.

U.S. Department of Homeland Security. 2008. *National Incident Management System*.

U.S. Government Accountability Office. 2009. *Influenza Pandemic: Monitoring and Assessing the Status of the National Pandemic Implementation Plan Needs Improvement.* Washington, D.C.: GAO-10-73, November 24, 2009.

Von Lubitz, Dag K.J.E., James E. Beakley, and Frederic Patricelli. 2008. "'All Hazards Approach' to Disaster Management: the Role of Information and Knowledge Management, Boyd's OODA Loop, and Network Centricity," *Disasters*, 32, 4: 561–585.

About the Authors

Christopher Ansell received his BA in Environmental Science from the University of Virginia in 1979 and worked at the U.S. Office of Technology Assessment from 1979 through 1984. He received his PhD in Political Science from the University of Chicago in 1993. He is currently Professor of Political Science at the University of California, Berkeley, where he teaches courses in public administration, organization theory, public policy, and regulation. Ansell's current research focuses on how public agencies manage societal risks and govern unruly public problems. He has a strong substantive interest in public health and environmental policy.

Ansell is currently U.S. editor of *Public Administration: An International Quarterly,* and was associate editor of the *Encyclopedia of Governance* (Sage 2007). He has been a visiting professor in the Department of Government at Uppsala University in Sweden and received an honorary doctorate in public administration from Roskilde University in Denmark. He is a co-founder of the Global Governance Club, an international group of scholars working on governance issues, and is currently co-editing the forthcoming *Handbook of Theories of Governance* (Edward Elgar) with Jacob Torfing.

Professor Ansell is the author of *Pragmatist Democracy: Evolutionary Learning as Public Philosophy* (Oxford University Press 2011) and *Schism and Solidarity in Social Movements* (Cambridge University Press 2001).With Jacob Torfing, he is co-editor of the forthcoming *Public Innovation through Collaboration and Design* (Routledge). His work has been focused on how organizations and communities collaborate to improve performance, address shared problems, build social solidarity, and deepen democracy.

Ann Keller is an Associate Professor in the UC Berkeley School of Public Health, where she teaches courses on health policy, environmental health policy, and science in policy making. Keller studies the role of expertise in public decision-making and is especially interested in how expert systems are designed in the public sector and how expertise is maintained in contested political domains. Keller has published work on the role of scientists in shaping policy debates about acid rain and climate change—her book on this subject, *Science in Environmental Policy: The Politics of Objective Advice,* won the Don K. Price Award in 2011—and on institutional mechanisms used by science assessment organizations to protect their credibility and relevance with policy audiences (*Journal of Public Administration Research and Theory*). Though she initially studied issues of environmental policy, Keller expanded her focus to include public health and health care systems during a postdoctoral fellowship with the Robert Wood Johnson Foundation's Scholars in Health Policy Research Program.

Keller's interest in expertise in public policy extends to consideration of non-expert participation in health policy domains. She and co-author Laura Packel examine a lack of collective action on the part of patient groups in health policy debates in their study published in the *Journal of Health Politics, Policy, and Law*. In connection with this work, Keller is conducting a comparison of patterns of citizen mobilization in environmental as compared with health system policy arenas. Keller is also currently researching the political dynamics surrounding federal programs to research the risks of firearm ownership and to produce and disseminate comparative effectiveness research.

Keller's work on expertise in crisis and emergency response stems from a multi-year, National Science Foundation-funded study that she and Professor Chris Ansell conducted on the organizational and decision dynamics involved in global pandemic response (*Risks, Hazards, and Crisis in Public Policy*). They have also published work that addresses the management challenges associated with trans-boundary crises (*Journal of Contingencies and Crisis Management*).

Key Contact Information

To contact the authors:

Christopher Ansell
Professor
Department of Political Science
University of California, Berkeley
210 Barrows Hall
University of California
Berkeley, CA 94720-1950
(510) 642-2263

e-mail: cansell@Berkeley.edu
Web page: http://polisci.berkeley.edu/people/person/christopher-ansell

Ann Keller
Associate Professor
Health Policy & Management
School of Public Health
University of California, Berkeley
50 University Hall
Berkeley, CA 94720-7360
(510) 642-7934

e-mail: annk@berkeley.edu
Web page: http://sph.berkeley.edu/ann-keller

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For more information:
Daniel J. Chenok
Executive Director
IBM Center for The Business of Government
600 14th Street NW
Second Floor
Washington, DC 20005
202-551-9342
website: www.businessofgovernment.org
e-mail: businessofgovernment@us.ibm.com

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