



Government Leadership in Addressing Public Health Priorities

Public Health and Climate Change Adaptation at the Federal Level: One Agency's Response to Executive Order 13514

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Climate change will likely have adverse human health effects that require federal agency involvement in adaptation activities.

In 2009, President Obama issued Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. The order required federal agencies to develop and implement climate change adaptation plans. The Centers for Disease Control and Prevention (CDC), as part of a larger Department of Health and Human Services response to climate change, is developing such plans.

We provide background on Executive Orders, outline tenets of climate change adaptation, discuss public health adaptation planning at both the Department of Health and Human Services and the CDC, and outline possible future CDC efforts. We also consider how these activities may be better integrated with other adaptation activities that manage emerging health threats posed by climate change. (*Am J Public Health*. 2014;104:e22–e30. doi:10.2105/AJPH.2013.301796)

CLIMATE CHANGE POLICY HAS

2 general foci: mitigation and adaptation. Mitigation refers to such actions as reducing greenhouse gas emissions to minimize the magnitude of future climate change. Adaptation refers to activities that reduce the vulnerability of natural and human systems to current or future expected climate change.¹ The difference between mitigation and adaptation activities is much like the difference between primary and tertiary prevention.² Current scientific evidence indicates that, although mitigation can reduce future adaptation needs, some adaptation will still be required.^{3,4} Climate change adaptation efforts cut across economic sectors and administrative boundaries. In any such adaptation efforts, the federal government is likely to have a substantial role.

The federal government has already undertaken a number of adaptation activities.⁵ How to handle such federal climate change adaptation activities in the long term—whether to create a national climate service⁶ or to pursue climate change adaptation in parallel throughout existing agencies—is the subject of debate. Recognizing the significant role of the Executive Branch in facilitating federal

climate change adaptation activities, President Obama issued Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, in 2009. This EO directed all components of the Executive Branch to develop and implement climate change adaptation policies within their organizations, among other actions, consistent with its organizational mission.⁷ In accordance with the EO, agencies devoted to public health have focused on climate change adaptation in the public health sector.

Climate change is projected to cause many adverse health effects in the United States⁸ and abroad.^{9,10} The adverse health effects will result from a range of direct and indirect exposures that come from shifting ecosystem dynamics: worsening air quality; increasingly frequent and severe extreme heat events; shifts in precipitation, including more frequent and severe storms and floods; sea level rise; and ocean acidification.¹¹ As part of the federal government, the Department of Health and Human Services (DHHS), which houses the Centers for Disease Control and Prevention (CDC) and other agencies, takes part in a wide range of activities that may be affected

by climate change. The activities range from ensuring food safety to conducting health research to formulating health care policy. As DHHS implements EO 13514, climate change adaptation will be integrated into the Department's planning, operations, policies, and programs, and there will be a corresponding effect on public health preparedness.

The DHHS response to EO 13514 is coordinated centrally within the Office of the DHHS Secretary, and in particular, the Office of the Assistant Secretary for Administration. This response has unfolded on several administrative levels. Sustainability offices are responsible for administration of DHHS mitigation activities in response to the EO. Meanwhile, programs in various DHHS agencies, including the CDC, are largely responsible for adaptation activities.

The purpose of this article is to highlight the portions of EO 13514 that guide DHHS's adaptation activities and to describe other EOs that have previously affected DHHS. We highlight the relevance of recent climate change adaptation literature to the department's EO compliance, outline initial efforts at the CDC in response to the EO, and consider future directions



for further integration of climate change adaptation in federal agencies that have public health missions.

A BRIEF PRIMER ON EXECUTIVE ORDERS

Executive orders are directives issued by the President of the United States. They are typically directed toward and govern actions by government officials or agencies within the Executive Branch. Executive orders can be issued either pursuant to an express or implied delegation of authority from Congress or pursuant to the inherent powers afforded to the President by Article II of the US Constitution. Some EOs have the force and effect of law. They can be used to implement existing law, to respond to unforeseen crises, or to implement the policy priorities of the President, and have historically been implemented in a variety of circumstances.¹² The issuing President or any subsequent President can revoke an EO. An EO is also subject to review by the judiciary. Furthermore, in the event that the President's authority to issue an EO comes from an act of Congress, Congress retains the authority to override the order legislatively.¹³

Each EO contains its own directives regarding federal agency compliance. An EO may give detailed directions for compliance, or it may afford an agency near complete discretion in how to comply. Executive order 13514 represents a middle ground between these 2 poles. The EO specifically authorizes the White House Council on Environmental

Quality (CEQ) to issue instructions for implementation of the order. These instructions list a number of actions that agencies (e.g., CDC) must undertake, but it is left to an agency's discretion on how to conduct those actions. For example, EO 13514 states that each agency must establish an agency climate change adaptation policy. Such a policy must state certain specifics, including the agency's process to ensure "effective adaptation planning implementation." However, EO 13514 does not state how the agencies are to create that policy or what choices agencies are to make about it.

The Department of Health and Human Services

The DHHS mission is to serve as "the United States government's principal agency for protecting health and providing essential human services to Americans."¹⁴ The DHHS is composed of the Office of the Secretary and 11 operating divisions, including 8 agencies in the US Public Health Service and 3 human services agencies. DHHS has a broad operational scope, with activities that include research, health protection, food and drug safety, health care policy, and health insurance provision. Its programs account for almost a quarter of federal government outlays, and it administers more grant dollars than all other federal departments combined.¹⁵ As previously mentioned, CDC is one of the DHHS agencies. DHHS's climate change vulnerability assessment and adaptation policy were released in 2011. The policy applies to all organizations within the DHHS umbrella, including the CDC.^{16,17}

Executive Orders and the Department

Executive orders from the last several decades have had implications for both the DHHS and CDC, including President Reagan's 1986 EO 12564 on drugs in the workplace and President Clinton's EO 12898 on environmental justice. The DHHS response to these 2 EOs illustrates how the administrative changes that EOs require can be carried out in practice.

In both cases, responsibilities for responding to EO directives largely devolved to the agencies with primary expertise in the relevant area. President Reagan's EO 12564 established requirements for a drug-free federal workplace, and the Substance Abuse and Mental Health Services Administration, the DHHS operating agency with the greatest experience with substance abuse issues, led the DHHS response¹⁸⁻²⁰ to this EO. It did so by issuing guidance on the identification of "sensitive positions" subject to drug testing and developing a program for compliance. By contrast, there was significant interagency activity in response to President Clinton's EO 12898, which mandated the development of federal guidance regarding the identification of disproportionate adverse health impacts on minority and low-income populations. The response included formation of an interagency group that included the Departments of Commerce, Defense, Energy, Health and Human Services, Housing and Urban Development, Labor, Justice, and Transportation. Within this group, the CDC and the

National Institute of Environmental Health Sciences took leadership roles in coordinating the DHHS response.²¹

IMPLEMENTING EXECUTIVE ORDER 13514

President Obama issued EO 13514 in 2009. The EO required federal agencies to comply with a number of specific new requirements, including setting a 2020 greenhouse gas emissions reduction target and developing both a policy statement on climate change adaptation and an agency-wide climate vulnerability analysis. Climate adaptation components of the EO, as prescribed in the implementing instructions, are listed in the box on page e3.

CLIMATE CHANGE AND EXECUTIVE ORDER 13514

Executive order 13514 contains directives on both climate change mitigation and adaptation. Our focus here is on its adaptation provisions. The EO explicitly links those provisions to support a federal national adaptation policy formulated by the interagency Climate Change Adaptation Task Force.

The EO neither defines adaptation nor specifies particular adaptation measures required for compliance. Instead, it outlines a process by which agencies are to engage in the implementation. As shown in the box on page e3, the process begins with creation of a policy and mandate. From there, it proceeds to an assessment of recent and projected future climatic shifts, considers how these shifts may



Summary of Implementing Instructions for Climate Change Adaptation Planning

1. Establish an agency climate change adaptation policy and mandate

- Each agency shall identify an agency climate change adaptation planning point of contact for the *Implementing Instructions*.
- Each agency shall issue an agency-wide policy statement signed by the head of the agency that commits the agency to climate change adaptation planning.

2. Increase understanding of how the climate is changing

- Each agency shall participate in CEQ-sponsored climate change adaptation planning workshops to increase agency understanding of how the climate is changing and share information within the agency about how climate change impacts the agency.

3. Apply understanding to agency mission and operations

- Each agency shall submit responses to guiding questions found in Appendix E of the support document.
- Each agency shall submit an initial draft high-level analysis of agency vulnerability to climate change.
- Each agency shall complete a final high-level analysis of agency vulnerability to climate change.

4. Develop, prioritize, and implement actions

- Each agency shall identify three to five priority adaptation actions to be implemented in fiscal year 2012.
- Each agency shall submit an agency climate change adaptation plan.

5. Evaluate and Learn

- Each agency shall participate in CEQ-sponsored climate change adaptation planning workshops and share lessons learned with other agencies.

Note. CEQ = Council on Environmental Quality.

Source. White House Council on Environmental Quality.^{22,23}

affect agency missions and operations, and then moves toward development of an adaptation plan and a formalized institutional learning component. Federal agencies must participate actively in the Climate Change Adaptation Task Force and “evaluate agency climate-change risks and vulnerabilities to manage the effects of climate change on the agency’s operations and mission in both the short and long term.” An agency must “develop approaches through which [agency] . . . policies and practices . . . can be made compatible with and reinforce [the Climate Change Adaptation Task Force national climate change adaptation] strategy.”⁷

Broadly construed, these steps are consistent with recent literature on climate change adaptation,²⁴ particularly in its emphasis on vulnerability assessment and institutional learning. The

Intergovernmental Panel on Climate Change defines climate change adaptation as

initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g., anticipatory and reactive, private and public, and autonomous and planned.¹

In the case of the federal government, climate change adaptation will likely be both anticipatory and reactive,²⁵ and carried out primarily through the public sector, although there may be relevant public–private collaborations. There is early evidence of such activities.⁵ In signaling its intent to pursue adaptation activities without having yet embarked on many specific adaptation initiatives, the federal government’s response is similar to those of governments in higher-resource settings around the world.²⁶ In

recent reviews of public health adaptation activities specifically, the United States is comparable to its peers both in exhibiting a moderately high level of engagement²⁷ and in the piecemeal nature of some of its public health adaptation activities.²⁸

The peer-reviewed literature on climate change adaptation is evolving. There are ongoing discussions regarding vulnerability assessment and preparation of adaptation plans that have yielded some consensus,^{29–34} but other areas are less settled.^{35,36} In general, the way in which vulnerability is framed can have significant implications for what adaptation activities are pursued.³⁵ Specific to public health, studies projecting the health effects of climate change are in agreement that climate change will amplify many familiar problems but will also bring novel challenges. The literature includes

general guidelines on government programs fostering adaptation³⁷ that are applicable to public health. Climate and health experts have emphasized the need to shore up capacity in some areas, such as surveillance,² although there has been less discussion of how public health should engage areas in which incremental adaptation may not adequately address certain needs, a concern that has been articulated in general,³⁸ if not for public health specifically.

As adaptation activities have begun, the literature on the nature of barriers to adaptation and frameworks for diagnosing such barriers³⁹ has grown. In public health, recent literature has identified several specific barriers to successful adaptation, including uncertainty in climate projections, limits in technological advancement and dissemination, institutional limitations on collaborative



efforts, limits on community social capital, and cognitive limits that inhibit effective risk management behaviors.⁴⁰ Inadequate funding has also been raised as a concern,⁴¹ as has the need for additional data to support adaptation activities.⁴²

Another theme of the literature is the need for adaptation and management approaches that are iterative, interdisciplinary, and systems-oriented, featuring the use of modeling to project exposures and compare the efficacy of various potential interventions.²⁵ Institutional learning is also a high priority^{43,44} in the literature on climate change adaptation, with a requirement for explicit, sustained emphasis on social learning within and across organizations.⁴⁵ Attention to these issues is likely to be important in determining the success of federal climate change adaptation activities.

CENTERS FOR DISEASE CONTROL AND PREVENTION

The DHHS and CDC have taken several actions in response to the EO's requirements as outlined in the box on page e3. As one of the department's agencies, CDC has adopted DHHS's vulnerability assessment and adaptation policy. CDC is also exploring adaptation activities within the organization, activities that are consistent with its mission, which is

collaborating to create the expertise, information, and tools that people and communities need to protect their health—through health promotion, prevention of disease, injury and disability, and preparedness for new health threats. CDC seeks to accomplish

its mission by working with partners throughout the nation and the world to monitor health; detect and investigate health problems; conduct research to enhance prevention; develop and advocate sound public health policies; implement prevention strategies; promote healthy behaviors; foster safe and healthful environments; and provide leadership and training.⁴⁶

Before the executive order, CDC had already placed a very high priority on public health preparedness and continuous operation in the face of extreme weather events and other threats. CDC's activities in response to the EO have focused less on operational issues to maintain activities in the face of extreme environmental hazards, but instead have focused more on developing projects, programs, and policies within the agency and in collaboration with extramural partners. We discuss each in turn.

Intramural Activities

Within CDC, the National Center for Environmental Health (NCEH) has taken the lead on climate change adaptation activities. This role predated the issuance of the executive order. To house the effort, NCEH started the Climate and Health Program (CHP) within NCEH's Division of Environmental Hazards and Health Effects. The CHP was established in 2006 and formalized in 2009 with Congressional funding; a full account of its activities has been published elsewhere.⁴⁷ As with many CDC programs, the CHP works collaboratively with other groups to pursue its mission, which is

to lead efforts to prevent and adapt to the anticipated health impacts associated with climate change. The Program seeks to identify populations most vulnerable to these impacts, anticipate future trends, assure that systems are in place to detect and respond to emerging health threats, and take steps to assure that these health risks can be managed now and in the future.⁴⁸

The CHP's 3 core functions are to translate climate science to inform public health adaptation to climate change, to create decision support tools to enhance preparedness for climate change, and to serve as a credible leader in planning for climate change public health impacts. The CHP has pursued these objectives through a variety of intramural and extramural activities.

The CHP has outlined priorities for agency-wide climate change adaptation. This process includes articulation of a public health framework for engaging climate change,² developing a practical framework for pursuing climate change adaptation activities,⁴⁹ and highlighting novel management strategies for climate change adaptation in public health.²⁵ The CHP has also engaged in outreach to a wide range of partners within the CDC, DHHS, and other parts of the federal government. In addition, it has cultivated partnerships with state and local government agencies, civic and other organizations, and the World Health Organization (WHO). The CHP works closely with agencies coordinating the federal climate change response (e.g., the US Global Change Research Program and the White House CEQ), and it supports state and local health departments'

climate change adaptation efforts through the Climate-Ready States and Cities Initiative cooperative agreements.⁵⁰ These efforts parallel activities at the WHO and the European CDC, and are aimed at advancing climate change adaptation efforts in member organizations.

The CHP has worked with other CDC programs that address health outcomes affected by climate change. These other programs have incorporated climate change adaptation planning into their activities, where it has been appropriate to do so. Examples range from disaster preparedness programs to vector-borne and zoonotic disease programs to programs addressing global health. The CHP seeks to build understanding of the theory and practice used to explore the impact of climate change on health. As previously noted, several technological, institutional, and human challenges to pursuing climate change adaptation in public health exist. However, for an agency such as CDC, which prizes "scientific excellence, . . . well-trained public health practitioners and leaders dedicated to high standards of quality and ethical practice,"⁴⁶ these challenges are not unlike learning challenges that the organization has faced in adapting to other public health threats.

One key partner of the CHP has been the CDC's National Center for Emerging Zoonotic and Infectious Diseases (NCEZID). The National Center for Emerging Zoonotic and Infectious Diseases has recognized the role of climate among other factors in driving the emergence, re-emergence, and



geographic redistribution of a wide range of such infectious diseases as dengue, malaria, plague, Lyme disease, and hantavirus. NCEZID began its climate adaptation efforts by exploring the potential effects of climate change on infectious disease⁵¹ and by outlining several priorities for developing laboratory and surveillance capacity to detect changes in the incidence and distribution of vector-borne, zoonotic, and environmentally associated infectious disease agents. NCEZID also maintains the subject matter expertise to recognize and respond to novel disease agents in areas where they previously have not been seen. This expertise includes the ability to model the anticipated effects of weather patterns and climate disruption on the emergence of diseases. Future NCEZID efforts may focus on investing in increased surveillance capacity for collecting disease distribution information (in humans, vectors, reservoirs, and the environment) at temporal and spatial resolutions that will allow integration with remotely sensed weather data and other databases that contain important climatic indicators.

Table 1 outlines potentially climate-sensitive operations and programs at CDC, grouped by health focus area, and examples of potential adaptation activities.

Extramural and Interagency Activities

As previously indicated, EO 13514 requires that agencies actively participate in the interagency Climate Change Adaptation Task Force. This task force is co-chaired by the White House CEO, the

TABLE 1—Climate-Sensitive Operations and Programs by CDC Health Focus Area and Examples of Potential Adaptation Activities

CDC Health Focus Area	Climate-Sensitive Operations and Programs	Examples of Potential Adaptation Activities
CDC operations: administrative services, facilities	Personnel safety, infrastructure and facilities vulnerability, disruption of health services provision	Vulnerability assessment of existing facilities and operations
Global health	Vector-borne and zoonotic disease surveillance, prevention, and treatment (e.g., malaria, dengue), emergency response	Enhanced surveillance of climate sensitive diseases, coordination with World Health Organization and World Meteorological Organization climate and health programs
Health preparedness and response, emergency operations	Emergency preparedness and response	Vulnerability mapping, revision of evacuation plans based on sea-level projections, review of National Planning Scenarios to determine climate change adaptation needs
State, tribal, local and territorial support	Climate-sensitive diseases within these jurisdictions (e.g., hantavirus); disruption of health services provision	Support outbreak investigations of climate sensitive conditions, assist with local planning for disaster response
Occupational Safety and Health	Occupational safety and health of workers exposed to climate-related hazards	Research, update guidelines, communications for affected workers and industries
Informatics, surveillance, epidemiology, and vital statistics	Surveillance of climate-sensitive health outcomes, formulation of case definitions and diagnostic guidelines, coordination of vital statistics research, and public and interagency access to health databases, mental health impacts	Facilitation of location-specific, longitudinal surveillance of climate-sensitive health outcomes; support surveillance of emerging and re-emerging diseases (e.g., dengue); dissemination of case definitions for climate sensitive health outcomes (e.g., heat-related death); training of public health personnel in new case definitions and surveillance priorities
Birth defects and developmental disabilities	Investigation of health outcomes associated with weather, climate variability, and climate change; surveillance of teratogenic compounds in the environment	Enhanced surveillance of climate sensitive conditions
Chronic disease	Education regarding climate sensitivity of certain chronic health conditions (e.g., heat and cardiovascular disease), promotion of local awareness of climate-health impacts	Facilitating early warnings to susceptible populations; expanded educational efforts
Environmental health	Heat, air pollution, extreme weather, emergency response, investigation of health outcomes related to weather and climate	Enhanced surveillance, expanded tracking of climate-sensitive indicators
Injury prevention	Injury from extreme weather events	Expanded educational efforts
Respiratory diseases, asthma	Surveillance and programming related to climate-sensitive respiratory conditions (e.g., asthma)	Facilitation of respiratory health tracking
Vectorborne, foodborne, waterborne, and zoonotic diseases	Spread of vectorborne, zoonotic, foodborne and waterborne diseases, migration effects on disease	Enhanced surveillance, expanded global migration and quarantine programs, increased collaboration with other centers
Sexually transmitted Infections, HIV/AIDS	Migration effects on disease distribution; surveillance of these diseases in displaced populations	Expanded educational efforts
Mental health	Mental health impacts from extreme events	Enhanced surveillance and prevention

Note. CDC = Centers for Disease Control and Prevention.



Office of Science and Technology Policy, and the National Oceanic and Atmospheric Administration. It includes official DHHS representatives from both CDC and the National Institutes of Health. In October 2010, in response to the EO, the Climate Change Adaptation Task Force issued a progress report in support of a National Climate Change Adaptation Strategy.²² In March 2011, the CEQ issued a set of implementing instructions that recommended actions for federal government agency adaptation planning.²³ These instructions serve as high-level guidelines for agency compliance with the EO. They provide a framework for integrating climate change adaptation into planning, operations, policies, and programs. The guidelines also note that each office and agency will need to do further work to develop its own adaptation plans. This work is to be accomplished in 5 steps, as summarized in the box on page e3.

The Climate Change and Human Health Group (CCHHG) of the United States Global Change Research Program (USGCRP) has helped to coordinate response to the EO from a health perspective. The group was created by USGCRP member agencies to integrate relevant science and technology programs and capabilities through interagency, interdisciplinary, and intergovernmental collaborations. These collaborations span basic research to decision-making to application, with the ultimate goal of building community resilience to climate change effects. The CCHHG published a white paper outlining climate and health

research needs.⁵² Currently, 2 of the 3 co-chairs of the CCHHG are from DHHS, and several members of the CCHHG also serve on the Climate Change Adaptation Task Force, including CDC staff.

In addition to producing the progress report and informing CEQ's implementing instructions, the Climate Change Adaptation Task Force co-hosted a series of workshops to facilitate agency adaptation planning. Four workshops were held in the summer of 2011 to help federal government agencies prepare for their required climate vulnerability assessments, a step in the adaptation process. Given anticipated health effects of climate change, the health sector was made a high priority. The CHP facilitated the June 2011 Federal Adaptation Workshop on climate and health vulnerability relating to the EO. This event included input from other CCHHG members, including the National Institutes of Health. It served to inform agencies of how they might incorporate health effects into their agency vulnerability assessments.

Next Steps

It is clear that the public health impact of climate-sensitive environmental exposures is already large⁵³ and that climate change threatens to increase this burden significantly. However, because precise, valid estimates of future burden are elusive, it is difficult to determine whether current programming is adequate to meet the expected need. In the context of this uncertainty, the CHP has endeavored to structure CDC's climate change adaptation activities according to theoretical frameworks

articulated early in the CHP's development—specifically, with an eye toward the 10 essential public health services²—and to update this framework as the program has evolved (i.e., to include an iterative approach based on adaptive management).²⁵ Because climate change adaptation needs potentially figure into such a wide range of public health activities, the CDC has had to focus on preparedness for high priority hazards (e.g., extreme heat) and activities (e.g., supporting state and local partners) while also highlighting priorities for future programming, such as those listed in Table 1.

As we continue to learn about climate change and its likely impacts, we will need to update our priorities and incorporate new information regarding threats and effective responses. For the CDC, near-term priorities include ongoing risk assessment through surveillance and monitoring, as well as engagement of state and local public health partners to continue developing climate change adaptation expertise at multiple levels. As these activities mature and needs become clearer, it will be possible to evaluate program impacts more formally. For instance, although the activities of state and local partners funded through the Climate Ready States and Cities initiative are not yet ready for evaluation, both impact and outcome evaluations are explicit requirements of the cooperative grant, and evaluation of findings is expected within the next several years. The CDC is looking forward to documenting and disseminating the best practices that result.

POTENTIAL EXPANDED LINKAGE AND ITERATION

The National Climate Assessment (NCA) is a quadrennial scientific assessment conducted by the USGCRP, as mandated by Congress in the Global Change Research Act of 1990 (15 U.S.C. 2921 et seq). The Act requires the USGCRP to produce a report for Congress and the President that evaluates, integrates, and interprets the findings of the federal research program on global change. The assessment currently underway will be complete in 2014. Compared with previous assessments, the current assessment has an increased emphasis on, among other priorities, risk-based framing, clarification of confidence and uncertainties, enhanced public engagement and communications, adaptation activities, and the need for sustained assessment activities.

Although EO 13514 does not explicitly link agency adaptation activities with the NCA, agency activities in support of the executive order—including assessments of agency vulnerabilities and adaptation priorities—are clearly relevant to the NCA process. Likewise, the assessments required by the NCA have clear relevance to the activities mandated by the EO. The 2 tracks could serve as a mutually reinforcing, iterative process. Such linkage might help address several challenges to public health adaptation by linking adaptation activities with systematic reassessment and processes that foster institutional learning. The NCA could generate strategies to close research and preparedness gaps and promote innovative



management approaches. Given the necessity of iteration in climate change adaptation,⁵⁴ such a parallel process could significantly strengthen federal adaptation efforts.

ADAPTATION BARRIERS AND EXECUTIVE ORDER 13514

In their discussion of barriers to climate change adaptation, Moser and Ekstrom³⁹ divide the adaptation process into understanding, planning, and managing phases. The understanding phase focuses on detecting the problem and reframing it for specific contexts; the planning phase focuses on developing, assessing, and implementing adaptation options; and the managing phase focuses on implementation, monitoring, and evaluation.³⁹ Each phase has potential barriers to successful adaptation. In addition to providing an adaptation mandate for federal agencies, EO 13514 has directives focused on each phase of the adaptation process. From a diagnostic and planning standpoint, it is reasonable to briefly consider how the barriers to adaptation, as defined by Moser and Ekstrom,³⁹ may affect activities in response to the EO, with the understanding that these potential barriers are common to any adaptation effort.

In the understanding phase, there are relevant issues regarding problem detection, which derive, in particular, from traditional reliance on surveillance and retrospective studies to characterize problems and from previous experience with emerging concerns

that have unfolded in real time. There are also issues related to data availability and defining thresholds of concern among the various operating groups under the CDC umbrella. In the planning phase, there are issues related to developing adaptation options at the appropriate programmatic level, and assessing and prioritizing these options in comparison with the many other immediate and pressing public health needs faced across the agency. In the managing phase, there are potential issues regarding implementation and coordination, as well as availability of appropriate technical resources; the need to develop monitoring plans for adaptation activities and the challenge of measuring efficacy against slowly emerging threats are also important considerations.

As previously noted, adapting to the health impacts of climate change is in some ways quite similar to other learning challenges that the CDC has faced. However, some other aspects of the challenge, such as the heavy reliance on modeled and projected impacts and the intergenerational equity nature of the concern, are new; close attention to potential barriers will be needed to facilitate navigation.

FOSTERING FEDERAL ADAPTATION BY EXECUTIVE ORDER

Some have noted the potential fragility of pursuing climate change adaptation by the EO,^{5,55} given the potential for repeal by a future executive and judicial review.¹³ It is also reasonable to ask

what adaptation activities consistent with agency missions would have occurred regardless. Finally, based on the literature examining barriers to action, it is appropriate to consider how other barriers to adaptation may affect implementation of adaptation activities in response to the EO.

It is difficult to speculate as to what might have occurred without the EO, which appears to have served as a starting point for federal agencies to develop long-term resilient adaptation strategies. Doubtless, activities directly related to EO compliance, such as the workshops aimed at facilitating agency adaptation planning held by the Climate Change Adaptation Task Force, would not have occurred as they did without the EO. It is more difficult to apply such a test to other activities within DHHS, where a departmental vulnerability assessment and an adaptation policy have been developed, and within CDC, where several intramural and extramural activities are underway. It is possible that some adaptation activities, particularly those most in keeping with CDC's mission and in response to apparent and emerging threats, would have occurred regardless.

However, it is also likely that the EO has encouraged explicit consideration of a wide range of public health threats and adaptation needs earlier than might otherwise have happened in the absence of executive leadership. Perhaps more important are the questions of how to build on existing activities and to evaluate their impacts. Ongoing needs assessment, program development,

attention to potential public health adaptation needs, and integration with other federal adaptation activities will continue to help improve preparedness by reducing vulnerability and increasing resilience to climate-related hazards.⁴⁹ Evaluation of these efforts, particularly those aimed at developing facility with climate change adaptation among state and local public health partners, should be a priority, both to guide future resource use and to build the evidence base for climate change adaptation in public health more generally.

CONCLUSIONS

President Obama's EO 13514 is a mandate to agencies within the Executive Branch to pursue both climate change mitigation and adaptation concomitantly.⁷ It provides a loose structure for pursuing climate change adaptation on an agency-by-agency basis while providing a framework for inter-agency collaborations. The EO and compliance activity to date are largely in keeping with current state-of-the-science regarding climate change adaptation. The CDC has followed the EO 13514 adaptation mandate and developed robust climate and health programming, and continues to seek ways to integrate climate adaptation into other programmatic areas. The EO supports further collaboration across federal agencies. The NCA offers an opportunity to integrate formal assessment of current vulnerabilities and adaptation activities with recommendations relevant to EO 13514 and to address



several known challenges to climate change adaptation in public health. These and related inter-agency activities will serve as a strong foundation for future adaptation activities addressing climate change. They have the potential to increase the public health sector's resilience to anticipated climate change effects. ■

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Contributors

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