

PROTECTING AMERICAN HEALTH FROM CLIMATE CHANGE: WHAT IS NEEDED TO
EXPAND ADAPTATION PLANNING BY U.S. STATE AND LOCAL HEALTH
DEPARTMENTS?

Alexandra Zuber

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Approved by:

Rebecca Slifkin

George Luber

Kris Ebi

Leah Devlin

Ed Baker

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ABSTRACT

Alexandra Zuber: Protecting American Health from Climate Change: What is Needed to Expand Adaptation Planning by U.S. State and Local Health Departments?
(Under the direction of Rebecca Slifkin)

Over the last decade, there have been growing calls for national and local governments to adapt to a changing climate to protect human health. Due to the shift in U.S. federal climate policy under the Trump Administration, leadership for this climate and health adaptation rests increasingly among state, local and tribal health authorities. These authorities need effective strategies for planning climate and health adaptation in funding-constrained environments. This study proposes an adapted model for planning climate and health adaptation among state and local health departments, based on a review of existing efforts in the U.S., with a particular focus on the U.S. CDC's Building Resilience Against Climate Effects (BRACE) model employed in the CDC-funded Climate Ready States and Cities Initiative (CRSCI).

Study methods comprised: a literature review of existing adaptation efforts in the U.S.; analysis of 11 CDC interviews with CRSCI grantees; and 11 online, videoconference focus group discussions with 46 city and county health officials. The study characterizes the key inputs and processes involved in BRACE implementation by 9 states and 2 cities, revealing key challenges and enabling factors that influenced successful climate and health adaptation planning. The study also summarizes the input of health authorities on operational requirements to expand climate and health adaptation at state and local levels, and their recommendations for

an adapted BRACE model. Lastly, the study proposes an adapted BRACE model for state and local health departments facing resource constraints, and recommendations for how CDC and the broader health community can advance climate and health adaptation nationwide.

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LIST OF ABBREVIATIONS

ASPPH	American Schools and Programs of Public Health
ASTHO	Association of State and Territorial Health Officials
BRACE	Building Resilience Against Climate-Related Health Effects
CDC	U.S. Centers for Disease Control and Prevention
CHP	CDC Climate and Health Program
CoP	Community of Practice
CRSCI	Climate Ready States and Cities Initiative
CSTE	Council of State and Territorial Epidemiologists
COP21	United Nations Conference of the Parties, 21 st Session
EPA	Environmental Protection Agency
EU	European Union
IAHAs	Insular Health Agencies
LHDs	Local Health Departments
NACCHO	National Association of County and City Health Officials
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NIH	National Institutes of Health
NWS	National Weather Service
WHO	World Health Organization

CHAPTER 1: INTRODUCTION

On December 21, 2015, global policymakers convened in Paris, France for the global United Nations Climate Change Conference of the Parties (COP21), to develop an agreement to curb the increase in global warming to a target of no more than 2 degrees Celsius from pre-industrial levels. This agreement calls on countries, when taking action on climate change, to “respect, promote, and consider....the right to health”.¹ This reference, according to Dr. Maria Neira, Director of the World Health Organization’s (WHO) Department of Public Health, Environmental and Social Determinants of Health Division, was a “critical step forward” for human health, reflecting a “growing recognition of the inextricable linkage between health and climate.”² Following this summit, in July, 2016, WHO hosted the second “Global Conference on Health and Climate”, where heads of state, scientific officials, and practitioners gathered to discuss the implication of COP21 on global health action.³

These recent global fora punctuate the widespread scientific consensus that has been established over the last two decades of the harmful effects of climate change on human health.⁴

⁷ The increase and variability of temperature, precipitation (i.e. floods and droughts), air pollution, extreme weather events (i.e. hurricanes, storm surges) and sea-level rise due to greenhouse emissions increase human exposure to injuries, heat and cold-related illness, vector-borne disease, water and food-borne contaminants, food shortages and malnutrition, cardiovascular and respiratory ailments, forced migration, and other effects.⁴ These climate-related effects are already occurring, and are projected to magnify throughout this century.⁸

WHO estimates that between 2030 and 2050, climate change will result in 250,000 deaths due to

malnutrition, malaria, diarrhea, and heat stress, and cost \$2-4 billion in health-related costs by 2030.⁹

Global stakeholders have strongly called upon countries to take action to protect human health from these climate-related risks.^{8,10-16} Policy options include *mitigation*- interventions taken to reduce or offset greenhouse gas emissions that cause anthropogenic climate change- and *adaptation*- interventions taken to reduce the impact, or exploit the benefits, of climate change on human health and well-being.¹⁷ In 2015 guidance, WHO indicates that mitigation is necessary for long-term protection of human health, however short to medium term health impacts can be prevented through adaptation efforts.¹⁸ In 2008 the World Health Assembly committed member states to develop health adaptation plans that build the capacity of public health leaders and systems to prepare for and respond to climate-related health effects.¹⁰ To date, many countries have developed these national plans, with the goal to protect health from climate variability and change, by reducing exposures and vulnerability to health effects (especially by vulnerable sub-populations), and by building resilience and adaptive capacity among community and health systems to mediate the resultant health effects.¹⁹⁻²¹

In the U.S., President Obama launched a Climate Action Plan in 2013, calling on federal agencies to build resilience among the health sector through partnerships with state and local governments and the private sector.²² The U.S. Department of Health and Human Services developed a national climate and health adaptation plan in 2014, which guided a series of new partnerships and adaptation efforts within the public health and healthcare sectors nationally.^{23,24} The U.S. Centers for Disease Control and Prevention (CDC) in particular has launched a significant and novel response through their Climate and Health Program (CHP). In 2010, the CDC designed a five stage model for state and local health departments to use for climate change

adaptation planning for health. The model is entitled “Building Resilience Against Climate Effects (BRACE)”, and the five sequential stages recommended for health departments to follow are: 1) Forecasting Climate Impacts and Assessing Vulnerabilities; 2) Projecting the Disease Burden; 3) Assessing Public Health Interventions; 4) Developing and Implementing a Climate and Health Adaptation Plan; and 5) Evaluating Impact and Improving Quality of Interventions.²⁵

The CDC introduced the first four stages of the model in 8 states in 2012 through a cooperative agreement entitled *Climate Resilience States and Cities Initiative (CRSCI)*. The objective of this cooperative agreement was to build capacity in states to develop Climate and Health Profiles (which summarize stages 1 and 2), to assess public health interventions to address the issues raised in the profiles, and to develop and implement a state (or city) climate and health adaptation plan. CDC expanded this initiative to 8 additional states and 2 cities in 2013, bringing the total number of grantees to 16 states and 2 cities. A map of CRSCI grantees is provided in Appendix 1. In 2016, the CDC established a new multi-year cooperative agreement with these same jurisdictions (*Building Resilience Against Climate Effects: Enhancing Community Resilience by Implementing Health Adaptations*), to implement and evaluate the interventions defined in their adaptation plans. In this same year, CDC also introduced new one-time funding to introduce BRACE to four tribal nations, entitled *Building Capacity for Climate Change and Public Health Programs at Insular Area Health Agencies (IAHAs)*, for the period of November 1, 2016- June 30, 2017. This cooperative agreement invited tribal nations to propose interventions in any BRACE stage.

In the future, CDC aims to expand climate and health adaptation planning in new jurisdictions, in particular local health departments. These new jurisdictions are state and local health departments that have not yet received CRSCI funding (hereafter referred to as “non-

grantees”), and may face greater constraints in terms of capacity and/or resources to implement the BRACE model than the original CRSCI grantees. CDC anticipates that the BRACE model and the CDC technical assistance approach will need to be adapted to meet the unique operational needs of these resource-limited settings, in particular for local health departments.¹

The change to the Trump Administration in 2016 heralded a new direction for U.S. policy and planning for climate change and health. President Trump and his EPA Administrator, Scott Pruitt, have publically challenged the science and existence of climate change,²⁶ and notably, in June, 2017, called for the withdrawal of the U.S. from the 2015 Paris Agreement, a move that will be effective in January, 2020.^{27,28} This decision makes the U.S. the only country in the world not party to the agreement.²⁹ In the 2017 Presidential Budget, the Trump Administration further proposed deep cuts to climate-related programming at EPA, NASA, NOAA, and the Department of Energy.³⁰ Over 2016-2018, the EPA budget alone was reduced by \$667 million, and all climate change-related material was withdrawn from its website.^{31,32} Expanding climate and health adaptation planning in this unfavorable political and funding context is a challenge.

Notably, as federal leadership has been constrained, states, cities, companies, and other subnational entities have stepped up to help deliver on the U.S. commitments to the Paris Agreement. Immediately after President Trump’s announcement to withdraw the U.S. from the agreement, three U.S. states formed the U.S. Climate Alliance, a group of now 17 U.S. states committed to advancing U.S. Paris Agreement goals.³³ New York City Mayor Michael Bloomberg and California Governor Jerry Brown next established “America’s Pledge”, a network of state and local governments and businesses committed to working towards, and reporting on, U.S. commitments to the Paris Agreement.³⁴ This group presented a report on the

¹ Correspondence with CDC Climate and Health Program Team. Fall, 2016.

actions of states, cities, and local businesses to the United Nations during COP23. A similar network of over 2,700 state, city, and county governments, tribal nations, and companies also emerged during the same time to sign a pledge “We Are Still In”, representing their commitment to the climate action agenda set forth in the Paris Agreement.³⁵ This movement of subnational actors is also happening on a global scale, to the extent that one journalist from the U.N. Foundation anointed the term “subnational” the “climate change word of 2018”.³⁶ This overall shift in the locus of leadership and activity in climate adaptation, from the federal level to the subnational level, makes CDC’s plan to expand climate and health adaptation among state and local health departments and tribal nations both important and timely.³⁷

The literature on climate change adaptation for public health in the U.S. is growing. Public health leaders have established frameworks for adaptation to climate change, based on the ten essential public health services and evidence-based practice.^{38,39} Climate change adaptation for health theory is also emerging, and focuses on mechanisms of adaptation governance, decision-making, multi-sectoral collaboration, and addressing socioecological factors that increase vulnerabilities to climate-related health effects.^{40,41} Public health interventions have been systematically reviewed to identify evidence-based options for protecting against climate-related health risks.⁴² Common challenges to effective adaptation planning have been illuminated, including uncertainties of future climate and socioeconomic conditions, access to and use of technology, fragmentation and inconsistent policy across key government institutions, lack of awareness and prioritization of climate change by the public and by public leaders, and lack of funding, among others.^{43,44} Lastly, key guidance documents have been produced by federal and non-governmental organizations, with tools and examples of adaptation planning for health in practice at national and local levels.^{45–48}

However, evaluations or implementation studies of climate and health adaptation planning at state and local levels that could guide the CDC effort are nascent. Research is needed to understand what has been learned from state and local adaptation planning to date (in particular with the BRACE model) that could inform efforts to expand adaptation among non-grantee jurisdictions, in particular local health departments. In addition, consultation with these jurisdictions is needed to more fully understand how adaptation planning guided by the BRACE model could be implemented effectively in their settings, and what modifications and other external inputs would be required. Models for advancing climate and health adaptation planning in funding-constrained environments should be identified.

This research would contribute to the literature and help inform CDC's programing to expand climate and health adaptation in resource-constrained jurisdictions, at a critical time when leadership at the subnational level is paramount. Additionally, this research would inform other interested non-governmental actors in climate and health in the U.S., such as the Rockefeller, Kresge, and Robert Wood Johnson Foundations, the Climate Reality Project, the U.S. Climate and Health Alliance, and the Georgetown Climate Center, which are increasingly important during this era of limited federal leadership.

CHAPTER 2: LITERATURE REVIEW

Methods

A plan was conducted to identify peer-reviewed and grey literature that characterize the experiences to date of climate and health adaptation planning at the state and local government level in the U.S. The literature review answers the question: *What are the lessons learned from state and local government and tribal nation climate change adaptation or resilience planning for health in the U.S. which could be applied to the CDC Climate and Health Program with U.S. state and local health departments?* Due to the increasing popularity of the concept of “resilience” in national, state, and local level planning to anticipate stresses and shocks, including climate change, this term was included as an alternative to adaptation. Definitions of these terms are provided in a separate section of this proposal.

Given the focus on climate change adaptation or resilience planning for health, the key search terms were identified as “climate”, “adaptation or resilience” and “plan or planning”. These terms were searched systematically in the following three electronic databases, which were selected due to their relevance to climate change and health:

- Scopus
- Social Science Citation Index (via Web of Science)
- PubMed

Relevant articles were also hand-searched from two additional electronic databases:

- Google Scholar
- Georgetown Climate Center Adaptation Clearinghouse

The Boolean operator employed was “climate” AND “adaptation OR resilienc*” AND “plan*”. The initial application of these terms yielded over 22,000 articles in each database. The search was then narrowed in the following manner: Scopus and PubMed were limited to those that had the search terms in the title, abstract, or keywords, while articles in Web of Science were limited to those that had the search terms “adaptation or resilience” in the title, as there were no abstract or keyword filter options. Three additional electronic exclusion filters were used to capture only articles published in English, between 2000 and 2016, and covering the U.S. territory. Given state and local governments in the U.S. operate officially in English, it is not expected that this led to the omission of any articles. The date range was selected to capture more contemporary models of climate change adaptation planning that would have greater relevance to current efforts and climate realities.

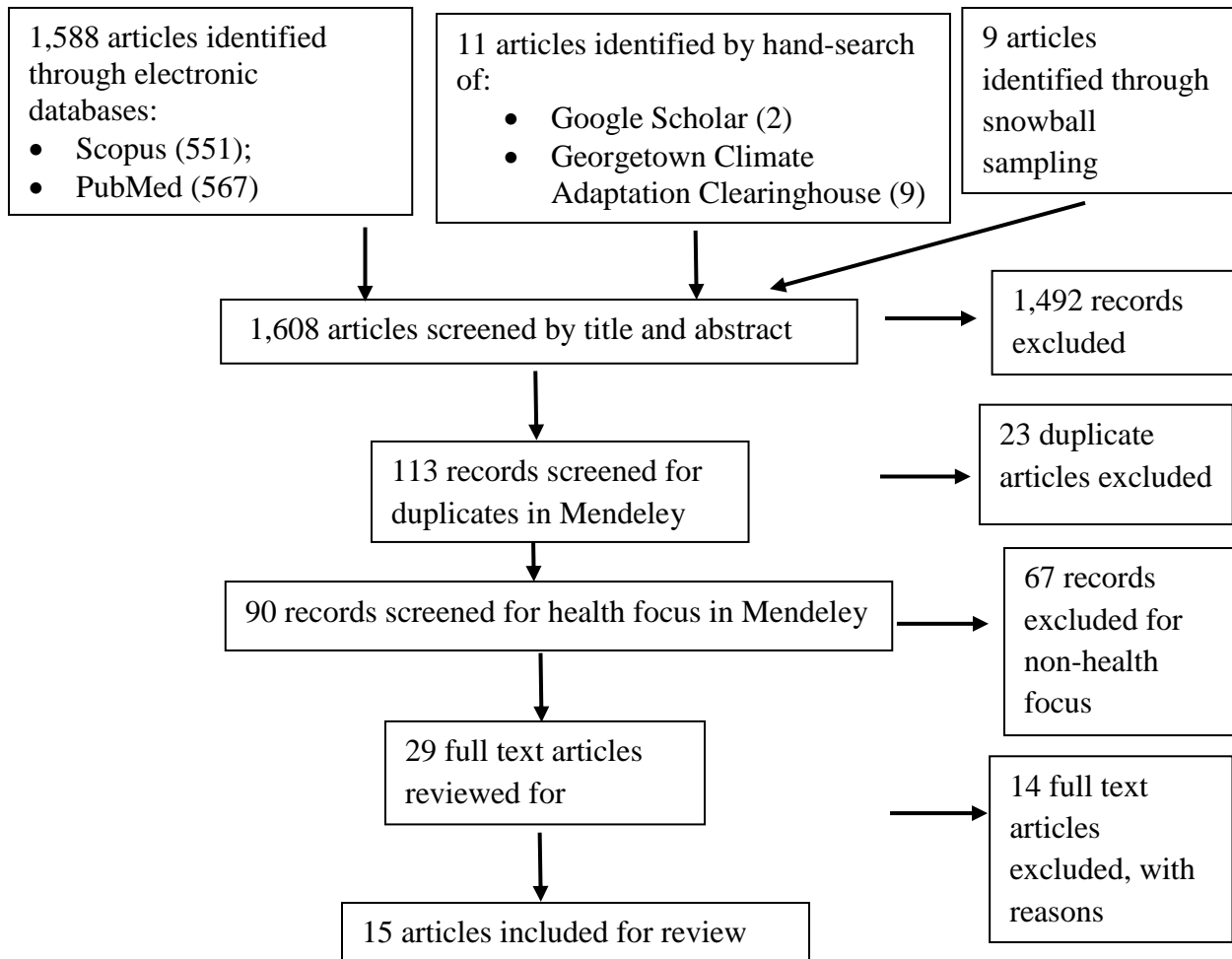
With respect to Google Scholar, the P.I. conducted a hand-search of relevant articles, due to the high volume of articles returned in that database (over 1 million). Additionally, the P.I. reviewed all resources contained in the “public health sector” section of Georgetown Adaptation Clearinghouse to identify grey literature for inclusion. This included reviewing “popular resources”, “public health basics”, “science and tools”, “plans”, “planning and guides”, and “education and communication” sections.

Articles were included if they: 1) documented a particular U.S. state or local government-led or tribal nation-led climate change and health adaptation planning experience, or 2) characterized the issues facing state and local government or tribal nations in climate and health adaptation planning. Articles that presented new tools for climate and health adaptation planning, such as a new disease burden modeling technique, were included only if they were applied in an implementation context at the state or local level. Planning products, such as a

state climate and health profile, were included only where they provided some overview of the planning process that developed these products. Given the expected paucity of literature in this area, no exclusion criteria were set regarding article type.

Once the electronic search was conducted, articles were screened for inclusion following the modified PRISM diagram, in Figure 1. Articles were screened for inclusion first by title and

Figure 1. Modified PRISM Diagram for Article Inclusion



abstract within the electronic database, and articles that met the inclusion criteria were retrieved and stored in Mendeley reference software. Given the high volume of included articles (n=90), only those articles that had “health” in the title, abstract, or keywords were included for full-text review (n=29). Any articles that did not meet the inclusion criteria after full text review were

excluded, and the rationale was documented. Additional articles were included by hand-sampling, through review of the references of included articles.

Upon full-text review, data were abstracted and analyzed in Excel. The data abstraction tool included the full article name and authors, year, study type, geographic focus area, key findings, and research quality ranking (low, medium, or high) with a summary of key methodological issues. Criteria for quality rankings included issues related to bias in selection, sampling, and analysis, response rate, sample size, and documentation and clarity of research methods and findings. Examples of methodological issues identified were the lack of randomization, small study samples, and lack of documentation of research methods. The author used an analysis tool (an Excel spreadsheet) to first document key themes that were common across the articles, and then to populate qualitative findings from each article according to key theme. Articles were excluded that were: editorial only (n=4), reviews of literature or tools with insufficient evidence of application (n=4), or guidance documents with insufficient information on state or local level examples of adaptation planning (n=6). Those that were excluded after full-text review were labeled as such in the Excel document, and folders within Mendeley were updated to reflect total combined articles and articles included and excluded from full-text review.

Results

A total of 15 articles were included in this review. The articles can be organized categorically by their study design; seven articles reported the results from surveys of state and local health departments (Appendix 2), and eight articles were examples of state and local climate and health adaptation planning (including five case studies, two state adaptation plans and one climate health profile (Appendix 3). One of the case studies included a survey of state and local health departments, and therefore the study was analyzed in both categories (making

the number of articles analyzed as local health department surveys 8). While all focused on the U.S., the geographic unit of analysis for the studies included local health departments only (n=4), state health departments only (n=4), city health authorities only (n=2), communities only (n=1) and multiple jurisdictions (e.g. state and local health departments, n=5). Two of the studies included tribal authorities.

Surveys of state and local health departments

The eight surveys of state and/or local health department (LHD) staff included both nationwide (n=6) and state-based (New York, n=2) samples. A mix of online and mailed questionnaires and in-person and phone interviews was used, representing both structured and semi-structured interview design with study samples ranging from 30-190 individuals (See Appendix 2). Three studies focused on efforts to reduce heat-related morbidity and mortality and sampled LHD and emergency response departments,⁴⁹⁻⁵¹ one was focused on community engagement in disaster preparedness and sampled LHD staff,⁵² and four were focused on LHD perceptions and actions on general climate change adaptation planning for health and sampled local health department directors and staff.⁵³⁻⁵⁶ Of these last four surveys, three are inter-related; one survey (Roser-Renouf, C. et al, 2016) is a follow-up of a 2008 study (Maibach, E. et al, 2008) to understand changes in perceptions and actions on climate and health adaptation planning nationally, while the third (Carr, J. et al, 2012) is a New York State-based study that compares state and local health department perceptions against the Maibach, E. et al, 2008 national sample. Thus these three studies use adaptations of the same survey instrument.

Inadequate and inconsistent planning

Researchers across several studies documented a lack of adequate adaptation planning to anticipate climate-related health threats at the LHD level. The O'Neill, 2013 study documented that only 42% of counties surveyed had programming to prevent heat-related illness

or mortality, while the White-Newsome, Ekwurzel, et al, 2014 study documented only 40% of counties had heat-related plans. The Eidson, et al, 2016 survey documented 60% of respondents were “unsure” if climate change adaptation planning was underway. The Roser-Renouf, et al, 2016 and Maibach, et al, 2008 studies further documented a lack of public health adaptation planning across their study samples, and the Roser-Renouf et al study showed programming in this area significantly declined between 2008 and 2012.

LHDs in every study were found to have some programs that addressed climate-related health effects, even if not explicitly defined to address climate change. For example, vector, food, and water-borne disease monitoring approaches were common,^{55,56} as well as heat forecasting and warning systems and heat-related public health communications.⁴⁹⁻⁵¹ In all four cities researched in the White-Newhouse and McCormick, 2014 study, a formal response plan to heat existed. Emergency preparedness was the most common intervention among the Eidson et al, 2016 national survey, and was the most important future adaptation priority area for the national sample of LHD directors in the Maibach et al, 2008 survey. However adaptation planning was not consistent across or within climate-related health areas,^{49,50} and commonly neglected areas included mental health, droughts, vulnerable populations, and displacement of populations.⁵⁵ Also, few interventions were developed explicitly to adapt to climate change. The Carr et al, 2012 study revealed that where counties did have plans, the number of public health interventions to prevent heat-related morbidity and mortality were twice as great; illustrating the importance of the planning process to public health action.⁵⁰

Low prioritization and perception of impact

A critical driver of the lack of adaptation planning is the mixed degree of prioritization of climate change adaptation planning for health among the LHDs surveyed. Four surveys revealed low degrees of current prioritization of climate and health adaptation among LHD

officials. The Carr et al, 2012 study of 22 New York LHD staff showed a minority of LHDs (39%) felt climate change was a priority for action, the Roser-Renouf et al, 2016 study of 174 LHDs nationwide showed present prioritization below the mid-point on their study index, the Maibach et al, 2008 study of 133 LHDs nationwide showed only 19% of LHDs presently have climate and health adaptation as a top 10 priority, and the Eidson et al, 2016 study of NY state and local health departments showed only 23% of LHDs have incorporated or would consider incorporating climate adaptation in their public health plans. The Roser-Renouf et al, 2016 study documents a decline in the overall perception among LHDs that climate change is a priority between 2008 and 2012, as well as a greater polarization of thinking; authors found that the proportion of LHDs that “strongly agreed” or “strongly disagreed” that climate change was a threat to health increased, while those with less strong beliefs decreased. The authors attribute this polarization to the divisive political debate over the existence of climate change during this time (which has existed despite the scientific consensus that anthropogenic climate change is already underway).

However, the findings were not consistent across all surveys. For example, the majority of LHDS in the Maibach et al, 2008 study noted that climate change *was* a priority for their LHD (albeit not in the top 10), and 56% of the respondents in the Eidson et al, 2016 survey indicated they had already incorporated, or would consider incorporating, climate change in their public health planning. Further, when respondents in the Eidson et al, 2016 study were asked if climate change adaptation *should be* a priority for their LHD, the majority of respondents (60% of state and local health departments and 90% of external stakeholders) agreed. These two studies represent the earliest and latest time points of the studies included in this review, which reveals

that LHD prioritization or perception of climate change as a threat to health cannot be seen to be associated with study year.

Additionally, surveys documented that state and local officials widely perceive that climate change is already having an impact on health in their jurisdiction, and will have greater impacts in the future. In the Roser-Renouf, et al, 2016 study, 66% of LHD respondents felt climate change was presently affecting health outcomes, and 76% felt it would impact health in the next two decades (61% deemed this impact to be “serious”). In the Maibach et al, 2008 study, a majority of the nationwide sample perceived climate change as a threat to health in their jurisdiction, and 60% felt their jurisdiction would experience one or more “serious” public health problems in the next two decades as a result.

Some surveys document a high proportion of respondents who did not know if climate change was having an effect on health. In the Carr et al, 2012 study, 43% of LHDs “did not know” if climate change was affecting health locally, and similarly in the O’Neill et al, 2010 study, the authors note that many responses to their questions regarding if heat-related illness was a concern were “I don’t know”, reflecting a lack of knowledge among the very staff the authors believe “should know”. The Roser-Renouf et al, 2016 study found that perception of public health impact of climate change is one of two predictors of whether respondents prioritized climate change adaptation.

Obstacles to climate and health adaptation planning

Consistent across the studies, the primary obstacles LHDs face to adaptation planning are funding, staffing, expertise, information and technology, and competing priorities and activities. Funding was a key driver in almost all of the studies; the lack of consistent, timely funding that is designated for climate-change related activities prevented many LHDs from initiating activity on climate change, and stymied others who attempted to cobble together resources from other

related program areas or the private sector.^{49,50,52–54,56} The lack of funding also aggravates the existing shortage of LHD staff, which was reported as a key constraint to managing adaptation planning and community engagement.^{50,52,53} LHDs report that these barriers have worsened due to the major funding and staff cuts caused by the economic recession in 2007.^{49,52,54}

Where staff exist, the capacity and expertise in climate change adaptation planning is reported as a major roadblock.^{51,55,56} In the Carr et al, 2012 and Maibach et al, 2008 studies, over 70% of LHDs reported that lack of staff expertise hampered their efforts in planning and preparedness. Another key deficiency reported is information and technology needed to project climate change in their jurisdiction or model disease burden or other health effects.^{53,55,56} This was evidenced by the low reported use of long-range weather forecasting data by local health officials, which was under 30% in two studies.^{55,56} One study reported that only 13% of data managers at LHDs in New York were using climate data of any kind, and that LHDs “lacked sufficient information” for action.⁵³

Lastly, the challenge LHDs face of competing priorities was routinely documented across the studies. LHDs reported in one study that it is difficult to “argue the hypothetical” that future climate change represents, when other more immediate health problems are present.⁴⁹ Compounding this issue is a commonly reported lack of effective metrics and evaluation of LHD level climate change adaptation planning for health, which could demonstrate the return on investment or positive impact of planning efforts.^{49,52,54}

Mediating factors and LHD operational needs

Notably, the studies document that these common challenges can be mediated by effective expertise, leadership, and community engagement. In the Roser-Renouf et al, 2016 study, the degree of expertise in climate change adaptation by LHD leadership can actually counteract funding constraints, and was found to be the greatest predictor of LHD

implementation of adaptation activities. Strong, capable leaders that endorsed and were visibly engaged in climate change preparedness were also seen as a success factor in effective disaster preparedness nationally.⁵² Effective leaders were documented in studies as forging important collaborations across local government and civil society organizations to maintain activities through funding constraints, and as integrating their work with existing disaster preparedness and health programs and plans.^{49,52,54} Indeed, the study of heat response across 190 counties nationwide found that where political will was high, resources for adaptation planning were higher and more activities were conducted.⁴⁹ The same study also found that where political will was lower, counties with strong community engagement and community-driven solutions managed most effectively to maintain their activities. Community engagement was also reported as an important component of adaptation planning, for designing appropriate responses, addressing vulnerable populations, and for ‘carrying along’ adaptation interventions when governmental resources or political will are low.^{49,50,52}

Operational needs

Not surprisingly, the key needs articulated by LHDs in these surveys include funding, dedicated staff, and capacity-building. Notably, LHDs from several studies repeatedly expressed the need to learn from the experiences of other local governments and communities, in particular their “best practices” and climate and health data techniques.^{49,52,54,56} Templates and technical guidance for the various stages of adaptation planning were also reported as being needed.⁵² Unfortunately, survey respondents seemed to lack confidence that CDC could adequately provide the training and expertise needed; in two studies, only about one-third of respondents felt CDC could be helpful or would have the expertise needed in adaptation planning.^{55,56} Study authors additionally called on LHDs to improve community engagement and “bottom-up” approaches,^{52,56} integration and cost-sharing with existing programs and activities to overcome

financial constraints,^{49,56} collaboration with stakeholders across local government, civil society, and the private sector,^{52,54} and more effective identification and targeting of vulnerable populations.⁵⁰

Examples of state and local climate and health adaptation planning

Case studies

Five case studies were included in this review. One case study contrasted the plan for emergency preparedness in New York City to the actual response to Hurricane Sandy within two public housing communities,⁵⁷ two case studies highlighted innovative models for community-based adaptation planning among indigenous residents in Alaska,^{58,59} and two case studies reflected state-based stakeholder assessment (n=1) and disease modelling (n=1) as part of the CDC CRSCI.^{53,60} The Schmetz et al, 2003 study of the Hurricane Sandy response relied on key informant interviews, while the other case studies were written by the staff responsible for the planning interventions discussed.

The Schmetz et al, 2003 review of the Hurricane Sandy response reviewed the municipal response to Hurricane Sandy in two Red Hook public health housing communities. Authors documented a local governmental response that was fragmented and poorly coordinated, which resulted in utility outages, lack of sanitation facilities, and the relocation of health services for up to three weeks. The authors argue that the three hazard mitigation plans in place before the disaster did not properly engage the community and in particular, the vulnerable residents of the city (including the Red Hook residents), or the community organizations that served them, nor did they address how to mitigate long-term power outages and relocation of health services. Authors recommend preparedness planning that more strongly engages the community, in particular vulnerable residents, establishes coordination plans with community organizations, and provides contingency planning for utilities and health services.

Two case studies in Alaska documented experiences of local health authorities using innovative tools for community-based surveillance, forecasting of climate change, vulnerability assessment, and priority-setting for adaptation plans. Brubaker et al, 2011 documents the use of a Climate Change Health Assessment tool by the Alaska Native Tribal Health Consortium (ANTHC) among indigenous villages in Northwest Alaska. The tool includes a four step process of (1) scoping of climate changes in the area; (2) conducting site visits to survey local residents' perceptions of climate impacts and to assess infrastructure changes, using an Excel based tool; (3) analysis; and (4) planning adaptation priorities with local governmental and tribal authorities. After implementing the tool among 29 residents and multiple sites, findings were presented in public bulletins and in local government and tribal meetings, to integrate community priorities in local planning efforts. The authors argue the process was effective at soliciting community input for climate adaptation, and the process has been replicated in three other areas of the state.

The Driscoll et al, 2013 case study similarly documents the use of a community-based surveillance system for identifying priority health-related climate effects for planning efforts. Funded by the CDC and APHA, the project team conducted sentinel surveillance among 91 residents over 12 months in 3 ecologically distinct areas of Alaska. They used a web-based tool (with phone interviews) adapted from the CDC National Health and Nutrition Survey (NHANES) and Behavioral Risk Factor Surveillance Survey (BRFSS). The tool consisted of community observations on: (1) local weather, (2) hunting and harvesting, (3) food and water safety, (4) general health and air quality, and (5) any additional impacts or moderating factors, and was administered over a 12 month period with a cash incentive of \$20. The team identified high-frequency health outcomes and risk factors, and compared health outcomes and moderating factors against two types of environmental exposures: "unusual" changes in weather and changes

in travel plans. They found significant associations between both exposures and health outcomes. The team then conducted follow-up visits with the communities to identify adaptation priorities that could strengthen moderating factors to climate change through facilitated workshops. The authors found the surveillance system was effective at engaging the community in identifying key health outcomes and mediating factors associated with climate change in Alaska, and represents a highly flexible and rapid approach to determine adaptation measures.

Lastly, two case studies documented adaptation planning activities as part of the CDC CSRCI, representing stages 1 and 2 of the BRACE framework. The Eidson et al, 2016 study documented the process of stakeholder assessment and adaptation planning by the New York State Department of Health (NYSDOH). A project coordination team of NYSDOH staff conducted seven electronic surveys: two were of NYSDOH program directors' perceptions of climate change and existing needs and expertise for adaptation; one assessed the capacity of the surveillance databases across the state for providing climate and health data; and four assessed adaptation priorities among NYSDOH, LHDs, and external stakeholder organizations. In the surveys on adaptation priorities, the NYSDOH asked respondents to prioritize across 9 health services (selected from the 10 essential public health services) and 77 adaptation activities. NYSDOH then convened 21 climate-related staff in a day-long workshop, where they reviewed the data and developed a 'strategic (road) map' with objectives and activities for adaptation. This map was presented through webinars and presentations with NYSDOH staff and stakeholders and was utilized to develop the state climate and health adaptation plan. These surveys were shared with other states, where they have been modified and used for adaptation planning.

The Conlon et al, 2016 case study also documents a state-based experience (Florida) with adaptation planning under the CDC CRSCI. Florida state health authorities and CDC Climate and Health Program staff conducted a two-year process to build capacity of health department staff to conduct the second stage of the BRACE model, “Projecting disease burden.” The steps included (1) developing a causal pathway; (2) assembling data elements; (3) projecting disease burden; and (4) performing uncertainty analysis. The team developed an adapted BRACE conceptual framework, as well as disease projection case studies related to temperature, drought, and tropical cyclones, and their related effects on average daily emergency department visits for asthma, heat-related illness, and all-cause mortality, among other health indicators. The authors emphasized the importance of interdisciplinary teams of technical experts for proper climate-related disease modelling, (such as in epidemiology, health education, environmental science, urban planning, demography, and sustainability) as well basic knowledge in climate modelling, general and downscaled models, and uncertainty analysis.

State adaptation plans and climate health profiles

Three reports documented climate and health adaptation practices at the state level, in Michigan, Minnesota, and Oregon. Two of these three reports represented state climate and health adaptation plans, and one report was the Oregon climate and health profile (a precursor to the state climate and health plan). All three documents were produced with funding from an external source; Michigan and Oregon received funding from the CDC CRSCI, and Minnesota received funding through ASTHO.

Michigan and Minnesota adaptation plans had the goal to establish a shared vision among stakeholders for the state public health departments’ strategies to protect public health from climate related effects. The leadership teams of each state, however, were different: Michigan’s planning process was led by the Michigan Department of Health, while Minnesota established a

Climate Change Workgroup of state agencies representing environmental health, emergency preparedness, public health laboratories, community and family health, health promotion and chronic disease, and others, as well as elected officials. Another key difference is that Michigan based its needs assessment and planning materials on the Essential Public Health Functions and the National Environmental Public Health Performance Standards, while Minnesota did not report a guiding framework for their work.

Both states undertook a substantial consultation process with stakeholders. Michigan engaged communities, academia, and state and local health agencies, while Minnesota engaged only state agencies and elected officials. Michigan conducted a robust needs assessment process in two steps: first, state officials conducted structured interviews with 34 leaders from LHDs, to determine the status and gaps in public health adaptation strategies for climate change, and second, they conducted key informant interviews with representatives from the state health department and other state agencies, non-governmental organizations, and academia. Both states held a series of workshops of key stakeholders to assess core principles and values, to prioritize the climate change –related public health issues, and to identify key areas of intervention. Michigan additionally included in their final workshop a statement of commitment by participants to support the process moving forward. Minnesota documented substantial input of technical materials throughout the workshops (including a presentation of climate effects in Minnesota, a chart of climate-related effects, and a list of selection criteria for priority areas of intervention).

Once focus areas were selected, Minnesota charged technical teams in each area to develop goals, objectives and strategies that would be assembled into the state plan. These technical teams were provided a literature review in their programmatic area, as well as

examples from neighboring state adaptation plans. Technical teams also conducted a SWOT (strengths, weaknesses, opportunities, and threats) analysis of their programmatic area. The Climate Change Working Group then assembled, consolidated, and merged submissions from the technical teams to produce their plan.

Both processes were completed within one year, and resulted in the formulation of a plan with key values or principles, goals, objectives, focus areas, and areas of intervention. Both states indicated that the plans would need to be refined over time, given the uncertainty of climate change effects. The Minnesota plan indicates that an important next step is to integrate this plan with other state plans, and to develop a local health department climate change adaptation plan that aligns with the state plan. Both plans stressed the importance of coordination between all levels of government, social services, and other organizations for effective implementation. Both plans indicated that the present lack of resources faced by state and local health agencies were impediments to implementation of public health interventions, however Michigan's plan called for the integration of the climate and health plan into all public health programming as a strategy. The Minnesota plan noted that the planning process helped information-sharing between state agencies and departments, learning about climate change, and generated enthusiasm for action.

The Oregon Climate and Health Profile was developed by the Oregon Health Authority as an input to its larger Oregon Climate and Health Adaptation Plan. Its goal was to describe the likely impacts of climate change on health outcomes in the state, and to present a broad, statewide assessment of demographic, geographic, and occupational vulnerability to climate change risk. To develop the profile, Oregon received technical assistance from the CDC CHP,

including training of select LHDs to identify climate and health needs (based on climate projections provided) and to develop local climate and health adaptation plans.

As a next step, the OHA will conduct in-depth vulnerability assessments, develop best practices, and use the five LHD adaptation plans as a basis to develop a state climate and health adaptation plan. Oregon is the only state of the three reviewed that reported the plan to include a monitoring and evaluation framework as part of their state climate and health adaptation plan.

Discussion

The eight surveys of state and local health departments in this review reveal low levels of state and local climate and health adaptation planning in the U.S. Adaptive measures including vector-, food-, and water-borne disease monitoring and interventions are common among state, local and tribal authorities, but strategic plans that forecast climate change, project disease burden, and plan for effective community and government collaboration are not well documented. This lack of climate and health adaptation planning at the local levels is consistent with what has been documented for health and non-health sectors in the literature.^{44,61}

It is notable that of the 8 examples identified, five were funded by CDC. This reveals the positive influence both funding and technical assistance by the CDC and other federal agencies can play to stimulate adaptation planning efforts locally, and underscores the importance of this dissertation research to inform expansion efforts. Since not all state and local health officials see climate change as a priority, CDC and other efforts to expand planning may benefit from starting work with LHDs where perceived impact and priority-setting for climate and health is highest, to maximize resources.

This review revealed that shortages in funding, staff, expertise, and information and technology are primary obstacles to making adaptation planning a priority at the local level. These shortages have worsened due to the economic recession of 2007; NACHHO estimates that

local health departments lost approximately 48,000 staff from 2008-2013, and twenty-eight percent of LHDs faced budget cuts in 2013. Looking forward, the Trump Administration's clear policy priority to reduce funding and support for climate change adaptation or mitigation, and the major health care reforms that continue to be discussed by Congress that could limit state health funding generally, only stand to further hamper future adaptation efforts. Thus climate and health adaptation planning at the local level will have to operate within austere or zero budgets and with limited staff for the foreseeable future. This research offers concrete suggestions as to how climate and health adaptation planning may be expanded in a context of little to no new funding.

Notably, the studies documented several mediating factors identified by local health departments that helped advance adaptation planning activities despite resources shortages. Political leadership and expertise in adaptation planning are two examples of factors that helped carry along adaptation activities despite resource constraints. These are qualitative factors that can be cultivated through capacity-building and awareness-raising activities by CDC and other key actors.

Across the surveys in this review, LHDs universally reported the need for more training and capacity-building in adaptation planning. In particular, "best practices" from other cities and county health departments, as well as templates and other technical guidance were noted. The case studies included in this review introduce a range of tools that can be employed in diverse settings to solicit stakeholder feedback, engage the community, and collect and analyze climate and health data to inform adaptation. In a 2011 article, the author reports national tools that could be adapted for this climate and health adaptation capacity-building, including the CDC Local Public Health Preparedness national assessment of state level capacity for disaster

preparedness, and a NACCHO toolkit on best practices and guidance for self-assessment and evaluation.⁶¹

CDC has already created select guidance and training for state health departments, and is well positioned to further document best practices and case studies of climate and health adaptation for LHDs and tribal nations. CDC could also help fill the gap identified in this review of effective metrics and evaluations, by providing standard indicators and evaluation protocols that LHD and tribal nations could use. This dissertation study provides recommendations on specific capacity-building priorities and formats, and evaluation methods, that CDC and others could support to this end. ,

Other mediating factors reported in the surveys included collaboration with other stakeholders and integrating of climate and health adaptation planning with other planning efforts. Cross-sectoral collaboration for climate and health adaptation planning is called for by several experts, as including partnerships with power, water, agriculture, built environment, disaster preparedness and other sectors.^{38,40,44,62} In a review of national climate change adaptation planning generally in the U.S., Bierbaum et al, 2012 notes that “mainstreaming” of adaptation planning for health, or the integration of climate and health planning into existing environmental, climate, or sustainability frameworks or sector-based plans,⁶³ is a popular strategy used by state and local authorities in the U.S.⁴⁴ These are two themes that also emerged from the state planning experiences in Michigan and Minnesota. Capacitating state and local health departments and tribal authorities on how to effectively forge strategic collaborations for adaptation planning for health and mainstream the adaptation planning for health agenda is thus an important component of capacity-building that CDC can provide, and should be addressed in this dissertation’s “Plan for Change”, which is a chapter of the proposed dissertation that will be

discussed in a later section of this proposal. This is doubly important for cost-sharing and leveraging existing funds in a constrained financial environment.

A last mediating factor, community engagement, is a key theme emerging in the literature, as a fundamental approach by state and local health authorities to design more responsive adaptation solutions, and as a key approach to tackling social determinants of health that create additional vulnerabilities to climate change for certain populations.^{40,64} Others note that engaging communities is essential in the effort to identify weaknesses in adaptive capacity and to build community resilience to climate-related health threats.^{65,66} In this review, four case studies demonstrated methods for community engagement in the early phases of planning, across diverse settings, from rural indigenous communities in Alaska to more highly capacitated stakeholder organizations of New York State. No studies articulated an explicit strategy for maintaining community engagement during the iterative process of implementing, evaluating, and updating the plans, which is an area for further research. The proposed dissertation research can help to examine the role of community engagement in adaptation efforts undertaken to date, and make recommendations on how to enhance this mediating factor in its plan for change.

Another key theme identified in this review is the weakness in state and local health adaptation efforts to address vulnerable populations. The Hurricane Sandy case study is a timely example of the harms to communities that come when vulnerable populations are not considered or engaged adequately in planning efforts. It is well established in the literature that climate change will have a disproportionate effect on vulnerable subpopulations, such as those of low socioeconomic status, and that addressing the special needs of vulnerable populations is a core component in the public health response.^{38,41} To this end, “Vulnerability Assessment” is a key component of the CDC BRACE framework,²⁵ and guidance has been produced on how it may be

conducted by state health authorities.⁴⁷ Further evaluations of effective models of community engagement, best practices, and technical tools for local health department and tribal authorities could be produced by CDC to further stress the importance of this step to adaptation planning. This study informs this effort by characterizing the efforts in community engagement to date by state and local health departments that implemented the BRACE model under CRSCI.

The three states that documented planning processes as part of a comprehensive state climate and health adaptation plan demonstrate commonalities and differences in their mission, inputs, processes and practices, and outputs. The formulation of the leadership team, the frameworks used, the rigor of the needs assessment, and the degree of technical materials and sub-team formulation all differed across these states, however the steps of consultation of stakeholders and the use of workshops to established a shared vision, to prioritize climate-related health effects, and to determine priority areas of intervention were shared. When reviewing the experiences of CRSCI grantees in implementing the BRACE model, this dissertation research similarly assesses the commonalities and differences in mission, processes and practices, and outputs, to illustrate essential inputs and enabling factors to climate change adaptation to health, which can inform future efforts by other jurisdictions.

Quality and study limitations

The peer-reviewed articles included in this review were reviewed for quality. In general, the LHD surveys utilized standardized survey instruments and recognized sampling techniques including snowball (n=1), purposive (n=4), and randomized (n=3). The Maibach et al, 2008; Roser-Renouf et al, 2016; and Eidson et al, 2016 studies had the largest study samples and highest response rates, ranging from 50-70%; while the other studies were more limited in their study samples, having low response rates of <40% (n=2) or failing to report a response rate (n=3). If a responder bias influenced the low response rates, whereby the most informed and

engaged LHDs were more likely to respond to the survey, then the findings related to the share of local health authorities that had adaptation plans or measures in place could be an overestimate of actual practice.

All but one of the case studies were written by the officials engaged in the planning process, which presents an investigator bias that may have over-estimated the effectiveness of the planning method presented. The remaining case study included informant interviews of just two key informants from a non-profit organization serving the Red Hook community, which presents a strong selection bias in terms of the study findings. Finally, one limitation of the Roser-Renouf et al, 2016 study was that although it was designed as a follow-up to the Maibach et al, 2008 study, the collection methods changed- from 45 minute phone interviews (Maibach et al study) to a 10 minute web-based survey instrument- rendering a strict comparison of results impossible.

The limitations of this literature review include the strict parameters set for number of databases (5), date of publication (2000 to the present), and the existence of the search terms in the title, abstract, or keywords of searched articles. It is possible that these parameters excluded some articles that would have met the inclusion criteria. Another important challenge faced by this literature review is that it is common for climate change adaptation planning activities to be integrated into other sectoral work (e.g. agriculture, water, land use), and not labelled explicitly as ‘adaptation planning for health’, making it difficult to identify for the literature review.⁶⁷

Nevertheless, this literature review identified a number of surveys that sampled an extensive number of state and local health authorities, and numerous case studies and state planning documents that focused on a range of health issues, from hurricanes and heat to permafrost thaw. Findings across the studies were largely consistent in pointing out the key

challenges and needs that state, local, and tribal health authorities face and key mediating factors that could be leveraged in the absence of new funding. This review underscored the importance of CDC's role to expand the cadre of local health leaders that have expertise and capability in climate change adaptation planning for health. It also identified the need for more research on state and local adaptation efforts, more documented examples of what has worked and why, methods to project risk, and how key mediating factors such as community engagement, mainstreaming, and addressing vulnerable populations can be conducted.

This dissertation attempts to address these needs, by reviewing the experience of states with BRACE planning to date, probing the needs and opportunities to expand adaptation planning among non-grantee state and local health departments and providing a plan for change that guides how local climate and health adaptation efforts can be expanded, such as under the CDC CHP program. This is also important given that the CDC CHP has stated intentions to expand their programming to new jurisdictions, in particular local health departments, but has not yet systematically documented how the first phase model could be modified or downscaled for use by these jurisdictions.

CHAPTER 3: METHODS

Dissertation aims and research questions

The goal of this study is to help expand and improve climate and health adaptation planning at the state and local level in the United States, to protect the health and well-being of Americans from the harmful effects of a changing climate. The aims of the study are to: 1) assess the experiences of state and local health authorities in the U.S. to date in climate and health adaptation planning; 2) consult stakeholders on how the BRACE model could be adapted for effective use by state and local health departments; and 3) provide a plan for change for CDC to expand adaptation planning among new jurisdictions, in particular local health departments.

The key research question for this study is: **What is needed to expand climate and health adaptation planning among U.S. state and local health departments, and what are the implications for CDC's BRACE model and strategy?** Sub-questions are listed below by research aim.

Aim 1: Assess the experiences of state and local health departments in the U.S. to date in climate and health adaptation planning

- What has been learned from examples documented in the literature of state, local and tribal health authorities in climate and health adaptation planning for health in the U.S. that could inform the CDC approach?
- What can be learned from the experience of the 16 U.S. states and 2 cities that implemented the CDC BRACE model as grantees of CDC's CRSCI, which can inform the CDC approach with non-grantee state and local health departments?

Aim 2: Consulting stakeholders on an adapted CDC BRACE model

- What changes do key health officials representing non-grantee state and local health departments perceive as necessary for the CDC BRACE model to be effectively implemented in their jurisdictions?
- What resources (human, material, and financial) are presently available in these jurisdictions for climate and health adaptation planning and what external inputs would be required to implement an adapted BRACE model?

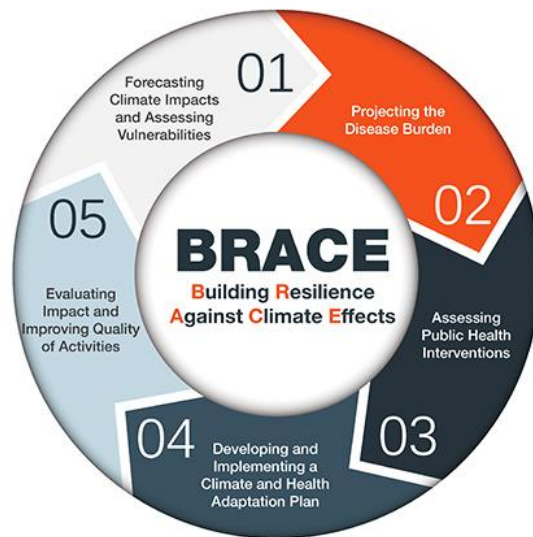
Aim 3: Providing a plan for change

- What adaptations should CDC make to the BRACE model to make it effective for new jurisdictions, in particular local health departments?
- What would an adapted BRACE model look like?
- What other external inputs can CDC provide to equip non-grantee state and local health departments to implement this adapted model?

This study aims to inform the CDC strategy to enhance climate and health adaptation planning among new jurisdictions, in particular local health departments. Additionally, given the dearth of evidence in this field, this dissertation makes an important contribution to the domestic and global literature on subnational climate and health adaptation strategies. This research also provides insights to public health professionals domestically and globally on how they might improve their own climate and health adaptation planning at the subnational level, especially in resource-constrained settings.

Conceptual framework

The first key conceptual framework utilized in this study is the Building Resilience Against Climate-related Health Effects (BRACE) model. The BRACE conceptual model was designed by the CDC CHP, and serves as the foundation for CDC’s CHP initiatives. The model follows an “adaptive management” approach, which has been called for in the literature and has Figure 2. Building Resilience Against Climate-related Health Effects (BRACE) Framework



Source: Marinucci GD, Lubert G, Uejio CK, Saha S. *Building Resilience Against Climate Effects — A Novel Framework to Facilitate Climate Readiness in Public Health Agencies*. Int. J. Environ. Res. Public Health. Vol 11. Pages 6433-6458.2014.

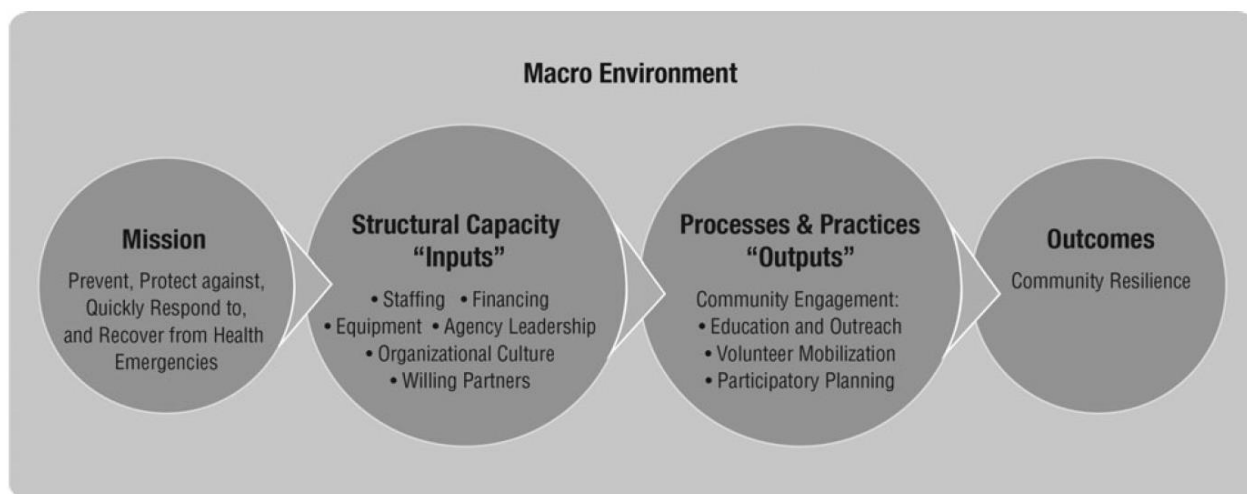
been shown effective in other sectors.^{25,68,69} Adaptive management in health can be defined as a structured decision-making approach for planning or managing health programs in a context of uncertainty, which considers a range of different scenarios and outcomes when designing plans, interventions, or approaches to protect human health.⁶⁸

As aforementioned, the model is comprised of five sequential stages recommended for health departments to follow: 1) Forecasting Climate Impacts and Assessing Vulnerabilities; 2) Projecting the Disease Burden; 3) Assessing Public Health Interventions; 4) Developing and

Implementing a Climate and Health Adaptation Plan; and 5) Evaluating Impact and Improving Quality of Interventions.²⁵

The second key conceptual framework that will be used in this study comes from a model adapted by Schoch-Spana in a 2013 study of local health department capacity for community engagement in the context of disaster preparedness. It was adapted from a framework for evaluating health systems performance developed by Handler, et al, 2001. This framework is hereafter referred to as the “Adapted Handler, et al framework”.

Figure 3. Community Health Engagement in the Context of Public Health Emergency Preparedness (PHEP) System Performance (adapted from Hander et al, 2001)



Source: Schoch-Spana M, Sell TK, Morhard R. *Local health department capacity for community engagement and its implications for disaster resilience*. *Biosecurity and Bioterrorism*. 2013;11(2):118-129.

Schoch-Spana considered the key elements of local health department capacity for emergency response to comprise: the *Macro-level environment*, which includes the social, cultural, economic, and political forces that directly or indirectly influence the functioning of the public health system, the *Mission*, which includes the goals of the public health system and how they are operationalized; *Structural Capacity* (“Inputs”), which includes the human, informational, organizational, physical, human, and financial resources that undergird public

health practice; *Processes and Practices* (“*Outputs*”), which are activities that identify and prioritize population health issues as well as design, execute, and evaluate interventions to address them; and *Outcomes*, which are short- and long-term changes in population health.⁵²

This study will utilize this conceptual model to explore and present the key operational requirements (“inputs”) and processes and practices (“outputs”) of state, local and tribal health authority planning for climate change. Due to the early stage of grantee implementation of their adaptation plans (starting in 2016), outcomes will not be measured as part of this study.

Definition of terms

“Climate change” can be defined as the changes in climate that occur over decades to millions of years, while “climate variability” comprises shorter-term variations from the typical or average climate, that takes place over one season to several decades.⁶⁰ Authors in Conlon et al, 2016 explain that inter-annual and inter-decadal variations in climate can occur, where relatively warm or dry periods are followed by especially cool or wet periods. Climate change and variability affect different geographic areas in different ways and intensity; for example, the northern interior of the U.S. experiences greater climate variability than the southern and coastal regions, while the western region of the U.S. experiences greater variability in precipitation (alternating drought with heavy rainfall or floods).⁶⁰ Interventions to protect human health will therefore address climate variability in the short and medium terms, which is affected by the longer term climate change. For this reason, this study on health adaptation planning does not use the term “climate change” as a risk factor, but rather “climate” or “climate variability”.

“Climate and health adaptation” is a term that has been commonly used in the environmental sciences to describe measures to reduce the harms of climate change on any human or natural system.¹⁷ For this study, “climate and health adaptation” can be defined as any short or long-term strategies that aim to capitalize on any benefits, or reduce any harms, to

human health caused by climate-related effects, in response to present or future changes in climate.^{25,43} Public health adaptation can take the form of: *primary prevention* – preventing human exposure to climate-related effects; *secondary prevention* – reducing vulnerabilities of people who are exposed to climate-related effects; and *tertiary prevention* – treating health conditions caused by climate-related effects to reduce morbidity or mortality.⁶² Categories of adaptation interventions include: legislative policies, decision-support tools, technology development, surveillance and monitoring of health data, infrastructure development and other activities.⁶²

“Adaptation planning” has been described in the literature as a process of using information about present and future climate variability and change, as well as human vulnerabilities and exposures to this change, to assess and prioritize current and planned practices, policies, and infrastructure, to design new policies and programs as needed, and to make recommendations about who should be involved and what resources should be used.¹⁷ For the purpose of this study, adaptation planning should be considered the process by which state, local, and tribal health authorities engage stakeholders to forecast climate variability and its related health effects, design and select adaptation interventions to prevent or mediate these effects, adapt to residual risks, and prepare for the implementation and evaluation of those interventions.

“Resilience” is another term borrowed from the ecological and climate change literature, which has been adopted in public health to comprise the ability of a community to “effectively anticipate, prepare for, respond to, and recover from climate change and other risks”.^{62,65,70} A key component of resilience is the “adaptive capacity” of communities or health jurisdictions, which can be described in short as the resources for adaptation and the ability to use them

Figure 4. Summary of Study Design Phases

Summary of Study Design Phases
<ul style="list-style-type: none">● Phase 1: Literature review of state and local climate and health adaptation planning● Phase 2: Secondary data analysis of 11 CDC CRSCI grantee interviews● Phase 3: Focus group discussions with CRSCI grantees and non-grantee local health officials

effectively, efficiently, and in a timely manner. These resources can be material (finances, staff, people, infrastructure) or non-material resources (such as social capital or cohesion, institutional decision-making, or knowledge and information management).⁶⁹ New initiatives, such as the *100 Resilient Cities Initiative* by the Rockefeller Foundation aim to explicitly strengthen the resilience and adaptive capacity of communities to mediate climate-related health and non-health effects.⁷¹

Methods

Study design

This study comprised a sequential, mixed-methods approach, including literature review, secondary analysis of interview transcripts, and focus group discussions. The study was conducted in three phases, summarized below. The study received official IRB approval by the University of North Carolina – Chapel Hill (study number 16-2858) in August, 2018.

Phase 1: Literature review of state and local climate and health adaptation planning

The first phase took place in fall, 2017, and included a literature review that answered the question: *What are the lessons learned from state, local, and/or tribal government climate and health adaptation or resilience planning for health in the U.S., which could be applied to the CDC CHP with non-grantee state and local health departments?* The literature review identified:

- Challenges to climate and health adaptation planning, identified by local health department respondents
- Mediating factors to climate and health adaptation planning, identified by local health department respondents
- Operational needs for climate and health adaptation planning, identified by local health department respondents
- Case studies of climate and health adaptation planning, with novel tools and lessons learned identified by study authors

The literature review comprised a systematic search of electronic databases of peer-reviewed literature, as well as a hand-search of grey literature on the Georgetown Institute Climate Center Adaptation Clearinghouse, an important database of adaptation planning materials in the U.S. Findings from the literature review inform subsequent study design phases 2 and 3, as well as the Discussion and Plan for Change chapters of this dissertation.

Phase 2: Secondary data analysis of CRSCI grantee interviews

This phase included secondary data analysis of in-person and phone interviews conducted by the CDC CHP with state and city health department leads of the CDC CRSCI. Fifteen of these interviews were conducted between March and August of 2016, however the number of completed transcripts of these interviews provided to the P.I. for analysis in this study totaled 11 due to staffing constraints. The interview subjects- the CRSCI leads- represent the responsible parties to the cooperative agreement between their jurisdiction and the CDC under the CRSCI. The interviews frequently included the team of health officials working on the CRSCI grant in that jurisdiction, and the number of participants in the interviews was not quantified.

The interviews aimed to understand the grantee experience with implementing the BRACE framework during the cooperative agreement period. In particular, the interviews probed how BRACE helped the grantees prepare for climate change health effects, their progress under the funded agreement, any challenges faced, and the quality of CDC technical assistance during the funding period. The interview protocol is included in Appendix 4.

These interviews were recorded on audio files, and transcribed by CDC CHP staff. The content had not been previously analyzed by CDC. The P.I. produced qualitative content analysis (described in the data analysis section below) of the interview transcripts, looking for trends and commonalities in the experiences of grantees in the implementation of BRACE, any challenges they faced, and their recommendations to the CDC BRACE model or technical assistance.

Findings from this second phase informed the questions utilized in the focus group discussions in Phase 3. In particular, the availability of operational inputs or practices that were deemed critical for BRACE implementation by CRSCI grantees in Phase 2 was probed among local health department participants in focus group discussions in Phase 3. Additionally, feedback was requested from Phase 3 focus group discussion participants on select recommendations for the improvement of BRACE made by CRSCI grantees in Phase 2.

Phase 3: Focus group discussions with state and local health departments

The third phase comprised focus group discussions with official government health officials from state and local health departments across the U.S. These focus group discussions were organized by jurisdictional level (state, city, or county) and by whether the jurisdictions had received CDC CRSCI funding (“CRSCI Grantees”) or did not receive funding (“Non-grantee Local Health Officials”). Eligibility criteria for focus groups was employment at a state, city, or county health department.

Recruitment for focus groups took place between September, 2017 and March, 2018. Efforts comprised in-person networking at two annual conferences (The American Public Health Association (APHA), Atlanta, GA, November, 2017 and Association of State and Territorial Health Officials (ASTHO), Washington, DC, September, 2017) and email outreach and presentations to key public health networks, including: the climate change subcommittee, and the Affiliate list-serve, of the APHA; the environmental health committee of ASTHO, the climate change and emergency preparedness sub-committees of the National Association of County and City Health Officials (NACCHO), the Global Compact of Mayors, and the U.S. Conference of Mayors. Additionally, the P.I. posted two advertisements on the U.S. Climate and Health Alliance list-serve, and reached out to individual health officials that were identified by snowball sampling.

Tribal nations were targeted for participation in this study, and were originally included in the study title and research aims. Special recruitment efforts were made to compose 1-2 focus groups with tribal health authorities. The P.I. sent emails and in some cases conducted phone calls and presentations to the National Indian Health Board, the Pacific Northwest Tribal Climate Change Network, the Institute of Tribal Environmental Professionals (including an advertisement in their newsletter), the APHA Tribal Public and Environment Think Tank, the Alaska Native Tribal Health Consortium, the Northwest Portland Area Indian Health Board, and the Oregon Climate Change Research Institute. Additionally, the P.I. made direct phone and email contact to three tribal nations that presently receive CDC climate and health funding through the National Indian Health Board, and submitted an IRB application to one of those tribes. Unfortunately, only two tribes volunteered, and one tribe could only make an external evaluator available for the focus group. This person was not a tribal health authority and was not

involved in BRACE implementation, and therefore was not eligible. With only one eligible tribe participating, a focus group was not possible. As a result, the P.I. does not provide any guidance in this study to CDC on changes to the BRACE model to assist its use among tribal nations.

The objective of the focus groups was to solicit input on a number of factors relevant to expanding climate and health adaptation planning to new jurisdictions:

- key stakeholders and capacity needs
- how climate change adaptation planning for health could be integrated with local planning activities in health and non-health sectors
- what partnerships would be instrumental to the process (including communities);
- what local funding opportunities may exist to support climate and health adaptation
- what inputs would be needed in order to implement the BRACE model
- If CDC should recommend a sequential or non-sequential process for jurisdictions to complete BRACE stages

Data collection and management

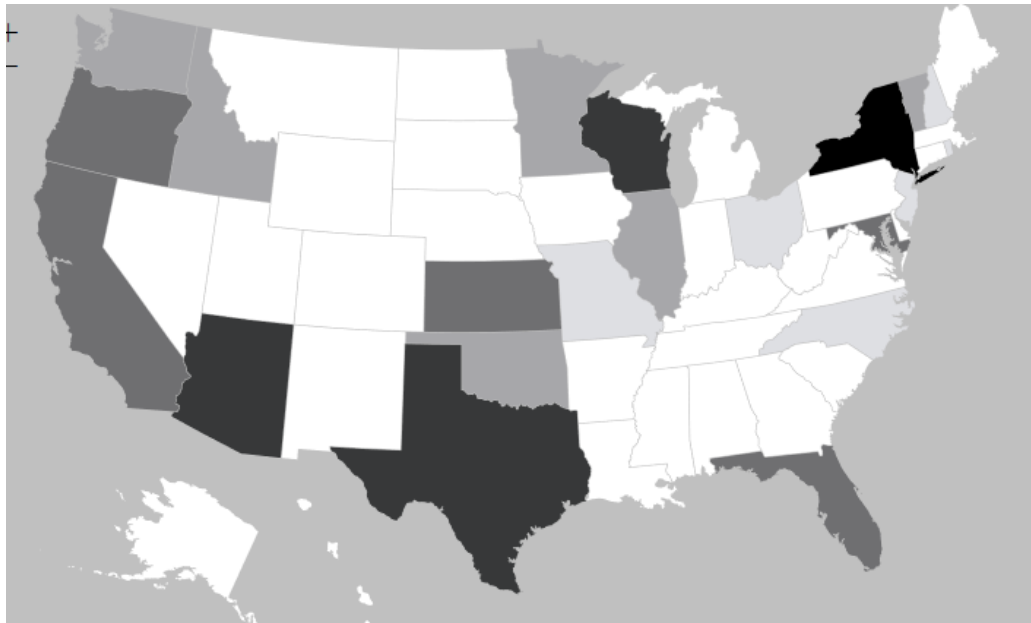
The CDC CHP team uploaded 11 interview transcripts to a password protected Dropbox for the P.I. to access for analysis. The P.I. downloaded these transcripts and stored in a file on her password-protected computer. She uploaded the files in to the NVIVO qualitative analysis software for thematic analysis.

Focus group discussions were 90 minutes long and facilitated by the P.I. over the Zoom videoconferencing platform. Focus group discussion guides were developed specific to each focus group and circulated two days in advance of the discussion. An illustrative focus group discussion guide is in Appendix 5. Video-recordings were encrypted and saved in the P.I.'s Zoom web-based account. A transcribing consultant transcribed all focus group discussions, de-identified the participants (using the terms "participant 1" or "participant 2", and emailed the de-

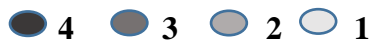
identified transcripts to the P.I. for analysis. The P.I. stored these and all study documents on her password protected computer and produced thematic analysis of the focus group discussions using NVIVO software. Written informed consent forms were obtained for every focus group participant via email, and consent information was provided verbally at the beginning of every focus group discussion. The focus group consent form is available in Appendix 6.

A map illustrating the 22 states represented by all participants in this study is depicted in Figure 5. Nine states and two cities were represented through an unidentified number of health officials who participated in the CRSCI interviews. For the focus group discussions, a total of sixty eligible state, city, county, and tribal health officials volunteered to participate, of which 12 were lost to attrition, and two were excluded, resulting in 46 participants in the study. Twelve focus groups we conducted. One focus group with non-grantee state health officials was excluded from analysis, because only one eligible state health official participated. The focus group planned for tribal nations was not conducted, due to only one volunteer. Respondent information is further summarized in the results chapters of this study.

Figure 5. Map of Total Study Participants, by State



Legend (number of study participants):



Analysis

The principal investigator used a three phase methodology recommended by Forman and Damschroeder to produce content analysis of the study data.⁷² First, in the ‘immersion’ phase, the P.I. produced a ‘memo’ after each focus group discussion, and after reviewing each key informant interview transcript, to capture key themes, observations, and follow-up questions. In the ‘reduction phase’, the P.I. entered all transcripts in to NVIVO software, and developed three code-books to guide analysis, one for the CRSCI interviews, and one for each of two categories of focus group discussions (CRSCI grantees and non-grantees). These codebooks included the name of the code, an abbreviated label, a standard definition, use examples, and the hierarchical position of the code. The three codebooks are included in Appendices 6-8.

Before finalization of the codebooks, the P.I. validated the coding hierarchy and strategy with external reviewers:

- For CRSCI interview transcripts, a CDC evaluator and the P.I. reviewed three CRSCI transcripts and independently produced and shared coding hierarchies. The P.I. then reconciled the coding hierarchy in to one consolidated code-book, which she applied and enhanced with in-vivo codes.
- For the focus group discussions, the P.I. worked with a doctoral researcher from Health Canada (for CRSCI grantees) and the CDC evaluator (for non-grantees) to conduct the following validation procedure: Each researcher reviewed two focus group discussion transcripts, independently produced coding hierarchies, and then met in person to reconcile those hierarchies and produce a consolidated code-book with standard definitions and use cases. Each research pair then coded a third focus group discussion transcript with the consolidated codebook, and discussed approaches to refine definitions and approaches.

The P.I. then used the finalized code-books to thematically code the transcripts and memos. The P.I. produced additional memos throughout the analytical process, to capture key observations and emerging trends. For the interview transcripts, a priori codes were drawn from two sources: the conceptual framework for the study (the adapted Handler, et al framework) and the literature review, and in-vivo codes were developed inductively through the course of transcript analysis. The adapted Handler, et al framework was used to characterize the implementation of the BRACE model across CRSCI grantees, and challenges and enablers to this implementation were also identified.

Additionally, the P.I. developed a “BRACE Model Completion Table”, to illustrate the completion of the five stages of the BRACE model by each CRSCI grantee interviewed. The P.I. assigned a qualitative score to measure completion: The stages for each grantee are

classified as “completed” (green), “partially completed” (yellow), “not completed” (red), and “unclear if complete or incomplete” (grey). Completion of a stage was “unclear” in some cases due to the fact that the interviewers did not consistently probe each grantee to describe each stage.

A “BRACE Stage Completion Index” was included in the table, to quantify the aggregate completion of the entire BRACE model among each grantee. The following point assignment was used: “completed” = 3 points, “partially completed”= 2 points, and “not completed”= 0 points. The aggregate score was then divided by the total BRACE stages. If a stage was marked “unclear if complete or incomplete”, this stage was removed from the denominator of the index for that grantee. The purpose of this index was to help identify the grantees that most thoroughly completed the BRACE stages, to enable analysis of the impact of key inputs and political factors that influenced BRACE stage completion.

Likewise for the focus group interviews, a priori codes included structural codes based on the research question and interests of the CDC (for example, whether the BRACE model should be linear or non-linear) as well as on the key inputs and practices identified in the first study phase analysis of interview transcripts. In-vivo codes were also applied inductively to the focus group analysis. Generally, the P.I. applied parent codes first, and then, opening up the coded content at that parent code within NVIVO, identified and applied sub-codes. When new codes were identified in-vivo, the P.I. returned and coded previous transcripts where that code had not been used, so that the coding was systematic. The P.I. updated the codebooks to reflect all final parent and sub-codes and their hierarchies. Lastly, in the “interpretation phase”, the P.I. applied interpretation and analysis to the coded data, to identify study findings and recommendations.

Findings are presented in the next two chapters on results. Chapter 4 summarizes findings from the CRSCI interviews in the following sequence:

- Characterizing BRACE Implementation with the Adapted Handler, et al framework:
The P.I. applied the adaptation of the Handler, et al Framework for Public Health Systems Performance (by Schoch-Spana, et al, 2012) to characterize the implementation of BRACE by 11 of the 18 CRSCI grantees.
- Documenting Challenges and Enablers to BRACE Implementation: The P.I. used the five stage BRACE conceptual model for climate and health adaptation planning to illuminate the key barriers and enablers to BRACE implementation, including CDC technical assistance.

Findings for focus group discussions are presented in Chapter 5. They are organized in the following format:

- CRSCI Grantee Focus Groups: The P.I. summarizes the key ideas generated by CRSCI grantees for how to adapt and enhance the BRACE model for new jurisdictions, in particular, local health departments.
- Non-Grantee Local Health Officials Focus Groups: The P.I. characterizes the operational resources and needs for climate and health adaptation planning among local health officials-particularly those deemed critical by CRSCI grantees in the study's first phase- and health officials identify action steps CDC can take to support climate and health adaptation in their jurisdiction.

CHAPTER 4: RESULTS OF CRSCI INTERVIEWS

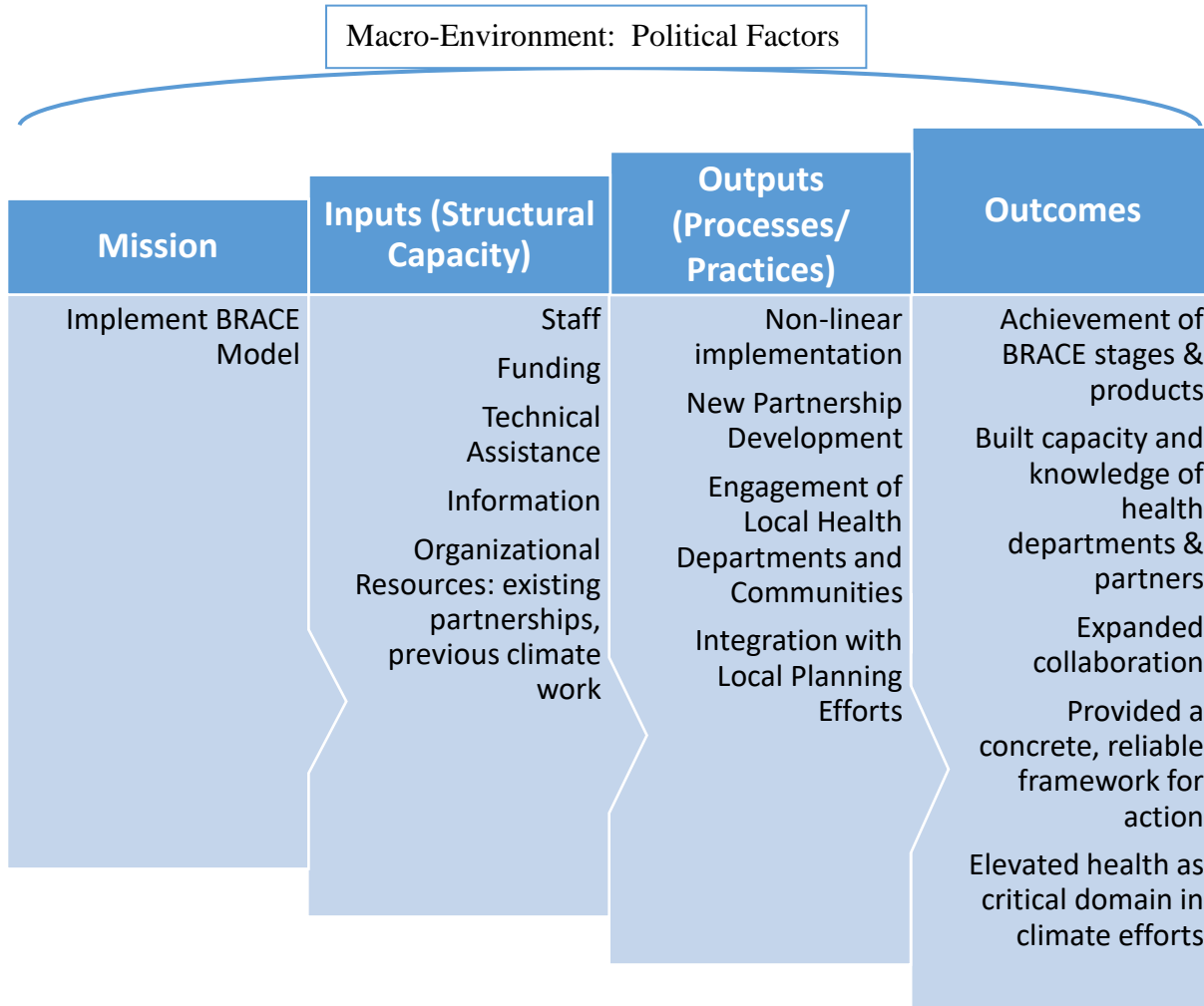
Interviews with 11 state or city CRSCI grantee health department staff were included in the study, representing the following jurisdictions: Arizona, California, Florida, Michigan, Minnesota, New York City, New York State, Oregon, Rhode Island, San Francisco, and Wisconsin. The number of interview participants in each interview was not quantified by CDC and is not available for documentation. Results of the secondary analysis of CRSCI grantee interviews are presented in two parts. The first characterizes BRACE implementation by CRSCI grantees using the adapted Handler, et al framework to identify common operational inputs, processes and practices, and outcomes of this subnational climate and health adaptation planning effort. The second identifies key challenges and enablers experienced by CRSCI grantees in their BRACE implementation.

Some recommendations for improvements to the BRACE model were also identified from these interviews, but because this question was probed more fully in the focus group discussions, the recommendations from these interviews are included in Appendix 10.

Characterizing BRACE implementation with the adapted handler, et al framework

The application of the adapted Handler et al, framework allowed for the systematic identification of key operational inputs, processes and practices, and outcomes of the CRSCI climate and health adaptation effort among CRSCI state and city grantees. The results of this analysis are illustrated in Figure 6 on the next page. Each domain in this figure is summarized in the subsequent narrative.

Figure 6. CRSCI Grantee Health Systems Performance in BRACE Implementation, adapted from Schoch-Spana et al, 2013



Macro-environment

The dimension of the macro-environment probed directly in the CRSCI interviews was the political environment for BRACE implementation. The majority of CRSCI grantees (n=7) reported a favorable political context, however all grantees noted political factors as influencing their work and nearly all mentioned taking special steps to secure political support from the public or policy-makers.

Favorable political environments were described as comprising general ideological support for climate-change among state government officials or strong leadership in the health department, to more specific political instruments, such as: a Governor mandate around extreme weather, a Governor executive order requiring climate to be considered in all state programs, state legislation to produce climate mitigation and or adaptation plans, and state-level working groups related to climate.

Several state-level CRSCI grantees reported that political factors are dynamic; three noted that the political factors that governed early implementation of the BRACE model changed at mid-point, either making it easier (n=2) or harder (n=1) to implement. The trend noted in five states appears to be toward greater prioritization of climate change, including in climate resilience, mitigation and/or adaptation efforts that extend beyond health.

Really in just the past 2 years there's just been an explosion of discussion around climate change and resilience. So our center for emergency preparedness and response is taking this new approach- really thinking about resilience and not just response. There has been a huge expansion in attention being given to this issue across all of our state agencies.

Four state-level CRSCI grantees reported unfavorable political environments that limited their BRACE implementation. One grantee reported that opposition toward climate-related work forced them to operate “below the radar”, not seek external or visible partnerships, and, in their words “hide behind the science” and focus more on the scientific products, and “less on adaptation”. This grantee ultimately moved the BRACE program outside of the health department and to a local university due to political opposition (correspondence with CDC CHP). Another state-level CRSCI grantee that once had a favorable political context, with state-supported climate working groups and a funded position to coordinate climate activities, faced the elimination of that position and a weakening of momentum. Another grantee reported that political opposition to climate-related work delayed the publication of the climate and health

adaptation plan to such an extent that the health team removed any policy-related statements from the document to aid in its approval, and ultimately had it published through a local university.

Despite their political environment, the majority of grantees reported taking specific steps to “educate” the public and stakeholders to reduce any opposition, such as through “climate 101” trainings or as introductory presentations to stakeholder meetings. Grantees commonly reported avoiding the word “climate” in selective settings, using “extreme weather” or opting only to use historic weather trends instead of future climate trends to avoid discussion of climate change. One grantee engaged potential opponents early in the process to help reduce their opposition, while another grantee opted to work locally to circumvent opposition by the state government.

The adaptation plan as we wrote it is more of an internal strategic plan because at the state level we no longer have a climate action plan and we really can't work at a state level from department to department in official capacity So we've really focused our efforts on the local level.

Mission

The specific missions of each CRSCI grantee in implementation of BRACE were not probed in the interviews. However, the overall mission of the CRSCI (and the explicit objective of CDC’s Request for Funding Assistance EH13-1305, entitled “Building Resilience Against Climate-Related Health Effects”) is to help grantees to “anticipate climate-related health effects by applying climate science, predicting health impacts, and preparing flexible programs”, through the implementation of the five-stage BRACE framework.

Inputs (structural capacity)

Key operational inputs to BRACE implementation among CRSCI grantees were funding, staff, information, organizational resources (existing partnerships and previous climate and health activities among the grantees), and CDC CHP technical assistance.

Inputs: Funding

All grantees reported that BRACE funding was a necessary input to their BRACE-related work. According to the CDC, funding was provided on an annual basis to each CRSCI grantee for 4-6 years, ranging from \$175,000-\$250,000 yearly. Several CRSCI grantees reported that their health department is “underfunded” and that BRACE could not be meaningfully implemented without dedicated funding. Moreover, CRSCI grantees emphasized that CRSCI funding was insufficient to operate the full program as outlined in the five step BRACE model.

Notably, six grantees reported receiving funding outside of BRACE that served as a key input to their BRACE-related implementation. Funding opportunities were not consistent across grantees or sources. National funding sources included CDC, NASA, and HUD, and ASTHO, while state- level funding was available to four grantees related to climate mitigation efforts or creating an office on climate change. Three grantees received private foundation support (including the Haas and Rockefeller Foundations) to establish a resilience office at the city level or to fund community planning among non-profits with whom the grantees partnered. Grantees used this funding as a key input to their BRACE related work, as illustrated in the examples below:

A new project we have been funded for is by NASA. We wrote this grant along with two other jurisdictions, who are also EPHD and BRACE grantees. We are building this as a project that we can use to inform our EPHD and improve on what we do for BRACE.

We received funding from <a local foundation> recently to focus on extreme heat. We are taking their products and going to go out and do massive community education. We are going to look for other organizations particularly non-profits to help get the word out for climate change issues that we are dealing with here

However, even where external funding was noted, as one grantee noted, CRSCI funding played an important role in organizing climate and health adaptation planning work:

We wouldn't be doing this without BRACE. With this other funding we could have done bits and pieces but BRACE puts the big picture together. It gives us the ability to pull in all of these different sorts of things that different parts of the state are doing and guide us in an overall path forward. So it has been absolutely essential.

Inputs: Staff

All grantees expressed reliance on existing, internal staff in the state or city health department to conduct BRACE activities, most of whom had just a portion of their time paid for by the BRACE grant. Of the handful of grantees that reported specific portions of staff time funded, all stated less than 2 full-time equivalents were funded. Students and interns were repeatedly mentioned as a critical asset to achieving BRACE activities; through doctoral or master's studies, or through the AmeriCorp, CDC Public Health Associate, or ASTHO Fellowship programs, students have conducted epidemiology, climate modelling, vulnerability assessments, program planning, communications, and publications directly supporting BRACE implementation across CRSCI grantee jurisdictions. Additionally, CRSCI grantees relied on newly hired consultants or contractors, or "borrowed" time volunteered by other state or city government departmental staff or academics in their area. Contractors were funded by the BRACE grant through academic partnerships with the state or city health department. In select cases, CRSCI grantees funded non-profit organizations or private consulting firms to implement the technical aspects of the BRACE model, such as GIS mapping, climate modelling, and burden of disease projections.

Inputs: Organizational resources

Two types of organizational resources of CRSCI grantees served as important inputs to BRACE implementation: 1) existing climate-related partnerships and 2) previous work in climate and health adaptation.

- *Existing Partnerships:* Ten of 11 grantees reported previous existing partnerships that contributed to their BRACE implementation. Four grantees reported the existence of interagency climate action teams, or climate change related commissions or councils, which together represented state-mandated task groups that convened a cross-section of state agencies and academic and non-profit partners to share information, coordinate programs, conduct adaptation or resilience planning, and develop research and other technical products. One such product is described below.

‘Clim-Aid’ is produced by our state <energy department> with help from <two academic centers> and <a large metropolitan area> and that provides us with useful (adaptation) strategies. Our climate action council also released an interim report in 2010 which includes 40 adaptations recommendations for 8 sectors which includes public health and these recommendations have helped us to guide us to establish our vulnerability assessments and developing appropriate adaptations.

Grantees also noted other government-led, multi-sectoral partnerships developed before CRSCI served as a foundation for BRACE implementation, including on heat, resilience, the environment, and sea-level rise. Internal working groups and advisory boards set up for these causes provided a platform for advancing CRSCI activities. For example, one grantee highlighted that an existing working group between the state farm bureau and the office of occupational health to look at occupational exposures to heat was a platform for their work under CRSCI on heat-related illness.

Several CRSCI grantees also benefited from partnerships led by non-governmental organizations. Three grantees participated in multi-sectoral partnerships organized out of local academic centers; two were funded by the NOAA RISA program as regional academic centers, and one was a private foundation sponsored academic center dedicated to advancing science and multi-sectoral partnerships focused on climate. In one jurisdiction, a non-profit environmental organization formed a “climate action

collaborative” between state agencies, community organizations, city leadership, and public and environmental health organizations to help a major metropolitan area in that jurisdiction to understand climate hazards to health and to develop an adaptation plan.

- *Previous work in climate and health adaptation:* Five grantees identified examples of previous climate and health related work that served as a resource for BRACE implementation. The vast majority of this work was heat-related, including heat-related illness toolkits, heat-related surveys, heat vulnerability assessments, and city-wide resilience plans to heat. The other most common work products referenced were health impact assessments, reported by four grantees as contributing in a meaningful way to their BRACE related work, as they laid a foundation of capacity and information in climate and health adaptation. Three of these grantees conducted the HIAs as part of CDC funding that pre-dated CRSCI.

Inputs: CDC CHP technical assistance

Most CRSCI grantees reported CDC technical assistance as a key input to their BRACE implementation. CRSCI grantees reported making use of: written technical guidance on stages 1, 2, 3, and 4, monthly calls with the CRSCI project officer, a technical mailbox for ad-hoc requests, a CDC-maintained web portal, “communities of practice”, (sub-groups of grantees organized by CDC around specific methodological or topical issues, such as the stage 3 literature review or evaluation), grantee meetings, and CDC webinars.

The communities of practice were considered the “the most effective component” of CDC assistance, as they fostered peer-to-peer collaboration and problem-solving. They were also critical for dividing and sharing the work of stage 3, without which most CRSCI grantees reported they could not have completed that stage. The evaluation community of practice was also especially helpful to grantees. City-level CRSCI grantees did not find the communities of

practice as helpful, due to the differences they encountered in the BRACE implementation with their state-level peers. Grantee meetings, and the sharing of PowerPoint presentations that summarized grantee experiences, were also reported as especially useful, because they allowed grantees to learn from one another's experience.

Inputs: Information

Information was a foundational operational input to CRSCI grantee implementation of BRACE, in particular for stages 1-3. The information identified and utilized by CRSCI grantees was extremely diverse in type as well as in the sources of data, and is categorized below.

- *Climate hazard data and projections:* Historical trends and future projections of temperature, precipitation, air quality, and occurrence of drought, floods, and extreme weather were commonly reported. Common sources of climate hazard data included the State Climatologist,² community monitoring stations, NOAA RISA program regional academic centers or other academic partners, the National Weather Service, the National Climate and Health Assessment, other state departments (such as emergency preparedness) and other state or city climate initiatives (e.g. cross-sectoral climate committees, such as on sea-level rise).
- *Health impact data:* Trends in health facility usage (e.g. emergency room visits), heat-related illnesses, emergence of notifiable disease, and injuries due to extreme weather were commonly reported. Select cases of using qualitative assessments of community perception of health risk, and economic costs of health impacts were also noted. Common sources included hospital records, environment health tracking databases, state health department notifiable conditions records, hospital associations, community or non-profit

² There are approximately 38 state climate offices recognized by the American Association of State Climatologists on their website, <https://www.stateclimate.org/>.

organizations, and in select cases, syndromic surveillance systems and the public health literature

- *Vulnerable populations data:* Data on populations at risk for climate-related health impacts included down-scaled climate model projections and socio-demographic data by county or vulnerable population category. Common sources of vulnerable population information were local health departments, vulnerability assessments conducted by other state agencies, the U.S. census, Council of State and Territorial Epidemiologists climate and health indicators, and community organizations.
- *Public health program data:* Data on public health programs included identification of existing programming by state and non-governmental organizations, assessments of the quality of local public health programs, and identification of evidence-based public health interventions. Common sources of public health program data included mapping of public health programs (such as location of cooling centers), surveys of cultural appropriateness, availability of services, and quality of disaster response efforts- such as in the case of Hurricane Harvey, and reviews of the public health literature.

One explanation for the diversity in data and data sources is that each grantee identified data that were: a) relevant to priority climate and health topics in their jurisdiction (which varied significantly across grantees), as well as b) available through existing data sets or through partnerships with academic or federal entities located in their jurisdictions. The volume of data available to grantees was variable; the three grantees with long-standing climate-related academic centers (two of which are funded by the NOAA RISA program) reported a higher volume, diversity, and sophistication of data available for BRACE activities. One novel information source that is worth noting is the CARIS database, described below:

[CARIS] is a climate adaptation resilience information system. It's a group that came together of state employees and some other agencies and non-profits to talk about data and how we shared it and how we model for climate change and what gets put out to the public. It tries to coordinate so we're not putting different models or different data out to the public. We're leveraging resources when we can so that we don't duplicate efforts.

Outputs (processes/practices)

The processes followed by grantees to implement the BRACE model were complex and highly variable between grantees. No two grantees followed the same process. Still, key commonalities were identified across CRSCI grantee practices, including non-linear BRACE implementation, partnership development, community engagement, engagement with local health departments, and integration with local planning processes.

Non-linear BRACE stage implementation

The BRACE model is linear in design, where stages 1-5 are intended to be implemented in sequence. However, only one CRSCI grantee implemented BRACE in this exact sequence. The other 11 grantees described a *non-linear process* for implementing the model, where they implemented key stages of BRACE out of sequence, or at times concurrently. Four grantees conducted their vulnerability assessments out of sequence, either before climate hazard identification and modelling or, in the case of grantee, after stage 3. Two of these grantees otherwise followed a linear process.

Another common area of non-linearity was the common approach by CRSCI grantees to implement stage 2 and later stages concurrently, or to skip Stage 2 altogether, due to the expertise and rigor required in that stage. In fact, implementing more than one stage concurrently was a general trend reported by eight grantees, commonly due to the need to have a planning instrument or to implement interventions at the same time as planning is occurring.

Two grantees explain their non-linear process as follows:

We tried to do it in order but as we indicated we are not as far along in step 2 as we would like. But we have a state wide assessment. And step 3, we started that but didn't finish it, and thought we would wait to see what the community of practice had. So even though we didn't finish 2 or 3 we wanted to have the strategic map so we jumped ahead and did that. And for step 5 because of the money for (a natural disaster) we were able to jump to step 5 and have some evaluations and interventions and all of that. So we were able to do something on all of the steps but not complete all of the steps.

I think we are doing assessments and little bit of interventions at the same time, learning more about who is impacted, what the sense of the impact is. We then had to develop interventions. Because it is information that we need, we can't just sit on it, and we have to come up with strategies that can address those questions.....I think for us it's fair to say it's not always sequential so as certain information was developed sort of as surveillance, certain parts of adaptation measures were promoted and then other climate hazards were assessed and other adaptations. We had an adaptive internal approach and we did it over time.

New partnership development

Developing new partnerships was a key practice to implement BRACE, reported by ten grantees. Commonly, grantees developed an interagency governmental advisory group that provided guidance to BRACE activities as a whole, or over select stages. These groups included a range of departments within health (e.g. injury, environmental health) and outside of health (e.g. agriculture, natural resources, and transit). Most grantees reported new or expanded partnerships with academic institutions in their jurisdictions, primarily for BRACE stages 1 and 2; two of these included partnerships with NOAA RISA academic centers. Several grantees also mentioned partnerships with the National Weather Service and NOAA (outside of the RISA program) to obtain and help analyze weather data for these two stages. CRSCI grantees commonly partnered with other grantees through the CDC communities of practice to implement stage 3, and partnered with other divisions of the health department, non-profit organizations, and other non-health sectors for planning and implementing activities in stage 4. For example, one grantee reported a new multi-sectoral partnership they formed to address Lyme disease, which

included the government agencies for state parks, vector borne illness, and tourism. Partnerships with faith-based organizations and the private sector were noted by only one grantee.

Engagement with local health departments

Eight CRSCI grantees reported engaging local health departments in the process of BRACE implementation. Most commonly, CRSCI grantees worked to produce climate and health datasets for cities and counties in their jurisdictions (n=4), as well as maps of climate hazards and vulnerability indices by census tract or county. One grantee produced vulnerability indices for 77 counties and 11 tribes in the state, as well as a city-specific health vulnerability map and report. Three CRSCI grantees used CRSCI funds to direct fund select LHDs, for planning, partnership development, and vulnerability assessment. Other CRSCI grantees consulted or partnered with LHDs on the development of BRACE products for the state or locality, such as through: a survey of local health departments to understand current activities, resources, and needs for state assistance in climate and health, partnering with the state advisory group of local health boards to solicit input on the vulnerability assessment, an ongoing syndromic surveillance collaboration with county health departments related to heat; and production of a training and video for all local planning commissions, city managers, and staff at regional planning institutions on climate and health.

While LHD engagement was common in BRACE implementation, three CRSCI grantees explicitly noted that engagement of LHDs as part of BRACE was limited in their jurisdictions. Two grantees reported as a challenge that the BRACE model does not offer a framework or guidance for how to appropriately engage LHDs.

Community engagement

Only four grantees reported examples of direct engagement with communities or vulnerable populations as part of BRACE implementation. However, the CRSCI interviews did

not directly probe community engagement, so this may be an underestimate. Three grantees reported robust partnerships with community non-profit organizations: including two focused on climate or resilience planning at the city- or state- level, and one network of community organizations focused on responding to natural disasters. Notably, one grantee conducted a specific review of the strategic plans and activities of community organizations and non-profits that represented vulnerable populations identified in BRACE stage 1, to map existing activities and needs. Two grantees reported engaging community emergency response teams on occupational and community threats due to extreme heat, and one grantee leveraged a funded tribal liaison position to obtain feedback from tribes on the social vulnerability indices produced under BRACE. One grantee opted to send BRACE-supported health communications on extreme heat days to partners that serve people with disabilities, and piloted BRACE health materials with elderly adults to ensure their usability. Another grantee summarized their efforts below.

We're trying to engage people from United Way, Red Cross, local health departments, emergency management, neighborhood associations, and other community leaders that you know are well-respected by some of the minority populations that traditionally haven't been part of the master planning process and I think the process has been really something that we've been really excited about....we are forming 'community action teams'.

One grantee identified community engagement was one of the priority steps the state “hadn’t spent a lot of time on” but “would be important to focus on in the future.”

Integration with broader jurisdiction planning processes

Ten of the CRSCI grantees integrated BRACE-related climate and health activities into the broader planning processes of their jurisdiction or sub-jurisdictions. Five grantees reported actively integrating climate and health content they developed under CRSCI into state- or city-wide plans for climate adaptation, mitigation, and/or resilience. Grantees provided staff time,

tools, and technical input in to existing cross-agency government climate working groups or taskforces. One grantee started a public health sub-group of the state climate action team, which met regularly to write the health section of the state adaptation plan.

Several of these grantees reported also working to integrate with multiple other planning efforts at the same time, both at the state and city levels. One grantee suggested this scenario might be more common among cities, where sustainability and resiliency planning is emerging “more than at the state level”. Other planning processes reported included those on sea-level rise, urban heat, urban forest planning, and green infrastructure, however, the most common was related to natural disaster and emergency preparedness. Four grantees reported integrating BRACE activities with natural disaster and emergency preparedness planning efforts such as developing a health specific section of the city flood preparedness plan, conducting a case study with the Department of Transit on flood and storms adaptation options, and conducting a review of integration opportunities for climate and health within emergency preparedness planning at the state level.

Notably, one grantee worked actively to partner with the state Department of Homeland Security and Emergency Management to provide climate and health vulnerability maps, locations of cooling centers, and climate and health toolkits to emergency preparedness managers throughout the state on a routine basis, which these managers are reportedly actively using in their plans around heat, cold, and flooding:

We distribute (information) by e-mail; each county and each tribe has an emergency management director so (the email is sent) to 72 counties in our state and 11 tribes. And the people at emergency management, we know them all, we work with them on a regular basis. I can tell you all their names and we push information out to them routinely. When I work with them on their local mitigation plans I recommend certain resources for them to use and those are required to be updated for every 5 years, and any time there are a lot of people working on their mitigation plans, I am pushing out these

maps and toolkits, and they are say this is very useful information that is very helpful to us so that is how I have been distributing to their local public health.

This example features another common integration practice among state-level CRSCI grantees- providing technical and programmatic support for LHDs and tribes to integrate climate and health into their local planning processes. Other examples of this form of local support include:

- One grantee provided climate and health information to all the counties across the state, including talking points and suggestions for working with city and county planners
- One grantee provided technical input from their experience in BRACE to support a tribal nation's vulnerability assessment and adaptation planning
- One grantee dedicated staff time and technical input to a city-based non-profit organization to assist in changes to local ordinances related to climate adaptation
- One grantee funded a staff person at a county health department to advance climate and health issues in the county land-use planning process.

These integration efforts required special efforts to align timelines and priorities with BRACE implementation. For example, one grantee waited to produce their BRACE climate and health adaptation plan for almost a year, to ensure it aligned with the city-wide approach.

Another grantee focused on mitigation co-benefits to health, because of the state-wide interest in mitigation. Notably, all five grantees reported the need to align BRACE content with a jurisdiction focus on *health equity*. For example, grantees noted that:

We try to align our activities (with) wider city efforts, because our health administration's main focus is on equity. We know that a lot of the (climate) health impacts will impact people differently so we really try to bring that equity lens to our work, to maximize... and align those missions.
(We are) leading a state adaptation plan subgroup, called the Equity and Vulnerable Communities subgroup, which is developing guidance ... to assure and promote equity...as they take climate change in to account in their investments and...planning.

Outcomes

The CRSCI interviews did not catalogue all outcomes produced by the CRSCI cooperative agreement. However, two important outcomes of BRACE implementation could be identified from the interviews: completion of BRACE stages as intended in the model, and reported benefits of BRACE to the overall health system.

Completion of BRACE stages

The CDC did not implement a standardized evaluation measure for assessing grantee completion of the five BRACE stages. Interim evaluations of CRSCI grantee activities focused on degree of completion of stages 1 and 2, and on utility of CDC webinars and guidance materials. The CRSCI interviews with grantees at the conclusion of their CRSCI grant were the vehicle to understand grantee completion of BRACE stages.

From these interviews, grantee completion of BRACE stages was assessed using a simple scoring methodology and completion index employed by the P.I. and described in the study methods, and a summary table was compiled in Table 1. A stage was considered to be

Table 1. BRACE Stage Achieved by 11 of 18 CRSCI Grantees as of August, 2016

CRSCI Grantee	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Completion Index
Grantee #1	Green	Yellow	Green	Yellow	Yellow	2.40
Grantee #2	Green	Red	Grey	Green	Red	1.50
Grantee #3	Yellow	Green	Green	Red	Yellow	2.00
Grantee #4	Green	Green	Green	Yellow	Green	2.80
Grantee #5	Green	Yellow	Green	Yellow	Yellow	2.40
Grantee #6	Green	Green	Green	Yellow	Green	2.80
Grantee #7	Green	Grey	Green	Grey	Grey	*
Grantee #8	Green	Red	Green	Yellow	Red	1.60
Grantee #9	Green	Light Green	Red	Red	Red	1.20
Grantee #10	Green	Grey	Grey	Green	Red	2.00
Grantee #11	Green	Red	Green	Yellow	Yellow	2.00

Red= No elements in this stage completed by the time of the interview

Yellow= Some but not all elements of this stage completed by the time of the interview

Green= All elements in this stage completed, for one or more health or climate condition, by the time of the interview

Grey= Unclear from the interviews if any elements were completed during this stage

** Score not calculated because number of stages that were scored “unclear” surpassed the stages that were scored, rendering the index inaccurate*

complete based on the grantee description of activities completed that aligned with that stage.

According to the objectives of CDC’s Request for Funding Assistance EH13-1305, entitled “Building Resilience Against Climate-Related Health Effects”, the initial expectations of the CRSCI grant were that grantees would complete all five stages within the cooperative agreement period.

This qualitative scoring and index reveals first that the stages were not discrete nor sequential, and that grantees worked on several stages concurrently. This is illustrated by the number of grantees that received a score of red or yellow for a stage, while subsequent stages are green. It further displays that all grantees completed many elements of stage 1, and most completed stage 3. With respect to stage 2, two grantees started the work but abandoned the project after key personnel left their posts. Another grantee opted not to undertake this stage due to its rigor and a perception that it would not ultimately benefit their climate and health adaptation planning. The interview transcripts for two grantees did not provide sufficient information to understand if this stage was completed. All but two grantees developed some form of adaptation plan, the first part of stage 4, however for some the plan was still ‘under review’ by stakeholders. Where the plan was completed, implementation of the plan was not undertaken in the funding period. Some grantees submitted an evaluation plan with their final deliverables, and one grantee completed an evaluation of select interventions.

The BRACE performance index allowed for the P.I. to identify the four grantees with the highest completion index scores of 2.4 and above. These grantees completed the most required elements of the BRACE model as of August, 2016. Comparing these grantees with other CRSCI grantees across key inputs of staffing, funding, political environment, and linearity of BRACE implementation, the inputs that seemed to most contribute the grantee success in achieving BRACE stages were: 1) depth and breadth of partnerships, in particular with, but not exclusive to, academic institutions; and 2) previous or related work (including external funding). All four grantees had strong and diverse partnerships, and three of the four grantees explicitly noted that they built upon previous or related climate and health activities occurring in their

jurisdictions. Notably, the grantee with the lowest completion index explicitly referenced an intentional lack of partnerships due to the politically unfavorable environment.

Benefits to the health system

CRSI grantees reported four outcomes of BRACE implementation that benefited their health system:

- 1) the building of capacity and knowledge;
- 2) expanded collaboration;
- 3) provided a concrete and credible framework; and
- 4) elevated health as a critical domain of climate and health adaptation.

All grantees reported that the BRACE model built important capacity and knowledge among state or city health officials and their partners, in particular around specific climate hazards, climate and health epidemiology, climate projections, and the special challenges and needs of their jurisdictions as it relates to climate and health.

A lot of the (BRACE) prescribed activities had the ripple effect of building my capacity as a climate and health epidemiologist....it was very effective at building capacities across agencies, across universities, anywhere, anybody I needed to get information from....

We've gained a lot more information on the historical climate, and we've really advance our projections on climate hazards in our state...The work was really helpful in identifying the challenges (faced by) the general public and county health departments and possible solutions...

Multiple grantees also reported that the BRACE model expanded collaboration between the state or city climate and health staff with other government departments, external organizations, and even international stakeholders. In particular, several grantees reported that the BRACE model “activated” stakeholders that did not previously see their role in climate and health, and helped convene stakeholders around common priorities for the first time. Grantees noted: “those connections that we were able to make and being able to talk to other

grantees....I've made some amazing connections over the years that I would not have been able to without the Climate and Health program". Other grantees expressed:

A lot of our partners within the agency, I went to them to get information, or for them to edit sections, so that they could see themselves in this climate change report. If they hadn't already articulated climate change as relevant to their work, by bringing in their work and their data in the report, they did.

(BRACE) activities were done with local health and a lot of outside partners and state agencies, so people...agreed on general principles and priorities...(including) incorporating climate change in to regular health functions....It sort of emboldened us to continue, knowing...we share a common goal.

Third, CRSCI grantees reported that BRACE provided a concrete and/or credible framework that enabled grantees to: follow a logical process; undertake difficult, but foundational, data collection and analyses that served as a "key foundation" for the program moving forward (for example, vulnerability assessment); pull together disparate activities under a common set of materials or document for public and policy-makers; and have "political cover" for navigating a limiting political environment. CRSCI Grantees shared that: "(BRACE) pushed us to do some things that we had not always prioritized because sometimes doing those kinds of assessments are more difficult" and "(BRACE) gave us a concrete framework. The fact that it was a CDC evidence-based model gave us credibility coming out of the gate", and "the framework was good for states like ours who had some political limitations because it provided us cover for what we had to get done and provided justification for the work we were doing..."

Starting with our climate and health vulnerability assessments really helped us lay the ground work for efforts for our program. I think it was because they were really data driven products and very visual and geographic that it was not only worked well with policy makers and people within the city and other departments but it really helped engage community members.

Lastly, CRSCI grantees commonly stated that the BRACE framework and CRSCI elevated health as a critical domain of climate adaptation work within the state or city, which

helped to institutionalize health in climate-related activities as well as climate-specific health activities in ongoing health programs. A common expression made by grantees was that BRACE provided state health officials a “seat at the table”- a mandate and resources to participate in jurisdiction-wide climate activities. One grantee stated that: “(BRACE) allowed us to be in larger adaptation conversations that are happening at this state because we have this foundation”. Other grantees added:

Before this program was initiated, the (city) department of public health had very little do with the climate efforts that were going on with the city... this program and this framework really helped propel us to have a seat at the table.

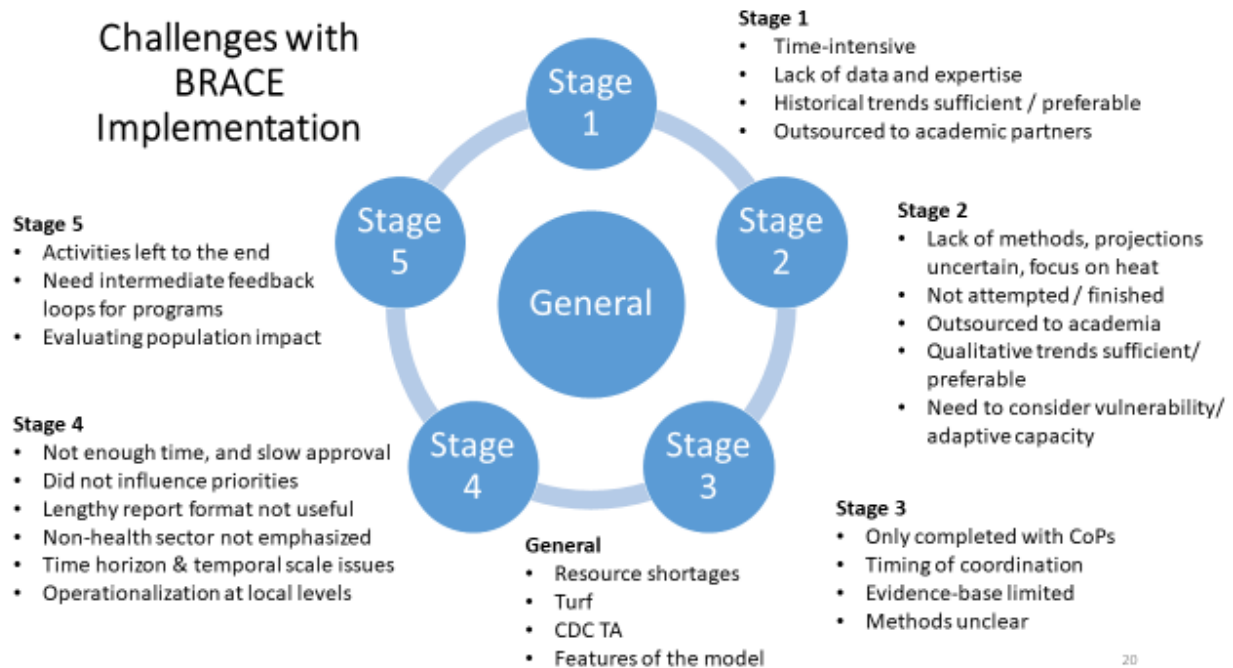
One of the biggest benefits to having the BRACE program is starting to institutionalize climate change as a health risk in (our state)...A lot of people don't see climate change and public health as being connected; having this program in place has really helped us to both build a relationship and a place at the table for our state initiatives, but then also to...develop a place for climate change across our (health) department.

Documenting CRSCI grantee challenges and enablers to implementing the BRACE model

Challenges

CRSCI grantees noted multiple challenges in implementing the BRACE model, which are summarized below in two categories: “general challenges” and “challenges with each BRACE stage”. All challenges are summarized in the figure below.

Figure 7. Challenges with BRACE Implementation



General challenges

The general challenges that CRSCI grantees experienced implementing BRACE included resource shortages, encountering tension over programmatic turf with other divisions in the health department, limitations with specific features of the model, and limitations with CDC technical assistance. All are summarized below.

- *General Challenges: Resource Shortages:* CRSCI grantees emphasized that resource shortages were a major challenge in BRACE model implementation. Over half of grantees reported a lack of sufficient funding as the primary barrier to completing all of the BRACE stages.

Given the level of funding it felt too big to do it, at the level we wanted to do it at, and at the level that the guidance recommended. The level of funding was not sufficient to do that.

It is very important that new states taking this on understand that there is a limited amount you can do with CRSCI funding. Pretty much all of what we have presented so far (as achievements) has been from other grants.

The major resource we never have enough of is money as you know....This is the kind of work that somebody couldn't just hand you. So if you want partners in the future to do that, it's something to keep in mind, that they are going to have to pay for help on this and they shouldn't (be responsible) by themselves.

The lack of funding prevented CRSCI grantees from hiring sufficient numbers of staff needed to implement the full range of BRACE activities. Grantees noted that CRSCI funding supported only a "maintenance level of (staff) involvement" and that the "focus and dedication" required for projections and other specific tasks was "just way out of reach".

The program is woefully underfunded and staffed for the expectations... (and) we didn't have students and fellows.

The biggest barrier was the funding can't support a sufficient number of staff to support the wide number of health effects. We had to prioritize certain ones and do parts of certain ones and we had to really rely on all these other sources of funding to do that. That was the primary (challenge).

Where funding was used to hire staff, two grantees reported long lag times in the hiring procedures that resulted in a delay to initiate BRACE activities. Five CRSCI grantees also reported turnover of key personnel during the CRSCI cooperative agreement period- such as the program lead or key epidemiologist- as a significant challenge. This turnover resulted in delays in program implementation, a slowing of momentum in key partnerships, and in two cases, the grantees abandoning an activity (e.g. projection modelling) because the expertise no longer existed at the health department.

The lack of adequate staff expertise was also reported as a challenge, especially for BRACE stages 1 and 2, where grantees experienced a steep "learning curve". Grantees felt that making climate projections and climate-related disease burden models was not a typical skill-set in the health department, and capacity had to be built within the

health department or gained through external contracts. One grantee noted that to do the projections required, one “needs PhD and Post-docs” and that it is not realistic to do this work on multiple climate hazards at the level designed. Another grantee agreed:

We didn’t feel like we had the in-house capacity to do that level of analysis. (Our most) advanced epidemiologists didn’t feel comfortable doing it....and (we decided) this going to be another one of those steps where we have to leverage our partnerships externally...

Another staffing challenge that emerged was maintaining an ongoing role for staff that were newly hired to implement technical activities in stages 1 and 2. Grantees explained that while BRACE stages 1 and 2 require highly technical epidemiological and statistical skillsets, stages 3-5 require more traditional skills of literature review, program planning, and evaluation. The result was a lack of clarity for some grantees on the role of newly hired technical staff in the later phases of BRACE, such as in the follow-on cooperative agreement related to implementation and evaluation.

My main concern with this next iteration is that you have encouraged grantees to build capacities around a certain areas- understanding risk, exposure pathways, and building technical scientific capacity. And now you left them in the lurch, I don’t see myself in the next iteration- instead I see roles for people who are more classic public health, such as program evaluation, program development, behavior modification... (But) now they’re stuck with me.

- *General Challenges: Encountering tension over programmatic “turf” with other divisions in the health department:* Four grantees reported they experienced tension with other divisions in the health department when implementing BRACE. This was commonly explained as a problem of “turf”, whereby other divisions appear threatened in some way by the interest of the BRACE-funded staff in their program area. As one grantee noted “one of the challenges we have is that we are going in to other people’s domains even at the health department and sometimes they don’t appreciate the extra

help.” Two grantees reported that their public health preparedness programs at the state level, funded by CDC, are resistant to collaboration around climate and health activities. Another reported tension between agencies working on tick-borne illness, regarding who “owns” the success of the Lyme disease program. The turf issue prompted two grantees to express the need for more guidance around the optimal role for a climate and health unit at the state level, vis-à-vis other divisions within the health department (i.e. does it play a supportive function to other divisions? Or is it its own program area with separate activities and funding?).

- *General Challenges: Features of the Model:* CRSCI grantees reported challenges related to missing features of the BRACE model. Three grantees observed the lack of a formal framework for engaging local health departments as being a challenge. Grantees faced challenges knowing how to effectively solicit local input to the climate and health adaptation plan, operationalize the plan at the local levels once it was created, and facilitate adaptation planning at local levels. One grantee noted “that’s one of my questions for the next phase:where is the right connection to make with municipalities, because there isn’t...a structure for that (in BRACE)”. Another grantee agreed:

If there was some framework that from a state perspective could be built in to this (BRACE) report to help the local health departments, because now we are trying to do outreach on the back-end of it...it is not only local projections and local capacity, it’s also the local political framework and interests which is needed in order to help interventions.

CRSCI grantees also expressed concern over the lack of a dedicated guidance on stakeholder engagement. Identifying the right partners, and effectively integrating their interests in to the process was a substantial component of BRACE, and yet no specific

guidance was provided on this. Another feature of the model that grantees expressed as a challenge was that stages 1-3 took up the majority of the 4-6 year cooperative agreement period, leaving much less time for the development of adaptation plans and interventions, which they considered to be more important. This was due to the specific challenges faced within those stages, which is outlined in the next section.

- *General Challenges: Technical Assistance:* While CRSI grantees universally had positive experiences with CDC technical assistance, and most reported it as a key input to their BRACE implementation, some specific challenges were reported. Most commonly, CRSCI grantees struggled with the late production of technical guidance by the CDC for stages 1 and 2, which for some grantees came 1-2 years after they completed those stages. The guidance itself had mixed reviews; some felt it was very helpful while others felt it was overly complex or “academic” and was hard to digest. Grantees also reported the lack of more detailed guidance or templates to inform their approaches to stages 3 and 4; several noted that this resulted in their spending more time than necessary resolving methods and issues with reporting format rather than producing the content.

I think there was some confusion throughout the program as to exactly how to go about things because this is so new, this field is so new, and is in the realm of creation still, but some more definitive guidance methodologically probably would have made things go smoother and more quickly so for the next round probably some more hands-on guidance would help.

The way we started (stage 3) assessment of interventions- because I think the (funding announcement) mentioned the Community Guide- was to go with the Community Guide. (But then we realized), ‘no, this isn’t going to work’. And then somewhere along the way <an external consultant> came out with a new approach, and we decided even that was a little more technical than we thought we could get in terms of the rigor... So I think if there were a guidance document, it would save people time in figuring out how to structure it.

Grantees also repeatedly expressed difficulty accessing the technical advice of the CDC CHP team, noting a lack of awareness of CHP points of contact for specific technical issues, a lack of awareness of CDC CHP resources for technical advice (e.g. mailbox or portal), insufficient response from CDC when requests were made, and communication gaps between a previous project officer and science staff. One grantee noted that they did not utilize CDC CHP assistance because they were already “ahead” of other grantees and specific technical resources were not available at early stages. Several grantees emphasized a desire to have an established personal relationship with one or more CHP staff, someone they can “bounce ideas off of” and who can help identify relevant experts on the CDC CHP team. As one grantee noted: “I felt like I didn’t know until half-way in to our funding cycle, what (CDC CHP) even had available for us, like the people, and their skills”, leaving them with the question “who had what expertise and who we were supposed to be asking questions to?”

Challenges with BRACE stages 1-5

- *Challenges with Stage 1: Forecasting climate hazards and assessing vulnerable populations:* CRSCI grantees universally deemed this stage to be important and helpful, however, they also reported important challenges. Grantees reported a lack of sufficient data needed for climate change projections- in particular at the city or local level- and a lack of staff expertise to analyze this data. As a result, nearly all grantees needed external contracts with academic or other technical partners to implement this work. Even collaborating on a technical basis with these specialists- or with the State Climatologist - was challenging and time-consuming, including how to interpret down-scaled data and how to determine whether to use region, climate, or ozone divisions for analysis.

Some grantees said the production of climate projections was not in the expertise of the state health department, and one grantee suggested it should instead be under the purview of another state agency. One city grantee said the process was “overly academic” for cities to implement, and another reported the difficulty in distilling all the complex data in to one report. The technical complexity and lack of capacity for this component of stage 1 was reported as the key reason it took many grantees 2-3 years to complete stage 1.

Grantees were widely supportive of the vulnerability assessment component of stage 1, however they had differences in opinion as to how these assessments should be conducted. Most grantees conducted vulnerability assessments at the state level, however, one large state reported that vulnerability assessment at the state level (per the BRACE guidance) “wouldn’t work”, and joined at least 3 other grantees to develop local (city, county, or neighborhood) vulnerability assessments instead. One grantee reported that the vulnerability assessments do not adequately capture social cohesion or resilience as important influencing factors of vulnerability, while two grantee stated that that vulnerability assessments would need to be conducted at the outset of every new intervention, rather than just once as part of the state planning process.

The strongest theme that emerged was the decision to rely on historic weather trends versus future climate projections. Five grantees expressed that historical weather trends were sufficient for setting priorities and engaging stakeholders under BRACE, and were, in many cases, preferred. This is because they do not rely on models, but are instead a factual account of what happened, and therefore were considered more reliable and accurate. This also helped grantees to avoid push-back by stakeholders over

weaknesses in modelling assumptions, as well as to circumvent political opposition in some cases by avoiding the discussion of climate change. One grantee noted that in the early years of the CRSCI, climate skepticism was rampant in their state, so they decided to speak only about historical weather trends, using data from the late 1800s to the present. They used the argument “if the trends keep going the way they’re going, we need to be prepared for that”, and they found this to be an accepted way of speaking about the issues without specifically mentioning climate change. Another grantee had a similar approach:

The first thing we say (to new partners) is ‘we worked with (our local academic center) on these climate projections...and then we automatically go with the historical – what’s happened, what are the current trends. With some groups we don’t even get to the projections because it’s just ...a barrier. We learned...working with people who are not as familiar with climate data...to start with the framework of first describing what has happened. We find a lot of the time when people hear what has happened, they realize that they can’t even manage their systems for the climate we’ve seen historically.... (over) the last 10, 20, 50 years...we use that as a foundation for our discussions. When people are interested in the future ...we don’t really need to bring in the climate projections. We can use what has already happened, we can look at the trends if there are any really strong signals, and we can project 5-10 years. When people want to start looking 25, 50, 100 years out, that’s when they really start thinking about model data...data quality...and red flags.

- *Challenges with Stage 2: Projecting the disease burden:* Grantees universally reported stage 2 as the most challenging stage in the BRACE model. Grantees reported that the lack of widely recognized and validated methods for conducting disease burden projections for most climate hazards forced them to struggle to identify adequate approaches. Grantees noted high variability in the state of the science between climate health effects (with little science on indirect climate hazards), the lack of appropriate source data to populate assumptions in the model (e.g. for dose-response), and the difficulty in accounting for the complexity of exposure pathways. As a result of these

limitations, all but a few grantees expressed a high degree of uncertainty in the results of the quantitative projections. Complicating matters further, grantees noted they had to use different time intervals for projecting health effects for each climate hazard; for example, one grantee used a 30 year time interval to project heat effects, but a 100 year interval for sea-level rise.

To get from wildfire particulate and climate projections to a projection of health outcomes it is really, really complex. First you have to project changes in wildfires from climate data...climate models give you temperature precipitation and a few other variables and you have to get from that to wildfires. And then from there you have to ... project how much smoke is going to come out from what wildfire, where, for how long, and what population is nearby that would be exposed...and then to respiratory outcomes. And then you know there's meteorological considerations.

What we are having problem with is looking at the base-problem and then pull the projection data to look at what future burden is going to look like. At this point we can't just pull precipitation values out of the air and say "this one will make floods"; it's all these local factors that cloud this relationship. It's not a one-to-one relationship. The risk also changes all the time. You put in a parking lot in one area and suddenly the risk has changed. So getting what we have for precipitation projection data and trying to translate that in to future flood risks has been very challenging.

There's a lot of uncertainty; you just can't get around some of that uncertainty, mainly in our climate projections but also in the dose-response relationships and adaptive capacity.

The projections are very sensitive, which is why you really have to know what is defensible....it can be pretty easy to pick apart and that's what we have to be very careful with. The disease burden side of things is really the sensitive activity.

As a result of these limitations in methods and data, seven of the 11 grantees opted to focus on heat to the total or near exclusion of other climate health hazards in this stage. Many grantees reported earlier analytical work on heat in their jurisdictions as an additional rationale for this focus. At least one of these grantees revealed that heat was

not even a priority for their jurisdiction, yet the methods were not robust enough for them to implement Stage 2 successfully on their priorities.

Interviewer: Now I've heard you both say, is it fair to say, that you both defaulted to heat because basically that it was easier to do?

Grantee: Yes. And it's not that it's not a concern...it is. But you know if we're going to talk to policy makers they're going to ask about drought and wildfires first.

One grantee decided not to publish Stage 2 projections, due to the concern about opposition and push-back arising from the uncertainty in the models.

Even when focusing on heat, grantees complained that this stage was highly labor-intensive and time-consuming. The stage took grantees multiple years to complete, and required very specialized capacity, which in the words of one grantee, was "unlikely" to be available among resource-constrained states or jurisdictions. Several grantees noted they faced a trade-off between the time and attention needed to complete this stage and the other BRACE stages. As a result, most grantees proceeded with Stages 3 and 4 before they completed Stage 2. Three grantees either abandoned their work on this stage, or opted not to implement this stage at all.

I spent a huge amount of time developing it...identifying the issues, figuring out how to structure the investigation, and what all the drivers were. It took a lot of time.

Of all the steps, the most difficult is step 2. It has been difficult to understand how much capacity we should put toward that stage versus planning, assessing, implementing and evaluating. It was a worthy effort, but felt more academic...and it didn't always feel as connected in terms of informing what actions or interventions we move forward with in the plan...It could have really gotten us off track if we would have really dedicated all the time that we needed...considering the many data limitations and uncertainties.

Seven grantees strongly questioned the utility of this stage as part of the BRACE model. One grantee found it useful to have information on par with other sectors at the

state- level, however, most grantees felt the information produced in stage 2 was too modest in terms of public health impact, too “uncertain” to publish authoritatively, and ultimately not useful for translating in to priority-setting or action. The utility of these projections was considered weakest at the local level, due to the lack of data available at the city or neighborhood level to make the projections meaningful or actionable.

We have a finite amount of money. We could pick finishing some of the other deliverables or working on (Stage 2), and we felt the information that would come out of that would be pretty underwhelming and that it was better for us to work on education, outreach, emergency planning and also our climate adaptation plan and to do something that would be more practical on a city level.

When we put a lot of resources in to doing the vulnerability assessment or the disease burden projections that takes away resources from working at the hyper-local level, which, we know in the end, is where we really have to be for any of this to actually do anything....And one question is: ‘is it worth it to spend this much time and resources on something that you know is going to be really uncertain?’ And the answer to that question might be no.

What we are hearing across the board is that spending the time and effort to do these very complex calculations and models to come up with projected numbers of disease burden at the local level does not pan out.... for a city you can’t take projected numbers from 2100 at a county level and translate that in to anything that will be actionable for you.

We have struggled with how to make this step applicable, how to make it useful, and I think we have asked a couple of times, what was your goal with this, how did you want us to take this high level guidance document in this step and translate that to something useful to local public health and local emergency management and we are still struggling with that right now, to be honest.

Four grantees reported that qualitative assessment of public health impact was sufficient, and in some cases, preferable, to convince stakeholders and policy-makers to take action. Qualitative assessments were described as identifying future trends in health impacts based on historical trends alone, or discussion of the associated health impacts based on the literature or qualitative sources and opinions. One state-level CRSI grantee that conducted robust quantitative disease burden modelling revealed they had to rely on

qualitative measures for some conditions, due to the science being weaker in those areas.

Perhaps my strongest critique of the BRACE framework is that step 2 may or may not be necessary depending on the political climate; I think we're lucky here unlike other states that we have decision makers who don't need to know the magnitude of change to act. The direction of change might be enough, it is enough to say we expect 'more' heat related illness.

We've found when we present the information, people are comfortable, especially if you bring in the historic data for their area. They are comfortable with us talking in broader strokes about projections.

I take it to the planners and the public, (and they want to know) is this really a significant issue? ...Is it going to be a major problem? Or are we talking about small numbers here? I mean, I think a lot of that we get from the vulnerability assessment itself. Because we know what the factors are. We have an idea just by looking at the historical data and the health data, and then finding if there is a correlation.

Select grantees noted that the qualitative *drivers* of climate-related health impacts may be more important to identify and assess, than projecting quantitative impacts. In the words of one grantee "it is not the final effect estimate that you care about, but all the little pieces together that give you an important source of information on the drivers of BRACE and how those might be changing". Another grantee noted that the adaptive capacity and vulnerability of communities are significant drivers of climate-related health impacts, but these more qualitative indicators are not captured in quantitative disease burden project modelling.

Grantee: There are a lot modifications (to the projections of disease burden) based on socioeconomic characteristics, age and pre-existing health conditions... The communities and the policy makers always ask the question: 'is this actually going to be a bigger problem for us because we have an aging population and a particularly unhealthy population'? Those questions to me seem like that could potentially change your qualitative assessment from small to large.

Interviewer: So you're saying that those effect modifiers have almost a bigger impact than some of the differences in the climate between one region and another, is that what you're saying?

Grantee: Yes. If you look at a recent city study from 2009 which reviewed the

dose-response relationship between temperature and mortality in over 100 American cities, you find that (the dose-response curve) is flat in Houston, which is hotter than cities like Detroit. But in Detroit there's also not a lot of air conditioning- which is tied to socioeconomic vulnerability- and there is more asthma and cardiovascular disease as a result.

- *Challenges with Stage 3: Assessing public health interventions:* In principle, grantees felt this stage of assessing the evidence-base for public health adaptation interventions was important. However grantees resoundingly reported that the comprehensiveness of the literature review made it unfeasible for a single grantee. In fact, grantees agreed it was only possible by dividing and sharing the work with other CRSCI grantees through the CRSCI communities of practice, which were organized by geographic region.

Unfortunately, this also meant that the grantees had to come to agreement on the climate hazard topics that would be the basis of the joint literature review, and this consensus was difficult. Some grantees also explained that the methods for completing this review were unclear and became a point of disagreement and barrier to group process in their community of practice. One group of grantees did not finish this stage because they were unable to come to agreement on the methods.

We were at the same time juggling trying to complete steps 1 and 2 so you know it was not feasible for us to do a semi-systematic literative review on all our interventions; piecing it together with states was helpful. But at the same time each state had its own interest and strict set of criteria to consider when assessing the interventions. So it was difficult to standardize the literature reviews across the whole nation for all the interventions.

We had a meeting in Chicago and most of it was focused on the hashing out of: how are we going to organize this? Are we going to organize it around health outcomes or around climate exposures? Which was actually harder to get through than we thought because there is some pluses and minuses for how you organize that.

Grantees also expressed that an obstacle in this stage was that the evidence-base for climate and health adaptation interventions in general is weak. Studies often do not

isolate specific interventions, do not have controls or examine confounders, or use only proximate indicators (e.g. changes in awareness as opposed to changes in behavior or health impacts). What's more, grantees were all implementing BRACE stages in their jurisdictions on different timelines, making the coordination of stage 3 difficult and time consuming.

I think some of the challenges were the fact that everybody had slightly different timelines for this, so some of us were for getting them done in a timely manner and some of them weren't planning to do it for another year.

- *Challenges with Stage 4: Developing and implementing the adaptation plan:* CRSCI grantees commonly had far less challenges in stage 4 than in stages 1-3. One important challenge was that stage 4 was not necessarily a product of the stages that preceded it, as was intended by the model. This was because several grantees said their jurisdictions “already knew their priorities” and/or were working concurrently on stages 1-4. For grantees that did complete some or all of the preceding stages, their complaint was that the time available for Stage 4 was far less than for previous stages, and in general, was insufficient. One grantee noted they “just ran out of time”, while another suggested their plan “could have been a different document if they had more time”.

Some grantees reported that their plans were still under lengthy review by stakeholders or their state governments, and were not yet published. This was a common challenge reported with the stand-alone climate and health adaptation plans- that they required a multitude of external stakeholders and government units to review and approve the content, thereby slowing the process. “It's taken a lot longer than expected to get feedback by all the different partners”, one grantee noted, including state departments of

environmental quality, water resources, and local health departments. Political factors as noted previously played a role in these delays in some settings.

A few grantees felt the stand-alone climate and health adaptation plans overemphasized identifying health department activities, and did not place enough emphasis on including non-health sectors of the state government. However, one grantee noted that this could be done as a next step:

(Our plan) is really focused on (state health department) work and not really focused on what we do with our partner agencies. I think there is some expanding we can do...we already have built so many partnerships across agencies I think it will be really easy to move in to an expanded plan.

Some grantees challenged the utility of the time horizon and lengthy format of the stand-alone climate and health adaptation plan. More than one grantee noted that the five year plan may be rendered “outdated” or obsolete after a short period of implementation, due to ongoing changes experienced in their context or programs. Grantees noted that plans may need several different time frames, to account for shorter term deliverables, as well as the longer impact horizons of particular interventions. For example, addressing heat-related illness by creating a tree canopy has a long- term horizon versus installing more air conditioning units. Others suggested the long format was not user-friendly for external stakeholders, and for that reason, shorter public-facing reports were created.

We can say we are going to create a 5 year plan. But the real planning is happening every year. Our funding mechanisms changes, our partners, our resources change, what we know about climate change changes all the time. So it is impossible for me to say in five years we are going to do this intervention...I mean we are going to have to do the planning, the research, the assessment, and interventions and at the same time all the time. Everything is cycling together because everything needs to inform each other. We will plan this year, but we are going to be doing interventions, and evaluation, and planning for the next year. And when we implement that we will plan for the next year.

Some of folks say that this document, they didn't really learn a whole lot from it, but it was really good to show other people. Like this is our assessment this is our document full of useful information.

For a 100 page report, even though we have it on our website, I think we are trying to evaluate how many people have actually even opened it. I'm not sure that it is a mechanism (for action) or a communications tool

Lastly, some grantees noted that the plans were helpful as a high-level priority-setting instrument, but lacked the ability to be translated or operationalized at the local level. This was due in part to the lack of systematic engagement of local health departments in the planning process, and the need to write a plan that applied to the whole state.

When you ask what is missing, what is missing is the practical application of (the plan). It is a useful foundation for us to set priorities as program. But then, like you said, operationalizing it (is the challenge). What is the practical application utility of it at a local level? We are not there yet but it's in the works.

- *Challenges with Stage 5: Evaluation and quality improvement:* Grantees reported the fewest number of challenges with this stage as compared with all other stages in BRACE. This is largely because grantees consider evaluation as a familiar skill set among state and city health departments, and one that did not require the extensive capacity-building or partnerships needed to complete stages 1 and 2. Grantees were also highly satisfied with the CDC technical assistance they received related to evaluation.

Of the six grantees that reported activities in evaluation, their primary challenge was that evaluation activities in the BRACE model should not be left to the final and last stage, after planning and implementation are already underway. This is already "too late" to design effect baseline indicators and measures of progress, which should be conducted in the planning process. One grantee also noted that having intermediate, real-time feedback loops to inform interventions is an important part of evaluation that should be

included, and aligns with the quality improvement element of this stage. Four grantees revealed that late or inadequate CDC guidance on evaluation was a barrier to their integrating evaluation earlier in the process. Some grantees also expressed the challenge of evaluating the population health impact of their programs, which is their ultimate objective, but very hard to achieve.

In terms of barriers, we did not receive (evaluation) guidance until the end of year 3. Ideally you have that program evaluation component day 1 so that you are able to collect your data and do your analysis and revise each year.

Evaluations should have been step 1.2, built in, because we didn't get to this later on but that guidance wasn't provided until half-way through year 3. So we had to do a lot of back- end evaluation. It would have been ideal to have the evaluation plan day 1, instead of year 4.

I don't think we should do any implementation without having evaluation built-in. We need to evaluate different triggers, evaluate when we need to differentiate or downgrade, determine the amount of lead time needed for an alert, and have plans that include mitigation efforts.

We haven't done much with the evaluation. Obviously, I'm tracking our products... It's more of a process evaluation not so much outcome evaluation. That's just the way the first plan was written.

Enablers

Grantees were not explicitly questioned regarding the “enablers” for their BRACE implementation. However, grantees commonly reported the following factors as being critical for achievement of BRACE outputs and outcomes.

- *Communities of Practice*: The communities of practice were commonly mentioned as an essential ingredient to achievement BRACE activities, due to the shared peer-to-peer learning and the division of labor that occurred. The majority of grantees noted in particular that Stage 3 would not have been possible without the communities of practice.

Well, I have to give a lot of credit to our Midwest partners. (The Minnesota grantee) is a very good leader and everyone contributed quite a bit to the

intervention assessment. I think without the collaborative we wouldn't have gotten it done.

- *Existing Programs:* Six grantees reported the importance of leveraging existing programs to achieving their BRACE activities. Existing programs provided funding or activities that established a foundational input to BRACE activities or helped accelerate momentum on BRACE activities due to additional staff or resources. Critical programs mentioned included CDC funding for health impact assessments, academic research on climate change and health, and other external funding sources for climate change (e.g. for a climate change office).

If you want to do (BRACE) in a timely fashion, you really need to have an existing program, like this one, to churn this out.

We are so fortunate to have so many staff work on research and getting funding from all these other sources and of course what we do for CRSCI is to pull them all together and take advantage.

We did draw from the first CDC grant, on health impact assessment. A lot of the training and methodology for health impact assessment is really relevant to adaptation planning because it takes you through the whole process of working with the community to identify issues and identify solutions. And so I think even though BRACE shifted away from the health impact assessment, having that background was extremely helpful to us.

- *Existing staff:* Five grantees reported that having existing staff and requisite expertise was an important enabler to achieve BRACE activities. Staff could be health department staff, students or interns, or even existing external contractors. One grantee noted that they were able to progress on their vulnerability assessment primarily because they had “subject matter experts that were an in-house capacity”. Other grantees noted that: “the only reason we have so many beautiful products to share is because of the amazing interns that we have had” and “our vulnerability assessment was done initially because we had the momentum to work with someone who had worked with our agency before”.

I feel that we really leveraged working with our contractors at <an academic center> and among our contracting group there we had our state climatologist and they had <a research institute>, which provided access to over 80 researchers working on climate issues.

- *Leveraging partnerships:* Grantees frequently referred to specific partnerships as being critical to their achievement of the BRACE model in their jurisdiction. Several academic partnerships were reported as being critical for the production of data and analysis and for lending credibility to the city or state BRACE efforts. Interagency or multi-sectoral partnerships were reported as being critical to obtain buy-in from key stakeholders, overcoming possible turf issues.

It was really important for us to partner with (regional RISA academic center) in terms of our credibility to have them as part of the (climate and health) profile and also the burden projection, as experts. It was very important that they were based in our state and they were not some group from elsewhere...that was almost, I think, more important than the projection in terms of getting people on board...

We have awesome partners in our asthma group, a pollen monitor in the state...Having the experts in the domain included in the process from the get go...helps (to overcome resistance) and promote buy-in.

We had to get by with the help of our partners. I think having so many partners that were supportive of this work and that were engaged and interested in seeing us be successful was really helpful in allowing us to achieve the plan.

- *Flexibility of the BRACE model:* Grantees commonly referred to the flexibility of the BRACE model as a critical enabler to achieving BRACE implementation. Flexibility was described as the model permitting grantees to customize the sequence of the stages, as well as the specific methods and topics employed to implementing the BRACE stages. One grantee noted that the flexibility allowed for better stakeholder engagement: “CDC provided us with flexibility and support to approach (BRACE) in a way that makes sense with our partners and stakeholders and their priorities”. Two grantees noted that the

flexibly was especially important given the strong political resistance to climate and health work in their stage.

(The BRACE model) let us customize (the grant deliverables) in a way that was locally relevant and made sense given our resources.... I think that under a more rigid-type situation, we would have been further constrained and would have definitely not have been successful in the parts that we were.

In this jurisdiction this directionality is all that you needed to get action (since you already had state level priorities identified and other agencies moving forward) but in another state they needed everything spelled out in incredible specificity. Here again the flexibility of the framework really made that possible.

CHAPTER 5: RESULTS OF FOCUS GROUP DISCUSSIONS

A total of 46 state and local health department officials participated in the focus group discussions that made up the second phase of the study (Table 2). Half of the study participants were recipients of CRSCI funding to implement BRACE (referred to hereafter as “CRSCI grantees”). The majority of CRSCI grantee focus groups were with state-level officials, however one focus group was conducted with officials from a city that received CRSCI funding directly from CDC, and one focus group was with officials from county health departments that received CRSCI funding through their state health departments.

The other half of the study focus group population comprised local health officials that have not yet implemented BRACE (hereafter referred to as “local health officials”). These officials represent target beneficiaries for future CDC BRACE activities. They comprised local health officials from a mix of county and city health departments, as well as consolidated regional health departments that had responsibility either for multiple counties-“Regional (County)”- or a city and its surrounding county, “Regional (City/ County)”. Combined, focus group participants in the study represented 22 states: Arizona, California, Florida, Idaho, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oregon, Texas, Vermont, Washington, and Wisconsin.

Table 2. Description of Study Participants in Focus Group Discussions

Jurisdiction	No. of Participants (CRSCI Grantees)	No. of Participants (Local Health Officials)	Total	No. of States Represented
State	17	0	17	12
Regional (County)	0	3	3	2
County	4	12	16	4
City	3	4	7	4
Regional (City/County)	0	3	3	2
Total	24	22	46	22

Findings from this phase are presented in two sections:

- **“CRSCI Grantees” Focus Groups:** This section summarizes the ideas generated by CRSCI grantees for how to adapt and enhance the BRACE model for new jurisdictions, in particular, local health departments.
- **“Local Health Officials” Focus Groups:** This section characterizes the operational resources and needs for climate and health adaptation planning among local health officials that have not received CRSCI funding, and identifies opportunities for leveraging local, state, and federal resources.

CRSCI grantees focus groups

The objective of CRSCI grantee focus groups was to solicit new ideas for how to address BRACE implementation challenges, as identified in phase 1 of the study, in a revised BRACE model focused on new jurisdictions, in particular, local health departments. CRSCI grantees were asked about key challenges and benefits of the BRACE model in their jurisdictions, as a means to help inspire recommendations. Grantees echoed the key challenges and enablers

identified by CRSCI grantees in the interview transcripts in the first phase of the study, elaborated in Chapter 5.

One new theme that emerged was the challenge of the BRACE model's sustainability. CRSCI grantee focus group participants noted that while the model was adaptive in philosophy, with an intent for an ongoing, iterative process,⁷³ jurisdictions faced problems keeping activities going or repeating the cycle once stage 5 was reached. In the case of local-level CRSCI grantees, several had to stop activities after funding grants from their state health departments ended, as there was no local funding to continue. For state-level CRSCI grantees, several reported they were unsure which elements of the BRACE model should be repeated and in what timeframes, and they reported an absence of CDC guidance on this. As a result, many CRSCI grantees are working to share the data and products of their CRSCI-funded activities with other local governmental agencies, with the hope that they can be continued with other funding.

This whole BRACE framework is a completed circle - once you get done with step five, you are supposed to go back to step one and reevaluate your impacts and how you are addressing them... We really only got to get through one cycle of this project before the funding ended. So there was almost no time at all to work on improving the quality of our activities... we haven't really been able to take what we have learned and start over and re-apply it to a different area or improve upon what we have already done.

We have pivoted at this point to using what we have learned in the data we collected and supplying that information to other agencies that might have funding or the ability to continue this kind of work. So that is where we have been left at this point.

CRSCI grantee ideas for improvement

CRSCI grantee focus group participants were asked for their ideas for improving the BRACE model and/or CDC technical or funding assistance to support climate and health adaptation in new jurisdictions, in particular local health departments. The ideas below were suggested by two or more participants.

Table 3. Summary of CRSCI Grantee Ideas for Improving the BRACE Model

1.	Downscale activities for LHDs in Stages 1 and 2 <ul style="list-style-type: none"> ○ <i>Simplify climate and health profiles and vulnerability assessments, including merging in to one step and product</i> ○ <i>Encourage qualitative assessment for detecting and attributing health impacts of climate hazards, and focus on “telling the story”</i> ○ <i>Encourage LHDs to begin the BRACE planning process with an ‘a-priori’ climate or health priority for their jurisdiction</i>
2.	Outsource Stage 3 to CDC
3.	Integrate adaptation into existing local planning processes vs. a stand-alone plan
4.	Add new dimensions to the BRACE Model <ul style="list-style-type: none"> ○ <i>Mobilizing stakeholders</i> ○ <i>Social determinants of health and health equity</i>
5.	Simplify evaluation activities
6.	Provide guidance for how the BRACE model can be institutionalized
7.	Collaborate at federal level with other CDC programs
8.	Role of State in supporting LHDs

Improvement idea #1: Downscale activities for LHDs in stages 1 and 2

In the first phase of the study, CRSCI grantee identified a range of challenges to BRACE stages 1 and 2 (elaborated in Chapter 5), which included the intensity of time, expertise, and resources required for these two stages, the questionable utility of long-form climate and health profiles, the challenge of multiple sequential reports that require separate approval, and the variable capability and capacity in quantitative disease burden projections. To respond to these challenges, CRSCI grantee focus group participants recommended that CDC downscale the activities in stages 1 and 2 for LHDs. Their most common suggestions on how this downscaling could be achieved are:

- *Simplify climate and health profiles and vulnerability assessments, including merging in to one step and product:* CRSCI grantee focus group participants expressed that local health departments should not be expected to implement the same type of climate and health profile and vulnerability assessment de novo, as state-level CRSCI grantees were required to do. Instead, localities should be encouraged to build off of the existing

information provided in the national climate assessment or developed by states (such as county-level climate and health profiles or social vulnerability indices by census tracts) and even merge the hazard risk assessment and vulnerability assessment in to one step and final product. Participants also recommended that the product of these two activities be in shorter and more user-friendly formats for stakeholders and the public, such as interactive portals or web-based content. One participant noted that web-based materials were “much more accessible than reports”.

In our state, most of our local health jurisdictions could not do their own profile report. They just don't have that capacity, but they can take work that we have done- if we do it appropriately with them- and take it down to the local level. We are continuing to provide some technical assistance to the local health department, even without funding them,... including to conduct their own vulnerability assessment at a much smaller scale, more simplified for them. The vulnerability assessment that we did for the counties are still not out and approved- it's almost a two year approval process.

To achieve this simplification of the climate and health profile and the vulnerability assessment, participants stated that CDC should help provide local health departments with tools and templates.

(I recommend) finding tools that can enable LHDs to really assess what these vulnerabilities are. Easy, user-friendly tools. In the urban planning role, the other role that I occupy, there is this sea-level rise viewer that anybody can use to identify whether their community is going to be under water in the next 15, 20, or 25 years. Something as crude as that could work.

- *Encourage qualitative assessment for detecting and attributing health impacts of climate hazards, and focus on “telling the story”*: CRSCI grantee focus group participants stated strongly that the BRACE model for stage two was “overly academic” and too rigorous, and would be even more problematic for LHDs that are more resource-constrained. Instead, CDC should encourage the use of qualitative assessments of climate health impacts, which they considered more beneficial for

identifying priority health impacts, because it avoids the high burden of time and expertise, as well as validity concerns, that CRSCI grantees associated with the disease burden projections implemented under CRSCI.

For us the CDC document on projecting disease burden was quite technical and we ended up relying on external experts to help us with the map component to do the disease projection because we didn't have in-house experience with that. For local jurisdictions...that could be a pretty heavy lift. One recommendation is that you do a qualitative assessment as opposed to a quantitative.

I feel like a weakness of this projection's framework is that it discounts qualitative projections. It is very focused on quantitative projections. I think that in a lot of cases, a qualitative assessment that draws on good climate science and expert opinion is actually going to get you just as far as spending a time coming up with a number that may or may not be any less precise than what you could have written in a sentence.

Moreover, several participants argued that the emphasis in this stage should be on how local health officials can tell the story of the how climate impacts health in compelling ways to the public, policy-makers, and other key stakeholders. One participant observed: "Being able to translate those messages about HOW the climate is changing in to health impact is probably of more value than being able to put a specific number on (it)."

I've often thought about this as what we have to do in some cases in order to prove that we need to take action, but often times the results of these studies projecting the disease burden are very underwhelming and actually aren't the most convincing. In fact there may be other ways in stage 1 where assessing what the climate projections are for the region, what the associated health risk with those changes is, and who is most vulnerable, that is sufficient to begin talking. Giving local examples, that is really key too. So I think stage 1 and 2 can be collapsed together. It's not about projecting or forecasting, it is about communicating and understanding the climate and health risks and vulnerabilities.

- *Encourage LHDs to begin the BRACE planning process with an ‘a-priori’ climate or health priority for their jurisdiction:* CRSCI grantee focus group participants expressed the BRACE model should allow local health officials to start the BRACE planning process with a pre-determined (or ‘a-priori’) priority area, either a climate hazard or a health outcome. This would enable local health officials to bypass the lengthy task of examining the universe of climate hazards and health conditions, and to consider other important factors in their priority-setting, such as political will or reducing duplication with other programs. The local health officials could then analyze related climate drivers, exposure pathways, vulnerable populations, and priority interventions related to this singular priority. This approach is being piloted by one state-level CRSCI grantee with several LHDs through a funded grant process. Jurisdictions could then repeat this process with other climate hazards over time, which could be encouraged.

If we are looking to provide guidance to local health, I think it would be useful to allow them, a priori, to identify what climate impact or disease burden is of concern to them. Maybe that is a non-scientific way, a more focus group or subject matter expert-based, but using it as starting point and evaluating what the potential interventions to address that issue...then guiding them in to what they are going to do and what they will measure.

In fact, multiple CRSCI grantee focus group participants expressed that in their experiences, engaging LHDs in climate and health adaptation planning, they were far more successful when they started the conversation with questions about local priorities, rather than starting with a “big data” approach or with the BRACE climate and health profile.

We have...reversed the way BRACE works. There is some advantage that we have found to not starting off with the, ‘Let’s take a big, ‘epi’ approach to big ‘epi’ kinds of problems, do the disease projections for the things that we can

and go to communities with those,' but instead let's start backwards. Start with the community questions about what health concerns are of greatest concern to them and then work backwards to say, 'Okay, is an adaptation to that going to be influenced by or going to influence a climate adaptation program.

When we work with local health departments, we bring a miniature climate and health profile and present to them on that, on what we see in terms of the data, but then we also just ask them if that is missing their perspective and their knowledge and expertise at the local level.If we just come in with this big data, we often get push back.

Improvement idea #2: Outsource stage 3 to CDC

In the first phase of the study, CRSCI grantees found stage 3 challenging; it could not be completed by any grantee alone, and the evidence-base itself was limited in rigor and breadth of climate hazards and health conditions. CRSCI grantee focus group participants strongly recommended that local health officials should not be required to conduct a literature review, because they do not have the time or resources and because the effort would be redundant across regions. Instead, CDC could assume responsibility for producing and updating comprehensive literature reviews by major climate hazard or health area. This information could be made available with other resources in a central, web-based repository, and, if possible, through a searchable database. Localities could work with CDC to obtain relevant literature, and also network with other jurisdictions in their state or region to learn about contemporary models and best practices that are happening in real-time.

I do not think that it makes sense for each grantee to be doing a review of interventions, when that could be done by CDC and just have one centralized document that can be added on to as we see things that come up. It just seems like a wasted effort.

CDC has done this for other causes, like in chronic disease or the 6|18 initiative. They have come up with high priority things that have a decent evidence base and can be done. They have pulled out all of the other things in one central place. As public health interventions and adaptations go, that would really be very helpful.

Improvement idea #3: Integrate climate and health into existing local planning processes vs. a stand-alone plan

CRSCI grantees in the first phase of the study questioned the utility of long-form vertical climate and health adaptation plans, many of which faced lengthy and sometimes politically-charged approval processes and became outdated with the fast-changing realities on the ground, and which, they reported, did not sufficiently engage non-health actors that were critical to their implementation. To address these challenges, focus participants recommended that local health officials should be encouraged to integrate climate and health considerations and activities in to existing local planning processes, rather than in a stand-alone plan. Examples for integration included inserting climate and health considerations into plans for community health assessment plans, hazard mitigation, disaster preparedness, and hospital assessment.

I think that there should be that kind of flexibility within any framework to fit our plans in to whatever is going to make the most sense for our jurisdiction so that it does not just get put up on a shelf somewhere but that it is aligned with a bigger effort or makes sense.

One state-level CRSCI grantee already requires their local health officials to map all existing plans that they have produced or participated in, including state-level plans, in order to examine opportunities for integration of climate and health adaptation activities. This is intended to help local health officials understand how to align their climate and health priorities and activities with existing efforts. If local health officials strongly wish to pursue a stand-alone climate and health adaptation plan, participants recommend that only high level priorities be established for a five year time horizon. Short-term implementation strategies should be developed for 1 year or less, to enable more experimentation, quality improvement, and adaptive management.

In particular, participants stressed the importance of integrating climate and health adaptation considerations in to non-health plans and programs. One participant gave the

example of county health departments in his jurisdiction that attempted to address extreme heat by planting trees; however the agency with the mandate to plant trees was urban planning, not public health. By forging a partnership, the health department was able to come up with a very promising adaptation.

I (question) the value of having a climate and health adaptation plan that is not connected to something outside of the health department, to other people who can actually implement the adaptations. Remember, rules and adaptations are not meant to be from health. They are going to be from elsewhere. The bulk of it is going to be how we design our cities, how we provide services, what type of physical environments we have, how we change and protect it....An intervention like housing may contribute more to improving health than any actual health care intervention.

Another participant noted that this work is especially important to leverage funding in resource-constrained environments.

One component that everyone has talked about but is not part of BRACE - I guess it's an assumed part of it - is building up partnerships, with not only your community partners, your health partners but other agencies that are non-public health agencies that are doing adaptation. I think that sort of comprehensive, integrated stakeholder approach is the way to get all of the things that I just talked about done without a ton of resources. Since everybody's doing a component of adaptation that may have overlapping benefits or co-benefits, but in a constrained resource environment, everybody cannot do everything at the same time so they can have these symbiotic relationships that can piggy-back off one another.

Improvement idea #4: Add new dimensions to the BRACE model

In the first phase of the study, CRSCI grantees identified that the BRACE model did not adequately address stakeholder engagement and social determinants of health and health equity. Participants recommended that these three dimensions be added to the model for LHDs.

- *Mobilizing stakeholders:* CRSCI grantee focus group participants across four focus groups commonly reported they would benefit from more guidance on how best to engage health and non-health organizations and communities in the climate and health adaptation efforts. Stakeholder and community engagement was noted as critical for leveraging resources in resource-constrained environments, navigating political

obstruction in state and local government offices, and identifying community priorities. County health official focus group participants in particular stressed the importance of assistance in mobilizing stakeholders, for example, having the state health department map, or otherwise identify, regional or state level organizations that could serve as new partners and sources of funding for climate and health work (e.g. private foundations, state level policy institutes).

We spent quite a bit of time in the earlier stages of our project talking about stakeholder engagement. We probably focused just on that for at least a month. I think there is room for improvement and more guidance on how to engage stakeholders. I'm not really sure what that would look like, but even if, at the state level, the climate and health program could reach out to somebody from the state drinking water program who might know who to get in to contact with at the local level. The state would probably have a lot more contacts than I do here at the local level.

Grantees broadly felt that providing best practices and examples of innovative or effective stakeholder engagement would be useful to LHDs. One state-level CRSCI grantee identified a specific tool- the Inventory Report Template- that her department produced for local health officials to help them map stakeholders, priorities, and activities, as part of their climate and health adaptation planning process. Another participant described the benefit of this kind of 'environmental scanning process' as helping them to "get to know the lingo and the players, and to form relationships with planning and community development departments." They shared that "that relationship building and environmental scanning step has perhaps been the most valuable (part of BRACE)".

I think it is hard for local health departments to do all of this and then on top of that have to identify the stakeholders, bring them in, engage them. But that is something that can also be facilitated at the state level. Bringing people who have similar interests or needs together and facilitating and negotiating. It is important

to find ways to bring different stakeholders together who don't normally speak to one another or who do, but just not in that context.

I think one of our major critiques of the model is that there isn't a step for community engagement and stakeholder engagement. I think a lot of the public health planning models do have that step and I think that is something we are really missing at this point. One would find out what the local priorities are through that engagement process. So that is a step that I would put in there if there is to be a sequential model.

- *Social determinants of health and health equity:* Participants strongly recommend CDC incorporate more language in their guidance and public presentations around the role of health equity in the BRACE model. In particular, participants argue that the model needs to recognize that the drivers of population vulnerability to climate change are the same as those behind health inequality, and that adaptation activities should be encouraged not just at the exposure level, but at the level of social determinants (e.g. housing or social policy).

The CDC BRACE model was meant to be exposure based - meaning to look at heat, or air quality, or droughts, one exposure at a time - and then following those pathways of the exposure through to the health impact. It's based on starting with the climate exposure rather than looking at living conditions and inequitable systems and all the different components that are involved in the very complex pathways to health inequities from climate change. That has been a challenge for us all along.

CRSCI grantees in one city-level focus group argued that if health equity is not a key principle in the BRACE model, then adaptation interventions will be distributed inequitably. For example, these participants explained that in their city, air conditioning is provided liberally (and even to excess) in office buildings, while it is not provided in many homes of vulnerable populations, where the health impact of the intervention is greater and where the greenhouse gas emissions of the intervention are lower. One participant noted: "I have seen CDC staff give amazing presentations on the 'epi' side of

it. What is often missing is how, as a society, we are expecting the poor to carry the burden”.

A lot of these climate health outcomes that we are trying to adapt around, the methods we are using to do that are very end-game oriented, such as the heat alert system, or children's education around smoke health impact from wildfire, and a lot of those things don't get at the reason why these folks are most vulnerable. So it's really my hope that we are going to be able to generate enough local interest and excitement around the adaptation work that we are doing to talk about long-term policy that will help this adaptation along - like housing and poverty reduction. I'm not sure how to do that so I really think that would be a really great place to have more CDC leadership in the future. To help us work towards more policy work that is going to be more impactful.

Improvement idea #5: Simplify evaluation activities

CRSCI grantees in the first phase of the study expressed that the process of evaluation started late in the BRACE model, after implementation was underway, making it difficult to establish a baseline or to establish clear feedback loops to continuously inform and improve implementation. CRSCI grantee focus group participants additionally expressed concern that many LHDs would not have the requisite expertise or manpower to implement evaluations of climate and health adaptations.

I don't think it is realistic to require (local health departments) to do an evaluation. Based on my experience, they are so resource poor, both staff and money. Unless there is a very clear template that we can pass on that they can plug and play, I don't know if they have the resources. I don't think that they would have the time to do it.

Participants recommended that evaluation be simplified in a BRACE model for LHDs, and gave the following options:

- CDC and/or state health departments implement evaluations of LHD adaptation activities
- State health departments fund and build capacity of LHD staff to implement evaluations, where staffing is adequate

- State health departments provide simple templates for LHD staff to populate with basic process and output measures on a routine basis. One state-level CRSCI grantee found success with this approach when implemented annually and with very simple performance measures, while another participant had compliance issues with LHDs when implementing on a quarterly basis with more sophisticated performance measures.

Improvement idea #6: Provide guidance for how the BRACE model can be institutionalized

Given the concern CRSCI focus group participants expressed over the sustainability of BRACE activities and the challenge of repeating the BRACE model as intended in the iterative, adaptive management approach, a common recommendation was for CDC to provide specific guidance on iteration of the BRACE model at state and local levels, and how to institutionalize the model in to local planning and programs for sustainability.

There has been a lot of information that has come out, for example, since we last did our climate and health profile or disease burden projections. I would really love if the BRACE program would start thinking about how they see these steps being reiterated. Because, for example, if we stay funded till 2021, some of the planning documents we have created will be way outdated by then.

Grantees stated that CDC should move the work beyond the “pilot” model, towards a more formal, established, and prescriptive model, whereby CDC sets out clearer expectations and allows less of “a universe of options”. CDC should help devise how to integrate the work in to what “county health departments do on a daily basis”.

Improvement idea #7: Collaborate at the federal level with other CDC programs

CRSCI grantee focus group participants in all but one focus group recommended that CDC strengthen its coordination with other CDC health programs, as a means to model the type of coordination that is needed at state and local levels, and to help create additional funding opportunities for climate and health adaptation. Collaboration with emergency preparedness was

the most commonly recommended. One participant recommended that “incentives” be inserted in Public Health Emergency Preparedness Program (PHEP) funding for states and localities to enhance climate and health adaptation. Others recommended that the PHEP approach to providing technical assistance and funding to states and localities be examined in general as a model for the CDC Climate and Health Program. In fact, when asked for ideas on local funding opportunities for climate and health adaptation, all but one focus group recommended collaboration with the public health emergency preparedness program at federal or local levels.

We are working across topic areas, but it seems that the CDC frame is to be more (single-issue) focused... They should be having conversations, not only with emergency preparedness folks but the communicable disease folks, the vector borne folks. That is how we are going to take this to the next phase. If there is cooperation on a national level, and then it will trickle down.

These other programs get CDC funding to do their work; if there were some way for them to get points or rewarded for working with their local level colleagues to get some of these climate assessments (funded), that would help us....

Improvement idea #8: Role of state in supporting LHDs

Grantees identified several important roles for the state health department to support climate and health adaptation planning at the LHD level, including:

- technical assistance and capacity-building,
- providing a central repository of data and tools,
- funding and notification of funding opportunities, and
- political leadership and advocacy.

The most common role recommended was to provide capacity-building and technical assistance to localities. In particular, grantees recommended technical assistance around simplified and downscaled climate and health profiles and vulnerability assessments, evaluation

and methods to communicate findings, and assisting localities with the integration of climate considerations in to local planning processes.

We are continuing to provide some technical assistance to the LHD even without funding them,... including to conduct their own vulnerability assessment at a much smaller scale, and more simplified for them. The vulnerability assessment that we did for the counties are still not out and approved- it's almost a two year approval process.

A lot of very approachable methods to communicating evaluation findings are being used - like little videos - that could also be factored in to just get the most value out there. I think it's really important for LHDs to know how the state did so that our evaluations can be a model for them to do their own evaluation with adaptations that work for them.

I think technical assistance (by the state is needed) for how LHDs can integrate climate considerations into their existing planning processes. So it might not be that they are creating their own stand-alone adaptation plan but helping them figure out how they can integrate climate and health in a number of different ways.

Grantees also recommended that states should encourage peer-based learning from other LHDs, including best practices and lessons learned. Participants specifically mentioned communities of practice as a recommended technical assistance approach, or one that is already being employed in their state.

We have a community of practice that we started over two years ago with our LHD. We worked with them on giving us input through webinars and also having regular calls. We emulated the CoP from the CDC BRACE project. It was really well received....It is monthly for just an hour.

I can see the state, when they define their areas of expertise or focus, providing the subject matter expertise when you have those communities of practice, either within a state or across multiple states or local health departments. A cross-section of LHDs with a state expert and maybe also people from CDC with related expertise to try to demonstrate how they approach a particular topic.

Grantees generally reported that states should serve as a resource for localities with respect to tools, research, and data and information on climate and health adaptation. States should maintain a “central repository” or “communications hub” to keep localities abreast of all

new developments in climate and health adaptation, where “(LHDs) can share different ideas, initiatives and experiences among other providers and health departments”.

Another important role recommended for states is to provide funding directly to LHDs on climate and health adaptation, and to notify them of any new funding opportunities that may exist. Participants observed that LHDs would not have flexibility in their existing funds to implement new climate and health adaptation activities, and that states should take on more effort to identify new funds, such as through regional planning commissions. At the same time, localities do not “have the time to hunt around government websites” for funding, and would benefit from having the state identify and make available opportunities that may exist.

States can also play an important role in providing political leadership and policy advocacy on the issue of climate and health adaptation. Focus group participants conveyed that in many settings, LHDs “look to the state for leadership” and that states can provide the mandate and officially-endorsed materials on climate and health adaptation that could help reinforce political support for activities at the local level. In one jurisdiction, LHDs report that the state-wide climate and health profile has been helpful to “refer to and build from” when discussing with local leaders, given its “stamp” from the state agency. Another grantee reported that “(states) can provide political cover, political leadership... giving county health departments the freedom to pursue these projects openly and not have to be so strategic or covert.” At the same time, in some settings, the state can be a political or implementation roadblock for some large and advanced cities, which have their own data and that may be in a more favorable political context towards climate activities.

We collect our own health data... We are a unique city. Our health commissioners have traditionally been activists. So we are often on the cutting edge of what is already out there. In some ways, we can be ahead of the state.

Non- grantee local health officials

Key findings from the focus group discussions with local health officials that are not grantees of CRSCI funding are identified below. The objective of these focus group discussions is to understand local health department interests, capacity, and operational requirements for implementing the BRACE model, and their recommendations for action steps that CDC could take to support adaptation in their jurisdictions. Key findings are summarized in Table 4.

Key finding #1: Diverse and fragmented climate and health activities are already underway at local levels, with priorities on health equity, flooding, and mosquito control

The majority of local health departments in this study are involved in climate and health adaptation activities, from more comprehensive adaptation and resilience planning to more single-issue based interventions. Many city health departments are working to integrate health concerns into a larger city climate action plan or adaptation plan, coordinated by the Mayor's office, or in two cases, the Rockefeller Foundation. More commonly, however, local health departments are engaged in more single-issue focused interventions, such as to address climate change impact on a natural resource (e.g. a bayou) or on a particular health condition (e.g. Zika). Health departments are actively collaborating across units in vector-borne disease, built environment, and emergency preparedness, and several are integrating climate and health considerations in to emergency preparedness and hazard mitigation plans.

Civil society-led coalitions were described as important actors in leading climate and health- related planning, such as those led by state public health association, universities, and community organizations concerned with a specific natural resource (e.g. a river or bayou). In particular, these organizations were reported as facilitating progress on climate and health work in politically unfavorable contexts where the local government would not engage or lead.

I am part of a Climate Resilience Coalition which came out of (our state public health association) and it includes representatives from surrounding county health departments.

We are going to be coming out with a white paper which is intended to be used by other local health departments throughout the state. It addresses the risks and adverse outcomes that the community, particularly vulnerable populations, are likely to face because of climate change effects. We will be coming out with that very soon and through this process we worked through the first two stages of the BRACE framework.

Table 4. Summary of Key Findings from the Non-Grantee Local Health Officials Focus Groups

1.	Diverse and fragmented climate and health activities are already underway at local levels, with priorities on health equity, flooding, and mosquito control
2.	Local health officials want the flexibility to focus on a singular, pre-existing climate hazard or health impact priority in the BRACE planning process
3.	CDC was the most helpful federal agency or national entity to local health department climate and health adaptation efforts
4.	Local health officials have strong interest in BRACE climate and health adaptation process, especially county health departments
5.	Use of alternative language to “climate change” is needed by many local health officials to advance climate and health activities
6.	Competing local government priorities and limited staff and funding are greatest operational challenges local health officials anticipate to implement BRACE
7.	The recommended leadership for climate and health adaptation planning at local levels differs by jurisdiction, and is not always in the health department or government
8.	Participants identified four key capacity areas needed to implement BRACE
9.	Optimal format for capacity-building is direct peer exchange with other similar jurisdictions, and by CDC maintaining a central repository of resources
10.	Guidance is needed on how to effectively form partnerships with new, non-traditional partners outside of the health sector, map stakeholder interests, and engage communities
11.	Local funding opportunities are limited, but local health officials see opportunities to strengthen federal funding through increased collaboration
12.	Availability and use of weather data and climate-related health data is highly inconsistent between jurisdictions
13.	Integration with local planning processes is recommended, and opportunities exist
14.	Most local health officials welcome their state governments to provide funding, convening, and technical assistance, but some see their state governments as a barrier

In most jurisdictions, multiple activities are occurring simultaneously and in a fragmented manner. One city health official describes a city-wide climate action plan led by Rockefeller Foundation and the City Mayor’s office, two strong university-led civil society coalitions advancing research and city planning related to a river watershed and sea-level rise, and a multitude of initiatives on heat, flooding, and disaster preparedness, all of which have a health component. None of these efforts are coordinated by or accountable to a singular institution or partnership, and many are outside of the health department. A minority of participants described their contexts as having little to no climate and health activities at all, due to an unfavorable political environment and lack of capacity and expertise at the health department.

Figure 8. Climate and Health Adaptation Priorities Among City and County Health Departments Represented in the Study

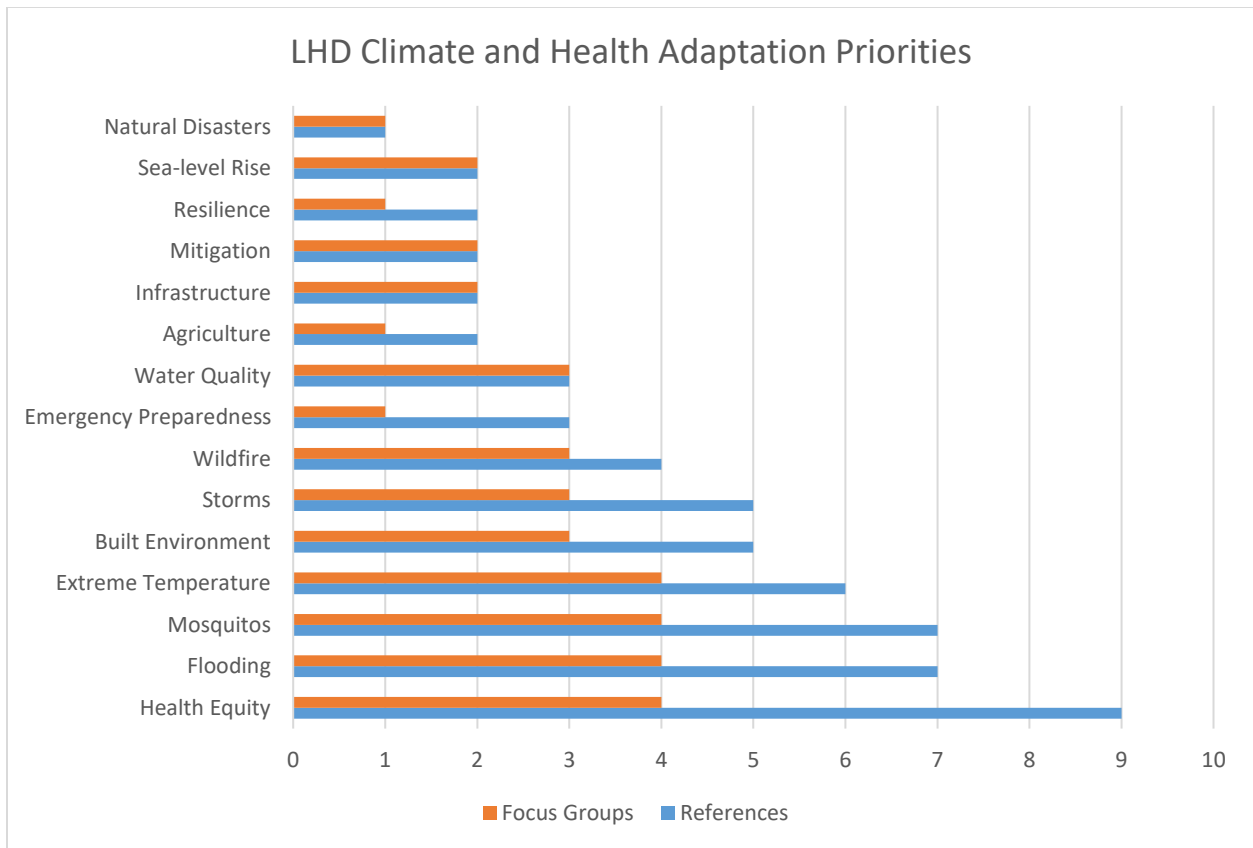


Figure 8 summarizes the climate and health adaptation priorities presently being advanced in the jurisdictions in this study, by the number of references to the priority area made by local health officials participating in the focus group discussions (“references”) and the number of focus groups in which this priority was mentioned (“sources”). It is possible that a reference was made more than once by a local health official. Health equity by far was the most commonly mentioned priority in the focus groups, followed by flooding, mosquito reduction, and extreme temperatures (mostly heat).

Key finding #2: Local health officials want flexibility to focus on a singular, pre-existing climate hazard or health impact priority in the BRACE planning process

Given the existing activities and priorities identified by local health officials, participants were asked if they preferred to implement stages 1 and 2 in BRACE by including the universe of climate hazards, exposure pathways, and health impacts in their jurisdiction, or by completing the stages on a singular pre-existing or “a priori” priority. The majority of participants felt the BRACE model should allow them the flexibility to focus on a specific “a priori” priority, i.e. a climate hazard or health impact. They felt this would make the process more manageable, efficient, faster to action, and more politically palatable with stakeholders. However, a minority of participants felt the structured process of examining the universe of hazards and impacts would lend credibility to their decision to focus on a singular priority, and would still be useful.

Key finding #3: CDC was most commonly referenced as the most helpful federal agency or national entity to local health department climate and health adaptation efforts

When asked which federal agency, national organization, or other entity has been most useful to local health department climate and health adaptation work to date, CDC was the most commonly identified. Most health departments in the study were familiar with the BRACE model, and had used it as a reference to their work, even though they are not funded grantees. Health departments also mentioned CDC in several jurisdictions as having provided a public

health associate or ASPPH fellow, who was key to advancing climate and health activities for the health department.

Health departments also commonly mentioned collaborations with the National Weather Service to obtain and analyze local weather data, and to a lesser extent NOAA for regional data. NACCHO and CSTE were two national organizations that health departments commonly referenced for their technical assistance on adaptation planning, and climate and health indicators, respectively. Lastly, EPA was referenced twice for providing some data and technical materials, and NASA was referenced for providing some project-based climate funding to their jurisdictions.

Key finding #4: Local health officials in the study have strong interest in BRACE climate and health adaptation process, especially county health departments

The majority of participants felt their jurisdictions would be interested in implementing climate and health adaptation planning as outlined in the BRACE framework, and that this work would be viable in the political context surrounding climate change in their jurisdiction. The high number of study volunteers representing county health departments (n=21), as compared to city health departments (n=7), indicates a special degree of enthusiasm by county health departments in the BRACE model and climate and health adaptation. (Note the denominators are not available, due to study methods, as explained in Chapter 2). In addition, three of the city health department volunteers represented combined city/ county health departments, with responsibilities both to the municipality and surrounding county or counties.

Key finding #5: Use of alternative language to “climate change” is needed by many local health officials to advance climate and health activities

Several jurisdictions felt a formal planning process like BRACE would not be viable politically for their health department, given resistance by industry (e.g. oil and agriculture) and/or policy-makers (often county commissioners) in their jurisdictions to recognize the human

causes of climate change. Even in jurisdictions where the politics are more favorable, the political support can vary between precincts, counties, or commissioners within their jurisdictions, or between the local health department and the state government. Navigating this patchwork of political support and opposition has led many health departments to avoid the terms “climate change” and to opt for alternative language, commonly: “extreme weather”, “increased flooding/ heat/ storm events”, “hazard mitigation” and “resilience”. They often remain neutral or silent on the drivers of the climate hazards they are addressing, and focus on demonstrating the changes that have already occurred, instead of forecasting possible future changes. These local health departments feel climate and health adaptation would not be supported in their jurisdictions if not framed in this more neutral language.

As a city, when we talk internally, we use the term climate change. But if we talk to the state, we definitely tone it down. We focus on how climate effects have gotten worse over the last couple of years or decades; and whether you believe that they are man-made or not, in the light of them getting worse, let's go ahead and address these issues as something that is happening in the city, which we need to acclimate to.

What has to be done is reframing climate change and talking about it with a little less political impact - so using words like resilience and using specific aspects of climate change...like flooding and heat islands. And while it would all be nicely packaged under climate change, maybe removing all of that terminology and still being able to address the issues minus the politics. Maybe even developing each of those areas individually, rather than as a whole.

If we were to do something like (BRACE), we would need to specify climate change and leave the issue of what is causing that climate change separate. I think if we tied it too much to human activity, it would impair our ability to proceed forward.

Key finding #6: Competing local government priorities and limited staff and funding are greatest operational challenges local health officials anticipate to implement BRACE

One of the two most common BRACE operational challenges local health officials anticipate is the strong competition for time, attention, and resources from other health priorities in their jurisdictions. The opioid crisis and behavioral health were commonly mentioned as current jurisdiction priorities. In the jurisdictions where the built environment, health equity, or

resilience to natural disasters and other shocks are priorities, some participants felt climate and health adaptation planning could be initiated, but will need to play a supportive, secondary role to these existing priorities, given they already have leadership, buy-in, and “traction” with stakeholders and decision-makers. Others noted that community health assessments drove the five-year health planning agenda in their jurisdictions, and since climate was not included as a priority in these assessments, it would be difficult to secure staff time and attention from decision-makers. Securing the approval of decision-makers at the health department and city and county leadership level (such as the Commissioner’s Court) was noted as a critical operational step in implementing BRACE.

The second most common BRACE operational challenge local health officials anticipate is the lack of staff and funding to support new activities. Many local health officials conveyed that despite the strong interest in BRACE, their jurisdictions would not be able to take on new activities, or to make climate and health a priority, without new staff. In particular, local health officials noted that dedicated staff, even in the form of a student or intern, would be needed for the “deep” research and analytical work required by BRACE and also to play a coordinating role between stakeholders. Local health officials also felt that funding constraints at the local level meant that new climate and health planning could be initiated in their jurisdictions in the short-term, but could not be sustained over time without ongoing funding.

Other commonly mentioned operational challenges noted by local health officials include difficulty obtaining and using climate and health data, narrowing down the comprehensive climate and health agenda to feasible priorities, and the need to partner with new and non-traditional partners outside of the health arena for effective action.

Key finding #7: The recommended leadership for climate and health adaptation planning at local levels differs by jurisdiction, and is not always in the health department or government

Most participants considered the city or county health department to be the appropriate responsible authority for BRACE climate and health adaptation planning. Most commonly the environment health or emergency preparedness units were mentioned, but so too were communicable disease and the built environment divisions. However, in several jurisdictions, participants recommended that this work would not sit in the health department, but instead in a city-wide resilience or sustainability office, or under a Sustainability Director. A few participants described how climate and health adaptation efforts were being led outside of the local government, by civil society coalitions, and stated that this may remain the only viable option for BRACE implementation in the short to intermediate term, due to political concerns. Some did not know where this work would best sit, and in one case this is being actively debated in the city. Decisions on the best institutional ‘fit’ depended on localized factors of capacity, resources, and political priorities.

The capacity of these authorities to implement BRACE adaptation planning is highly variable. In a few cases, health department participants felt confident about the staffing volume and expertise in data collection and analysis, as well as planning and evaluation, to implement BRACE. Additionally, almost all jurisdictions had student interns or fellows through partnerships with area universities, the CDC Public Health Associates Program, AmeriCorps, and the National Academy of Science, who were already responsible for important climate and health activities in their jurisdictions and could be leveraged in the future. In the majority of cases, however, the health departments felt their staff were already overcommitted and could not take on additional work associated with BRACE without new funding or staff.

Key finding #8: Participants identified four key capacity areas needed to implement BRACE

- *Learning from other jurisdictions:* The most common area of capacity that local health officials determined would be needed to implement BRACE in their jurisdictions is to learn about the best practices and lessons learned from other similar jurisdictions. This need is not only to help provide direction and ideas for their own activities, but to convince leaders and decision-makers in their jurisdictions that this work is important and that there are successful examples underway in other jurisdictions.

Having examples seems to make a big difference for folks. When coming out and saying, "we need to do this", to be able to illustrate "here's what a climate and health adaptation plan looks like," would be really useful. One of the questions we always get is, "Is this something (only) for big cities? Who really does this work?" So examples of smaller communities would probably be helpful. We are being asked, from our county leadership department as well as our department leadership: What's happening nationally? What else is being done and whether there are some things that have been tried and were successful or not?

- *Data analysis and use:* Many jurisdictions expressed concern that their staff lacked expertise in climate and health research, epidemiology, and data analysis that the BRACE model required. In particular, capacity is needed in how to best analyze weather and health data, and how to present the data graphically in a way that is compelling and understandable to their stakeholders. The lack of this capacity was a special concern for rural jurisdictions.
- *Implementing BRACE in rural and resource-constrained settings:* An emergent theme in the focus groups was the need for specialized guidance for rural health departments on how to advance climate and health adaptation in rural settings, with limited funding and staffing resources. Several participants described the need for a "decision-tree" or other guidance for health departments in rural areas, or in environments where funding or data

were limited. This decision tool would provide tiered guidance that would aim to lead jurisdictions to alternative methodologies, information sources, and implementation options, customized to their relative availability of resources.

- *Communicating key messages on climate change impacts on health:* Many jurisdictions perceive that key stakeholders and the public do not understand the impacts of climate change on health or do not understand the opportunities for intervention, leading to a lack of action or prioritization of the issue. As a result, they felt that “telling the story” of climate change was more important in some cases than providing more data or planning itself. Jurisdictions commonly expressed the need for “key messages” and even content for trainings and presentations that could help them in this area.

Climate change has not gotten elevated as a major concern...Part of the capacity needed would be to communicate the real impact and threat of climate change to human health. The more equipped we are to do that, the more we are able to think about how to weave this into the work we are already doing. And that would be really good for capacity building. It is probably more important than how to actually write out a plan, at this point.

Key finding #9: Optimal format for capacity-building is direct peer exchange with other similar jurisdictions, and through a CDC central repository

The most recommended format for BRACE-related capacity-building is direct peer-to-peer exchange between jurisdictions working either in a similar stage or topic of BRACE. Several local health officials already opted to network with other jurisdictions to learn from their experience, and said this direct, real-time learning is more useful than trainings or webinars they have seen. Two participants even recommended that CDC consider “regionalizing BRACE” (i.e. dividing up the country into regions), and offering training, technical support, and data based on the shared climate hazards and issues in those regions. Where webinars or other regional trainings are developed, local health officials recommended that they be tailored towards “similar sized jurisdictions and topics that are of mutual interest”. One local health official

recommended that the training be certified for continuing education credit to create an incentive for busy local health officials to participate.

As far as the format, we have looked at (BRACE) webinars, but they haven't been- well, they are a good learning tool, but I think we have to go beyond that to really take action and so peer exchange would probably be the most helpful.

Key finding #10: Guidance is needed on how to effectively form partnerships with new, non-traditional partners outside of the health sector, map stakeholder interests, and engage communities

Local health officials enumerated dozens of different partnerships they maintain as part of their existing climate-related health activities, from other health department offices, community organizations, health care coalitions, non-profit environmental organizations, offices of the Mayor or Governor, other counties or precincts, and in some cases, federal agencies and foundations. These partnerships emerged in some cases from dedicated climate action planning at their city or state level, but more commonly in response to a natural disaster, to protect a natural resource, or to advance work on existing health conditions (e.g. asthma or vector-borne disease). Notably, almost all participants described an existing partnership between their health department and local universities for technical or funded collaboration, which could be leveraged for BRACE activities. Some local health officials said their departments even have offices dedicated to assisting them with stakeholder or community engagement.

Despite their strong knowledge of traditional health partners, many local health officials expressed interest in guidance on how to effectively form partnerships with new, non-traditional partners outside of the health sector for climate and health adaptation, such as from transportation, urban planning, infrastructure, land use and other sectors. They would like to see best practices or effective models for identifying these partners, mobilizing them, and maintaining them over time. Even with traditional health partners, the local health officials welcomed guidance on tools or templates that would assist in mapping stakeholder interests,

priorities, and existing activities, in order to help them best leverage shared and complementary missions.

The strongest partnership theme among local health officials was the need for a framework for community engagement as part of climate and health adaptation planning. Many local health officials are actively engaging communities and community organizations, and some see it as the “focus” for their work. They see communities as the most “active” stakeholders because of their vested interest to protect their homes and environment. They do not need to be convinced that climate change is happening because they are “already seeing the impacts”. They can effectively lead climate and health adaptation activities, and advocate freely to policy-makers and the public on the need for adaptation investments. Local health officials also perceive engaging communities in adaptation planning as critical for advancing their mandates for community preparedness and resilience. Notably, several participants perceived that BRACE as a model lacks a framework for this community engagement. While local health officials are skilled in engaging communities for health programs, they commonly expressed the need for guidance related to community engagement for climate and health adaptation planning.

There is great benefit in having community partners as well as other agency partners, just because often times the community can advocate with a louder voice than official agencies can. I told somebody once, ‘You are allowed to yell at my boss (and I’m not).’

Community engagement is a big part of what we do. It's not really included in the BRACE framework, which is all internal prioritization. It doesn't give us a guide for community engagement... and how to speak about it.

More focus on community engagement would be helpful. Maybe something like a process that involves engaging communities. When I look at the climate and health adaptation guides, it seems to me like you need a lot of data and a lot of it is looking at public health from a one-thousand-foot view, whereas we don't really have that data available to us - what we have is just our partnerships and relationships with community members.

Key finding #11: Local funding opportunities are limited, but local health officials see opportunities to strengthen federal funding through increased collaboration

Local health officials agreed that the funding opportunities for climate and health adaptation in their jurisdictions was limited or non-existent, and that funding from CDC would be a critical input to any new climate and health adaptation planning activities. Some local health officials suggested that work could be initiated in their jurisdiction without new funding, but that a funded program would be needed to maintain momentum over time. Most local health officials were comfortable with this going through the state health departments, as is common for CDC funding. However, several focus group participants expressed concern that given the political resistance of their state governments, this would effectively eliminate some cities and counties that have the political will and capacity to implement BRACE activities. “Just because the state is opposed to it, doesn’t mean the local jurisdictions are”, one local health official noted. For these jurisdictions, they encouraged CDC to consider direct funding to enable them to participate. And as one participant noted, advancing local level work may even “influence the state opinion”.

Local health officials identified some local opportunities for funding, such as leveraging city-wide business plans and city resiliency initiatives, or partnering with local or national foundations (most commonly the Robert Wood Johnson and Kresge Foundations). However, the funding opportunity the local health officials felt was the most promising is federal grants, namely the CDC Public Health Emergency Preparedness (PHEP) and Hospital Preparedness Program (HPP) funding. Multiple local health officials suggested ways that these federal grant programs could induce collaboration between emergency preparedness and climate teams in local health departments, and encourage climate and health adaptation activities.

First and foremost, I am saying that direct grants from CDC to pay for the work involved in one or more of the steps of the BRACE model is absolutely needed....That is one

carrot to push...and the pull on the other end is: ‘Okay, we have this other grant that CDC is giving in the area of, say, vector borne illnesses. And by the way, you get a couple of bonus points if you can show that you have a climate adaptation plan in place or that you address, in your grant response, how we take in to account climate change.’

Examples given for how CDC could integrate climate and health in to existing CDC PHEP funding include:

- When HPP capabilities are up for review, CDC could insert guidance that climate and health adaptation is a priority for high level capabilities, and include this in the deliverables of the grant to the federal level.
- Offer “bonus points” or a point preference to jurisdictions that have a climate and health adaptation plan, or collaboration in place, or for addressing climate in the application
- Include climate change as a priority for health care coalitions to address in their HPP applications
- Require climate issues to be included in the mandatory risk or vulnerability assessments performed by LHDs

One local health official stated that the best way to fund climate and health adaptation at the local level is to “feed the work into a number of different grant programs, helping it become not just a single program that is stand-alone but something that is woven amongst all of the different programs”. Another stated this effort as a “climate in all” policy.

Key finding #12: Availability and use of weather data and climate-related health data is highly inconsistent between jurisdictions

Wide inconsistency exists between local health officials in terms of the climate data they have available and are able to use to analyze in conjunction with health data. Most local health officials reported they obtain climate data from academic institutions in their areas, NOAA, and the National Weather Service. The next most common source local health officials identified is

city or county reports on specific topics, for example, flooding or resilience. Lastly, local health officials also identified regional databases, Climate Central, community weather monitoring, and the state government (e.g. climatologist) as sources of climate or weather data. Most jurisdictions are doing priority-specific analysis of weather and health data, such as examining average temperatures and emergency room visits for heat-related illnesses, or examining issues of flooding and illness after a natural disaster.

However these approaches were described as ad-hoc, based on the interest or capacity of a particular staff, or prompted by a natural disaster. Approaches to this analysis varied between jurisdictions. Access to health data through environmental health tracking or syndromic surveillance was mentioned in only two jurisdictions. One local health official noted they did not even have access to hospital data in her jurisdiction, as it was not required to be reported in their state.

Key finding #13: Integration with local planning processes is recommended, and a range of opportunities exist

Local health officials agreed with Phase 1 findings that integration of BRACE activities in to local planning processes would be a helpful step to secure buy-in and overcome resource constraints.

I think the challenge would come back to the staffing levels and how much time people can commit to it. If we are working on the capacity level, trying to build capacity and getting some program to commit staff resources for a certain duration, that is probably more likely to get support than saying we have to develop an ongoing commitment to addressing this. If it can be woven into the preparedness program or some other existing program, that would make it easier to stomach.

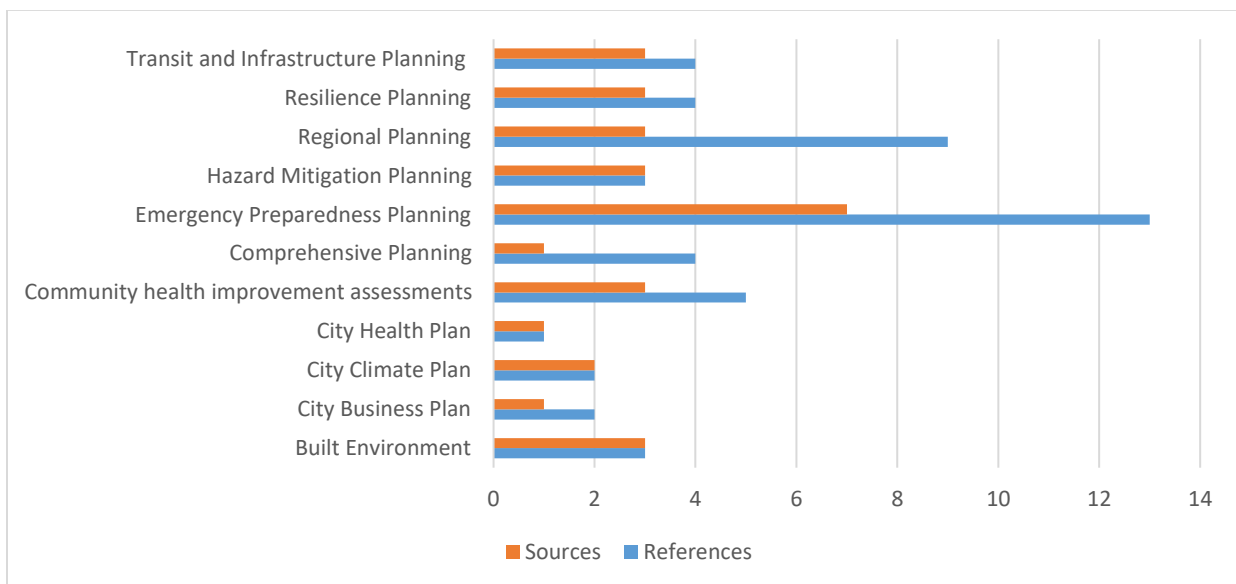
When asked to identify the opportunities for integrating BRACE climate and health adaptation planning activities in to existing local city or county planning processes, local health officials commonly identified the eleven areas illustrated in Figure 9. The most common area of

integration was with city or county emergency preparedness planning, which in some settings already tracks weather and temperature trends. A substantial number of focus group participants were themselves responsible for emergency preparedness activities in their jurisdictions, which signals a degree of interest in the climate and health topic from this community. One local health official noted that the area of emergency management at the local level is “probably the closest thing you have to all the different disciplines coming together”, which could be leveraged for climate and health adaptation.

Some local health officials warned, however, that the emergency preparedness planning process was too “top-down” in process and shared different values:

In some cases, the state health department will basically give you a template and you will fill in the blanks and from there you've got a plan...It's literally that bureaucratic. We don't really bring the community together and talk about what our priorities are. I think that it could be incorporated into disaster preparedness, if anything. In the county we have a local emergency planning committee; they are members of different organizations that meet every month to make preparedness plans, hazard mitigation plans and they are working on a document to make a disaster plan. But the problem is that those groups tend to be more conservative than people that we see at the health department. It would take a long time for them to get on board with making a climate adaptation plan.

Figure 9. Areas of Opportunity for Integrating BRACE in to Local Planning Processes



For this reason, local health officials want guidance on how to work with people “across disciplines”, who use different language and priorities for their work. The second most common area of opportunity for integration of BRACE activities that local health officials mentioned is regional planning. Regional planning includes coalitions of city and/or county public departments or health care facilities, regional planning commissions, and regional planning boards. Local health officials felt these groups were advantageous in that they already convened a wide range of stakeholders, and represented strong planning capacity. One local health official observed that approaching climate and health adaptation planning from a regional perspective would be “the best approach, particularly for smaller jurisdictions, with smaller populations”. Another local health official from a small department agreed:

I think (a regional approach) is the only way for us to feasibly try to do it - to have the help. When I said region, I was thinking of the healthcare coalition. I think they can do a lot because there are so many sectors and there may be a way to get some of that in to it because it involves hospital and public health.

However, one local health official noted that these coalitions often do not have as many non-health sectors that would be needed for climate and health adaptation planning. Still, one local health official noted that their regional health board just adopted a “master plan” that included health and environmental components.

Key finding #14: Most local health officials welcome their state governments to provide funding, convening, and technical assistance, but some see their state governments as a barrier to progress

Most participants welcomed the role of state governments and state health departments to support climate and health adaptation planning in their jurisdictions, and identified six useful roles states could play, illustrated in a hierarchical table in Figure 10, in cascading order of importance (with the most common roles representing larger boxes that are higher in the table).

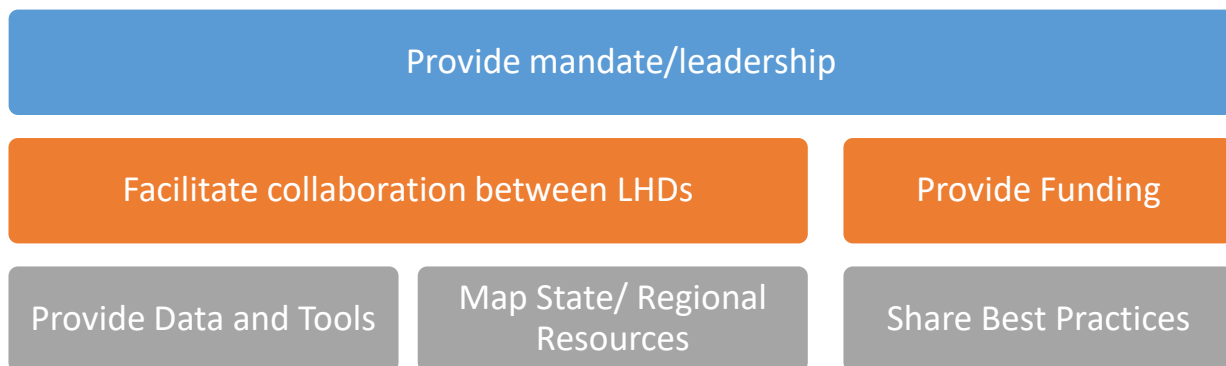
The most important role that local health officials felt states needed to play is to provide

leadership and a mandate on climate and health, which local health officials could use to justify their work. The second most common role is to facilitate collaboration between local health officials in the climate and health adaptation area, allowing them to work on climate issues that transcend a single jurisdiction.

In our state there has been a big push under the previous administration - they termed it population health - and if the state health department chooses to get on board I think climate change would sit very well under the umbrella of their topic of population health without saying climate change, per se. So there is a framework where it could fit in, but it's if they choose to step up to that leadership role.

Something I really think would be really cool is if the state facilitated more of a collaboration between all the local health districts... it would be nice if there was a better process in place for communicating with other health officials who might be working on the same issues.

Figure 10. Hierarchical Table of Roles State Government Can Play to Support Climate and Health Adaptation Planning Among Local Health Officials



Many local health officials also recognized that states could provide funded activities on climate and health adaptation, as well as climate or weather data and tools for implementing various aspects of BRACE. Lastly, a few participants suggested that state governments could help map resources, such as partners, existing grant mechanisms, and foundations, which local health officials could use to support their work, as well as best practices from other areas of the state and country.

In our state, for BRACE to be implemented, it would have to come to the state, which would have to accept it and then implement it within collaboration with locals. Even if they didn't implement it in all of our counties, they could implement it within the two major metropolitan areas and expand from there.

However, participants in every focus group expressed concern about the limitations of the state role. Some participants mentioned that political opposition or low levels of capacity at the state level could slow down adaptation activities at the local level or stop them altogether. States may also face the challenge of reaching consensus on priorities given the heterogeneous nature of climate issues across the state. For this reason, some local health officials wanted to work around states or simply keep them informed of their work. One local health official mentioned that local health official preference for state involvement may depend largely on the degree of centralization of authority between the state and local governments.

Our state health department needs to kind of step aside and let us do what we need to do. Yes, I think that's the best thing that they can do. They're a very under-resourced department and I think often just slows processes down.

It is probably best if we just do our own thing. The big cities are moving at their own pace and if they can work with each other that would be better.

CHAPTER 6: DISCUSSION

This study was designed to answer the central research question: **What is needed to expand climate and health adaptation planning among U.S. state and local health departments and what are the implications for CDC’s BRACE model and strategy?** The study comprised three research aims:

- 1) Assess the experiences of state and local health departments in the U.S. to date in climate and health adaptation planning;
- 2) Consult state and local health departments on operational resources and needs for climate and health adaptation planning, and their recommendations for improvements to the BRACE model
- 3) Provide a plan for change for CDC to expand adaptation planning among state and local health departments that have not yet implemented BRACE

The study’s literature review and secondary analysis of CRSCI interviews were designed to assess state and local health department experiences with climate and health adaptation planning to date, while focus group discussions were designed to consult state and local health departments nationwide on their operational requirements and resources for climate and health adaptation, and recommended improvements to CDC BRACE model and assistance strategy. Findings from both phases of the study are discussed below. Research aim 3 is discussed in its own chapter, entitled Plan for Change.

Standardization and evidence-based approaches

The literature review and the analysis of BRACE implementation by CRSCI grantees paint a similar portrait of climate and health adaptation planning among state and local health departments in the U.S. - one that is highly nascent, fragmented, and context-specific.

Documented examples of climate and health adaptation planning at the subnational level in the U.S. are few in the literature, and where they exist, authors describe planning efforts as ‘inadequate’ and inconsistent across jurisdictions, and highly contingent on structural capacity and political context, in addition to jurisdictional variations in climate hazards and population dynamics. Even in the context of a funded program with a shared conceptual model, this study found that CRSCI grantees conducted highly diverse processes and practices, with different datasets and tools, focused on different climate and health priorities, and leveraging diverse partnerships.

The experience above underscores the message made by one author that “there is no one-size-fits-all approach” to climate and health adaptation planning at the local level. However, with the growing magnitude of health impacts from climate change, and the extremely limited resources available for adaptation, the adaptation community would benefit from shifting from this approach of “letting a thousand flowers bloom” and move toward more standardized, evidence-based approaches, which maximize public health impact and efficient use of resources, and which can be conveyed in a compelling business case to policy-makers, communities, and other stakeholders to secure their support. Roser-Renouf suggests in their 2016 national survey with local health departments that one of the barriers to prioritization of adaptation expressed by respondents is having to demonstrate their value against competing priorities and programs that can show impact in the short term (i.e. not in some future time horizon), a finding supported by non-grantee focus groups in this study, which identified it as a primary obstacle they anticipated

to adaptation in their jurisdiction.⁵⁴ This reinforces the need for more guidance by national authorities, including CDC, on proven interventions, and for greater investment to expand the evidence-base demonstrating the impact of these interventions.

This call for greater reliance on evidence-based approaches has been made many times in the literature, and several authors have stepped forward to provide common adaptation interventions, best practices, and systematic reviews of evidence-based interventions.^{42,62,74} What appears to be missing is the systematic translation of this work at the subnational level, a role CDC is uniquely positioned to play given its historical role of translating public health evidence to practice across disease areas, through use of guidelines, technical assistance, advocacy, and funding. The CRSCI grantee call in this study for CDC to provide more ‘prescriptive’ approaches is a strong indication that many state and local health departments would welcome CDC to provide more synthesis of the evidence-base and greater endorsement of particular interventions or approaches through its funding and technical assistance.

This study’s characterization of BRACE implementation among CRSCI grantees is itself a useful contribution to the limited evidence-base in the literature. Analysis of CRSCI grantee interviews identified key challenges and enabling factors CRSCI grantees experienced implementing BRACE, and, using a systematic framework, identified key inputs, processes and practices, and outcomes of climate and health adaptation planning among state and local health departments across the U.S. The subsequent focus group discussions with CRSCI grantees offered a unique opportunity to directly consult the health departments with the most experience with the BRACE model to provide recommendations on its improvement. Having these focus group discussions occur after the analysis of CRSCI interviews allowed the researcher to summarize key challenges identified by the grantees, share them for discussion in the focus

groups, and focus the majority of the discussion on finding solutions to the shared challenges. The researcher was then able to take these grantee solutions, coupled with her own ideas, to the focus group discussions with non-grantee local health officials, to seek their direct feedback as well as their own novel solutions. This methodological sequencing was a successful approach that could be employed for other operational studies designed to improve a program's model or implementation approach.

Continuation and adaptation of the CDC BRACE Model

On the whole, CRSCI grantees gave strongly positive feedback about the impact of the BRACE program in their jurisdictions. The benefits provided to grantees by BRACE, including building capacity and knowledge among health department staff, expanded collaborations with other health and non-health stakeholders, providing a concrete and credible framework for planning, and elevating health as a critical domain in climate work within the jurisdictions all suggest that CDC's Climate and Health Program played an extremely significant role in initiating and expanding climate and health adaptation in the U.S. Indeed, this program was the first of its kind to pioneer a national climate and health adaptation model for state and local health departments.

The depth and breadth of the adaptation interventions that were inspired through CRSCI lend further evidence to the important role vulnerability and adaptation assessment plays in facilitating adaptive capacity and resilience. As such, continuing and expanding implementation of the BRACE model is an optimal approach to building adaptive capacity and resilience across the U.S., a finding that was echoed in a recent review of CRSCI climate and health profiles.³⁷ This conclusion is reinforced by the finding that non-grantee local health officials deemed the CDC the "most helpful" federal agency or national entity to their climate and health adaptation efforts in their jurisdictions, despite not being funded by CDC. This paralleled the finding from

the literature review, where 5 of the articles were funded by or pertained to CDC-funded activities. As a result, this study makes it clear: what CDC chooses to do or not do in climate and health adaptation matters to the work of states and localities, even those that are not funded directly by CDC.

However, the findings also suggest that the BRACE model in its current form will not be easily or readily adopted by local health departments. The primary challenges CRSCI grantees experienced were first and foremost a lack of funding, followed by a lack of adequate staffing and expertise, information availability and use, and collaboration with other units in the health department, which are highly consistent with other studies of local climate and health adaptation planning.^{44,75,76} And yet the CRSCI grantees identified dedicated funding, new staff, CDC technical assistance, and existing partnerships related to climate and health as essential inputs to successful implementation of BRACE. CRSCI grantees and non-grantee local health officials agreed in this study that local health departments generally face greater constraints in these key inputs than CRSCI grantees, and will have even more challenges implementing the BRACE model. Therefore, this study confirms the study hypothesis that substantive adaptation of the CDC BRACE model and approach will be needed for its effective use at the local level. The “enablers” identified by CRSCI grantees, of funding, communities of practice with other jurisdictions, existing staff, partnerships, and flexibility in the model, are all helpful to understanding the success factors that will need to be in place to implement this adapted BRACE model, which are consistent with those found in other adaptation studies.^{77,78} These can be articulated in guidance as well as technical criteria that jurisdictions are required to speak to in their applications for funding.

Funding and integration with local planning and programs

It is not surprising that funding was identified as the number one operational need by non-grantee local health departments to implement climate and health adaptation, as this is a barrier commonly found in other adaptation studies.^{49,50,52,53,56} Funding and a higher income overall in jurisdictions has been repeatedly correlated with higher levels of adaptation at local levels globally.⁷⁷⁻⁸⁰ However, as discussed in the introduction, new opportunities for federal funding will be limited in the intermediate term, and non-grantees in the study identified few new funding opportunities for climate and health adaptation at the local level. Advancing adaptation without new funding requires us to examine other enabling factors that may be supported. Promising findings by Roser-Renouf and other researchers have identified national planning requirements, staff expertise, political leadership, national policy commitment, and integration with local programming to be mediating factors or actions that can advance adaptation in the absence of new funding.^{54,78,80}

For this reason, this study actively explored the possibility for integration of adaptation with other local planning and programmatic efforts, as an approach to leverage other funding sources. This study found that CRSCI grantees commonly worked to integrate BRACE-related climate and health activities into other health programs, such as disaster preparedness or vector-borne illness, even though they received dedicated ‘vertical’ funds for the work. This practice reflects the “mainstreaming” called for across the global literature, and, importantly, contributes to institutionalization of adaptation activities that CRSCI grantees felt is lacking from guidance around the BRACE model.^{20,81,82} Non-grantees made it clear integration with other health and non-health program areas in their jurisdiction is critical for programs to be feasible and durable, perhaps even more so, they suggested, than at the state level.

These findings are at odds, however, with the experience of some CRSCI grantees, who encountered tension or issues related to ‘turf’ when attempting to collaborate with other health units. These grantees mentioned this is coupled with a lack of clarity around the role of their climate and health program vis-à-vis existing environmental health programs. This finding offers insight into a key operational obstacle that stymies the mainstreaming called for by so many in the literature. A vision for, and real-life models of, how climate and health teams / programs operate in relation to other health teams/ programs in state and local health departments would be a simple first step to strengthening integration and mainstreaming of adaptation in the U.S.

So, while new funding is needed to made serious gains in adaptive capacity among state and local levels in the U.S., an immediate opportunity exists in work to advance integration of climate and health adaptation with other local planning processes and programs. The “America’s Choice” review of mitigation and adaptation efforts across the U.S. goes a step further to recommend that the federal government “should facilitate coordination of the many interrelated components of America’s response to climate change with a process that identifies the most critical coordination issues and recommends concrete steps for how to address these issues.”⁸³ This lends further encouragement for CDC to support localities with specific guidance to improve integration of climate and health adaptation into local planning processes in their jurisdictions.

De-emphasizing the stand-alone adaptation plan

Another integration issue that emerged in the study was the decision to produce a stand-alone climate and health adaptation plan for the jurisdiction, versus integrating this content as a chapter or annex to a general jurisdiction-wide climate adaptation or action plan. Several CRSCI grantees, and notably the two city CRSCI grantees, opted for the latter, and deemed this

necessary for the plan to be relevant, funded, and supported. Grantees that produced stand-alone health-focused plans expressed satisfaction with producing the document, but noted many challenges related to the length and format of the report, its usability to a wide audience of stakeholders, difficulties getting the report approved by higher levels of government, and the difficulty in translating it to action. These findings suggest any efforts to advance climate and health adaptation should emphasize integration with the most relevant and strategic local planning instruments in each jurisdiction, rather than production of a stand-alone climate and health adaptation plan. Indeed, in UK guidance on climate and health adaptation to localities, “including adaptation planning in their local high level frameworks for planning and development” is considered a program “expectation”.⁸⁴

Adequate staffing and more peer-based capacity-building

Second to funding, the lack of adequate staff and expertise was articulated by CRSCI grantees as a primary challenge to implementation of BRACE, which aligned with the experience documented in the evidence base.^{49,52,53} It was also echoed as one of the key operational barriers that non-grantees expected to face when implementing a BRACE model of climate and health adaptation. Given that department staff expertise was found to be the greatest predictor for climate and health adaptation implementation among local health departments surveyed by Roser-Renouf et al in 2016, this may illustrate one of the most important areas for investment by CDC and others to help advance climate and health adaptation among state and local levels. Clearly, the CDC investment through BRACE was a critical first step in building this capacity among state health leaders; this study provides further support for a new phase of capacity-building that elevates the capacity, expertise, and leadership of state and local health department staff as perhaps the most important step to advance climate and health adaptation at local levels.

When discussing the state of staffing with non-grantee jurisdictions in the focus groups, it is noteworthy that many *non*-health department authorities were identified by non-grantees as the responsible authorities for climate and health adaptation in their jurisdiction. This is an important consideration for anyone interested in advancing climate and health adaptation in a local jurisdiction- the institutional home for these activities may not be in the health department, or among health officials. A recent review of climate and health adaptation among local governments in Japan similarly identified a range of health and non-health authorities leading climate and health adaptation initiatives.⁸⁵ This has implications for how eligibility is determined in CDC or other funding agency announcements for climate and health adaptation, for outreach and communication strategies, and even for the development of technical guidance.

The degree to which state and local health departments commonly depend on students and interns to advance climate and health adaptation planning is also notable. In the long-term, a viable climate and health program in each jurisdiction needs ongoing, paid staff. However, in the short term, actively leveraging students and interns is proven strategy that new jurisdictions could adopt as a means to make progress amidst resource constraints. CDC could advance dialogue with its Public Health Associates and Association of Schools and Programs of Public Health fellowship programs to see where additional opportunities may exist to support state and local jurisdictions in climate and health adaptation. Schools of public health around the country could also look to advance opportunities to match students with local health departments to advance climate and health adaptation activities.

Regarding the CDC technical assistance provided to CRSCI grantees related to BRACE, the CRSCI grantees faced challenges, including the late release of guidance and the lack of awareness of available technical expertise or of ongoing relationships with experts at

headquarters. Many grantees also complained the technical guidance was “overly academic” and difficult to interpret. CRSCI grantees universally deemed the “communities of practice” supported by CDC to be a critical enabler to their achievement of BRACE, and so, too, were other opportunities for jurisdictions to communicate directly with each other to share tools, resources, and lessons learned. CRSCI grantees recommended that more peer-based learning models be supported, a recommendation wholly supported by non-grantees, who stated that their most important area of needed capacity is to learn from other jurisdictions, and their most optimal format for training is peer-based models.

These findings are consistent with the literature, which repeatedly express the need of local health departments for case studies, best practices, and templates from adaptation planning in other jurisdictions, and the desire for more direct peer-to-peer learning.^{49,52,54,56} CDC and others could respond to these findings by making guidance more operational in nature, such as by providing a toolkit or workbook for localities (akin to Ontario’s climate and health adaptation planning tool or the UK guidance to local health departments on climate and health adaptation planning).^{84,86} Likewise, CDC and other entities could enhance existing peer-learning approaches by adopting more structured methods employed by formal learning collaboratives, such as those successfully undertaken by Institute for Healthcare Improvement, Robert Wood Johnson Foundation, and CDC global HIV programs.^{87–89}

Non-grantee local health officials mentioned specific needs for training and technical support, which were most commonly: identification and use of data in climate and health adaptation planning and simplified evaluation techniques. Non-grantees felt conducting evaluations of their activities could not be completed without targeted assistance, and would require funding, staff, and expertise that most did not have. Non-grantees also recommended that

CDC technical guidance include simplified approaches for rural areas and resource constrained settings. So as not to hamper the highly resourced local jurisdictions (like major metropolitan areas), the implication is that CDC guidance, or guidance by another interested entity, will need to be modular and tiered by capacity (such as by “high” and “low” or “long time horizon” or “rapid assessment cycle”).

CRSCI grantees recommended that CDC bring together local jurisdictions in a program organized by common topic of interest, or their common stage in the BRACE model, so that jurisdictions can benefit more from conducting activities at the same time as their peers. This recommendation was echoed by non-grantees, who recommended that CDC consider “regionalizing” BRACE, or forming sub-groupings of jurisdiction based on climate regions, so that jurisdictions would be working on the same climate hazard. The implication is that CDC consider changing its approach by moving away from organizing grantees just by geographic region- wherein jurisdictions may have several distinct climate hazards that are prioritized- and towards groupings based on specific climate hazards. In considering how to group grantees, CDC may further consider the strong interest and participation by county health departments in this study; while counties were not the initial focus of CDC expansion plans, this study suggests they should be considered an eligible grantee alongside cities and states. The experience shared by CRSCI grantee city health officials in this study also suggests that different levels of jurisdictions (i.e. city and state) should not be combined in the same community of practice.

Coupling adaptation with a health equity paradigm

There was broad consensus among grantees and non-grantees regarding the need to address health equity and social determinants for health in their climate and health adaptation planning. CRSCI grantees stated that the connecting their work in climate and health with the subject of health equity was paramount in their efforts to integrate into local health planning

efforts; one grantee’s climate and health program was located in the office of health equity, while others stated that health equity was a stated priority in their jurisdiction-wide health plans. Non-grantee focus groups also identified health equity as one of the most popular areas of current climate and health priorities in their jurisdictions, which is consistent with the literature, which widely calls for addressing vulnerable populations and inequities in vulnerability as a fundamental component of climate and health adaptation.^{68,90,91} However, the need for health department staff in the U.S. to explicitly tie climate and health adaptation efforts with stated priorities in health equity and social determinants for health for the purposes of improved integration or mainstreaming did not emerge in the literature review, and appears to be a novel finding from this study and one that could be addressed in the new BRACE model or other adaptation efforts.

CRSCI grantees recommended that the new BRACE model provide guidance on how to connect climate and health adaptation with a health equity paradigm. The European Union “Strategy for Adaptation to Climate Change” calls explicitly for nations to include health equity and social determinants for health as a paradigm for their adaptation efforts, and a follow-up evaluation found three European countries as models in this regard- Austria, England, and Sweden.⁹⁰ CDC and those interested in advancing the health equity and social determinants for health agenda in adaptation planning could look to these countries as examples.

More guidance on models and best practices for stakeholder engagement, in particular, communities

This study also revealed another gap in the present BRACE model- guidance around stakeholder mobilization, and in particular, community engagement. Examples of community engagement were not abundant in CRSCI grantee interviews, as compared to other common practices, such as integration. In the CRSCI focus groups, CRSCI grantees recommended that

more guidance would be beneficial on how best to engage communities, as well as non-health stakeholders. Non-grantees echoed the importance of community engagement at their level and the majority confirmed that guidance in this area would be welcomed. Regarding other stakeholders, non-grantees stated that they are very well aware of the health partners in their jurisdictions, however they agreed that having the state health department map state-level or regional partners, or funding opportunities, would be useful, as would learning best practices from other jurisdictions on partnering with non-traditional partners from non-health sectors.

Many authors, including from WHO, have called for community engagement as a critical component of adaptation, and Maibach and other researchers even suggest community-led adaptation can help advance adaptation in areas where political will or government capacity is low^{18,55,64,81,92,93} Because the health impacts of climate change are specific to population and regional vulnerabilities, community engagement is critical for understanding local risks and vulnerabilities, developing appropriate solutions, and fostering collaboration, buy-in, and ownership.^{18,94} Ebi and Semenza, 2008 provide a helpful framework for community-based adaptation that could be considered in the production of guidance in this area.⁶⁴

Likewise, global research and WHO guidance deem multisector partnerships as critical to the success of adaptation efforts.^{18,68,95} In one review of adaptation among OECD cities, the researchers found that “early stakeholder engagement” through clear coordination mechanisms was “critical to enhancing effectiveness” of adaptation efforts, and even helped secure funding for ongoing adaptation.⁹⁶ As a further measure of the importance of stakeholder engagement to climate and health adaptation planning, “inclusion of stakeholders” is one of 14 criteria used to evaluate global vulnerability and adaptation assessment models in a 2008 review.¹⁷ These

findings suggest that community engagement and stakeholder mobilization are key domains for a revised BRACE model, and that grantees would benefit from specific guidance in this area.

Weather and climate information and analytical methods in accessible, user-friendly formats

Non-grantees reported widely inconsistent availability and use of climate data in their jurisdictions, a challenge also articulated by CRSCI grantees. This is not surprising, given studies in the literature review that suggest as few as 13% - 30% of local health departments are using long-range weather data in their work.^{53,55,56} However, with continual advent of new federal data sets such as those produced by NOAA, EPA, NIH and others, attention should be paid to why these data are not being used. Awareness of the data, the availability of simplified, validated methods for using it, and the expertise to apply those methods are all explanations that shed light on the challenge. CRSCI grantees generally called for guidance that is more “prescriptive” than a menu of options; it is recommended that CDC and others consider more operational, user-friendly formats for presenting priority weather data to localities and methodologies for their use. Given the overwhelming focus on heat as the priority area among CRSCI grantees (due to wider availability of literature and science in this area), it is recommended that non-heat areas be given priority for this guidance.

Small-scale efforts build adaptive capacity for more robust adaptation over time

The BRACE implementation performance index employed by the study helped to reveal that existing partnerships and previous climate and health activities matter; these inputs allowed select jurisdictions to implement BRACE stages more thoroughly in the time provided than jurisdictions without these inputs, in a way that seemed to surpass funding, staffing, or even robust sources of information as comparable inputs. The lesson this imparts is that even climate and health measures that are small in scope can help build critical adaptive capacity that enables more robust climate and health adaptation planning over time. The implication for CDC and

others is not to let the ‘perfect be the enemy of the good’, but to focus on inspiring and supporting climate and health adaptation activities- even modest in scope- in a wide breadth of jurisdictions nationwide, instead of employing more robust approaches in only the highest-capability jurisdictions.

Flexible models allowing for non-linear adaptation planning

Nearly all CRSCI grantees implemented the model in a non-linear fashion, and felt that the flexibility afforded by CDC for them to do so was a key enabler to their success. Further, many grantees and non-grantees described the need or benefit to enter various phases of the model concurrently. Focus group discussions with non-grantees illustrated that a wide range of climate and health activities are already underway in many jurisdictions, and some of these activities follow the BRACE model to some extent. Consequently, these jurisdictions are not starting with a tabula rasa at stage 1, but will in reality be undertaking stage 1 activities at the same time as the activities of several other stages. The implication for the CDC BRACE model or any other adaptation model is that it should retain flexibility in the sequencing of major activities, allowing grantees to enter the planning cycle at any phase and to conduct the stages concurrently as needed. This is not a principle that is widely described in the climate and health adaptation models of other industrialized countries, which are depicted as least graphically in a linear or circular sequence, and appears to be a novel finding from this study⁹⁷⁻¹⁰⁰.

Greater use of down-scaled methods of risk assessment

The analysis of CRSCI interviews revealed that grantees were not able to complete all of the stages of the BRACE model, even those that had six years of funding and technical support from CDC to do so. For CDC to accomplish its objectives to expand climate and health adaptation planning among state and local health departments, a substantive change to the BRACE model is needed to reduce its time and resource requirements. CRSCI grantees deemed

the most resource intensive stages were 1-3, and that these should be downscaled and made more accessible to resource-constrained jurisdictions. As one example, the majority of grantees noted that using historic weather trends and qualitative assessments of current and future health impacts were sufficient – and at times preferable to quantitative projections- to persuade policy-makers and the public to support adaptation efforts in stages 1 and 2. While relying on this qualitative approach will not be sufficient for comprehensive adaptation to climate change in the U.S., it is an incremental step that should be recommended as an optimal approach for local health departments facing constraints in staff, funding, and expertise (rather than its current framing as an acceptable alternative). In fact, a recent global review of adaptation efforts in 35 global cities from OECD and non-OECD countries found that the majority of cities used qualitative risk assessment methods, over quantitative ones.⁹⁶ Comparative research of climate and health adaptation planning models endorse this downscaling of assessment methods based on jurisdictional capacity, even calling for low resource settings to use vulnerability-based assessment approaches instead of the more robust hazard-based approaches.⁹⁷

Another strategy for downscaling stages 1-3 used by CRSCI grantees is to enable local health departments to select ‘a priori’ health or climate priorities for adaptation, instead of using stages 1 and 2 to determine the universe of climate hazards, exposure pathways and impacts as a means to formulate priorities. Non-grantees resoundingly agreed they wanted the option to do this; however it is important to note that a minority felt the process of examining the landscape of hazards first would lend credibility to their planning. This is an area where jurisdictions could be provided the option and guidance to decide for themselves the appropriate approach, based on interest, capacity, and resources. CRSCI grantees also commonly encouraged outsourcing of the

more technical aspects of these stages to academic partners, and the outsourcing of Stage 3 to CDC.

Shorter adaptation planning-implementation feedback loops and temporal scale issues

The trade-off in time spent on planning versus implementation was also discussed by CRSCI grantees as a challenge in the BRACE model. Non-grantees agreed that they have even shorter implementation cycles than the state, and less of the ‘luxury’ to spend long periods of time on planning processes and more ‘pressure’ to implement. A revised model will need to enable a more rapid transition from planning to implementation, to produce momentum from small ‘wins’ and contribute to an iterative development of capacity and interventions. This aligns within the construct of adaptive management upon which the BRACE model is based. One strategy is to have a shorter, high level framework for climate and health adaptation for a jurisdiction, comprised of key objectives for a five year period, and a more actionable implementation plan that is written each year. Certainly, the integration of planning elements to other local planning processes may also help catalyze implementation, as officials are not left waiting for the approval of a stand-alone plan before taking action.

Additionally, the discussions with CRSCI grantees and non-grantees revealed a tension experienced by local jurisdictions between the need to plan for adaptation measures to address present health threats due to climate variability and preparing to adapt to future health threats projected due to climate change. Some grantees noted that insufficient adaptive capacity was in place for present health threats, and that focusing on this first was one way to secure political and stakeholder support. Other jurisdictions welcomed the opportunity to address future health threats, but expressed desire to have more guidance in terms of the time-scale of these adaptations (e.g. should they be framed in 20, 50, or 100 year time frames?) Moving forward, the planning process would benefit from providing specific guidance on how jurisdictions should

address the temporal scales of adaptation. One assessment approach in the literature provides a useful approach to this end, by proposing that jurisdictions first analyze current health risks and then identify adaptation options to address those current risks (i.e. “coping strategies”), before taking on analysis of future health risks and adaptation options (i.e. “adaptive strategies”).⁹⁴ This is in subtle contrast to the BRACE model, which combines these two temporal scales in stages 1 and 2, before adaptation options are identified and prioritized.

Navigating politics and use of language

Consistent with the literature, the analysis of BRACE implementation in this study revealed that the politics surrounding climate change will continue to play an out-sized role in influencing adaptation efforts at the sub-national level in the U.S.⁵⁴ Notably, many of the CRSCI grantees describe their environment as having favorable politics towards climate change; however, even in these settings, grantees stated the need to employ extensive efforts to train and sensitize stakeholders on the impact of climate change and health and to use alternative language to obtain the buy-in of the public, policy-makers, and key stakeholders. In unfavorable settings, CRSCI grantees faced delays, narrowed scope of allowable activities, and even the removal of the program from the state health department. The increased polarization of American politics regarding climate change, as noted in the literature, signals that the effect of politics will influence adaptation differently in local jurisdictions- catalyzing it in some and stymieing it in others.⁵⁴ CDC and others would benefit from a strong understanding of the political environment of climate and health adaptation in the jurisdictions they aim to serve.

Non-grantees confirmed that politics will continue to play an influential role in their adaptation efforts, and they strongly recommended CDC use alternative language such as “extreme weather”, “resilience” and “sustainability” or frame initiatives in terms of specific health impacts (e.g. heat-related illness) to help its acceptability in their jurisdictions. This is

consistent with the literature that “reframing” of climate change has had to occur in many settings for action to progress.¹⁰¹ Of particular importance, non-grantees conveyed a strong need for CDC technical assistance to communicate key messages on the impact of climate change on health, and on the availability of effective solutions, to their public and key stakeholders, to bolster support for climate and health adaptation. Several studies point to the role perception of risk by communities and policy-makers plays in driving adaptation, irrespective of funding or other resources.^{76,78,102} This is an important opportunity for CDC to assist local jurisdictions to reduce political opposition through the provision of science-based public health messaging, a core CDC function that it provides across its many disease areas.

Common metrics and shared evaluation practices

Given the dearth of climate and health adaptation planning examples in the literature, it is noteworthy that CDC made evaluation an important component of BRACE, and supported the development of evaluation plans among its CRSCI grantees. However, the grantees felt that the evaluation efforts came too late in the process (after the plans and implementation were well underway), preventing them from collecting baseline information or controls that would enable more robust evaluation methods. CDC is not alone in this approach; multiple global vulnerability and adaptation assessment models depict M&E as a final stage in a linear adaptation planning process, even if their guidance may call for jurisdictions to design evaluation early in the planning process.^{82,84,86,99,100} In the field of evaluation, it is best practice to design evaluations alongside program plans, not retrospectively.¹⁰³ To make this recommended approach more explicit, CDC would benefit from adjusting the BRACE model to include monitoring and evaluation as an explicit component of early stages (such as implementation).

CDC supported a “community of practice” on the topic of evaluation, and provided technical assistance in form of an evaluator to assist CRSCI grantees in the design of their

evaluation plans. However, grantees still employed a diverse range of both evaluation methods and indicators, representing a lack of standardization between the grantees. Further, CDC does not maintain a national evaluation of the BRACE program, which would be essential for benchmarking progress, identifying high and low performers, and for conveying impact to policy-makers and funders. Globally, monitoring and evaluation efforts for climate and health adaptation are nascent, and repeated calls have been made for more robust monitoring and evaluation, and for standardization of indicators, even on a global scale.^{44,67,68,79,104} Immediate opportunities exist to link with efforts such as the Lancet Commission to track a core set of climate and health adaptation indicators in the U.S., and with neighboring Canada, which is developing a national evaluation framework for their climate and health adaptation capacity-building program in 2018.

Enhanced collaboration at the federal level, and between state and local levels

In resource-constrained settings, where material capacity and expertise are also limited, close collaboration between state and local health departments becomes more paramount to advancing more standardized, evidence-based adaptation approaches. This study probed the opportunities for such collaboration, by inquiring about the optimal role of state health departments in supporting local health department adaptation efforts. Consistency was observed between the responses of CRSCI grantees (who are mostly state level staff) and non-grantees (who are all city and county health department staff) regarding the optimal role the state should play in climate and health adaptation planning among local health departments. Optimal roles included providing a mandate and political will, policy advocacy, the provision of data, tools, and funding, and technical assistance and capacity-building.

These findings have important implications for CDC, which historically maintains direct funding relationships with states, more than with cities and county health departments. The

optimal roles identified for states represent activities that could be encouraged of states in future funding agreements, as a means to support more local adaptation planning. At the same time, the non-grantee focus group discussions reveal that providing resources directly to states will inevitably preclude some localities from receiving support due to political opposition at their state level. Thus CDC could consider how technical and/or funding support can be provided to select cities or counties that wish to advance adaptation in the absence of state-level support.

Both CRSCI and non-grantee focus groups also commonly suggested that CDC itself could be a source of new funding, by coordinating its Climate and Health Program more closely with the CDC PHEP (and other offices), and integrating climate and health adaptation activities into their guidance, funding solicitations, and evaluation metrics. This may make new funding available at state and local levels, or at the very least, provide a mandate and positive encouragement to state and local health departments to support climate and health adaptation activities (such as a state climate and health profile). As an example, the current scorecards for the PHEP program at CDC includes the “availability of a climate adaptation plan” at the state level as one indicator. This does not necessarily require a health component to the adaptation plan, which could be added. Improving linkages with PHEP and, in particular, its national assessment of local public health preparedness, has also been called for in the literature as early as 2011.⁶¹

CHAPTER 7: PLAN FOR CHANGE

The third aim of the study is to: **Provide a plan for change for CDC to expand adaptation planning among health departments that have not yet implemented BRACE, with a focus on local health departments.** In this chapter, the P.I. provides eight recommendations for CDC based on study findings to improve the BRACE model and assistance to states and localities, and presents a new BRACE model for local health departments based on these recommendations. Finally, this plan for change presents a strategy for how the recommendations and model could be implemented by CDC, and, as an alternative option, by a civil-society led coalition, followed by a summary of the study limitations.

Recommendations

Table 5. Summary of Recommendations to CDC in Order of Priority

1.	Downscale and consolidate stages 1-3 in to one domain
2.	Implement stage 3 at CDC, using CDC staff
3.	Advance more standardized evaluation practices at national and local levels
4.	Outsource stage 2 to academic partners through a funded agreement
5.	Make CDC technical assistance and materials more operational and peer-based
6.	Focus adaptation planning (stage 4) on integration with local planning processes rather than a stand-alone plan
7.	Coordinate with other CDC units to mainstream climate in to other vertical health initiatives, in particular emergency preparedness
8.	Add a stage / domain on stakeholder mobilization and community engagement

Recommendation #1: Downscale and consolidate stages 1-3 in to one domain

CDC would benefit from diminishing the technical requirements of stages 1-3 and consolidating them in to one domain. This consolidated domain would have the objective to identify and analyze all necessary information for evidence-based priority-setting, planning, implementation, and evaluation for climate and health adaptation. The stage would include the core work of BRACE stages 1 and 2- analyzing climate hazards and trends, exposure pathways, and health impacts, as well as implementing vulnerability assessments. However, it could also include other assessments that CRSCI grantees have undertaken, such as on public health programs, adaptive capacity, feasibility, stakeholder and community priorities, and more. It would also include the literature review formerly identified as BRACE stage 3, but not only to identify public health interventions, but also to identify research that can help health officials understand exposure pathways, health impacts, disease burden, analytical methods, and more.

Tiered guidance could be provided that allows jurisdictions that have the interest and capacity to follow the former BRACE approaches to stages 1-3 in this domain, while directing resource-constrained jurisdictions, or those with less time for planning, to follow other down-scaled assessment models, such as the health impact assessment model used among localities in Australia and in multiple developing countries.^{98,105}

CDC could encourage jurisdictions that are resource-constrained or new to climate and health adaptation planning to focus on historic trends and qualitative assessments of health impact, rather than encouraging quantitative approaches and futuristic projections that stymied CRSCI grantees. Guidance could identify and categorize datasets that local health departments could access, organized by purpose (for an example, see a table from the UK national climate and health adaptation guidance for health organizations in Appendix 11, or see the Ontario climate and health adaptation guidance).^{86,106} The emphasis of this domain for local health

departments would be to assemble and synthesize the information needed in a rapid and timely manner, to enable rapid transition to planning and piloting interventions.

The disadvantage of having all this content in one stage is that it potentially dilutes the structure and logic that BRACE once provided for the analysis of climate hazards, exposure pathways, and disease burden projections, and makes the domain more of a menu of analytical options. However, this is directly responsive to findings from the CRSCI grantees, who expressed that they wish they had implemented stages 1-3 as one stage with a common objective to inform decision-making, to maintain common methods and units of analysis, to avoid long clearance processes for separate reports, and to keep the steps from becoming “overly academic” and instead focused on the primary objective of planning and implementation. It also helps to encourage grantees to consider more a more holistic set of information to inform policy-making. Lastly, consolidation balances the model between data collection and analysis and the other key aspects of adaptation planning, helping local health departments to prioritize implementation- a key operational need expressed by non-grantee focus group participants.

Recommendation #2: Implement stage 3 at CDC, using CDC staff

CDC could take on the responsibility to maintain up-to-date literature reviews on climate and health adaptation topics for state and local health departments. It is more efficient to have one central authority implement this work (with input from jurisdictions on priority topics), and CDC could make the findings available in a centrally-available, searchable database on their website. The European Climate-ADAPT website (climate-adapt.eea.europa.eu/), which houses all grey and peer reviewed materials related to climate adaptation across the EU in a searchable, web-based database, could be reviewed as a reference. CDC has the technical staff and access to CDC fellowship programs that could provide the expertise and staff time to complete this work. This would also help to keep the CDC Climate and Health Program abreast of the latest

evidence-based practice, and allow them to directly connect studies with grantees in a way that would help translate research in to practice. Alternatively, CDC could fund a partner that already has mandate in this area, such as the Georgetown Climate Center. This academic research group maintains an “Adaptation Clearinghouse” as a searchable, web-based database of grey and peer-reviewed literature on climate adaptation in the U.S., including a section on health.

The only disadvantage of this approach is that state and local health departments will not be encouraged or required as part of grant funding to implement the reviews. However, this is a strength and not a weakness, because they can focus their scarce time on adaptation activities that are more critical for them to perform (such as engaging stakeholders or implementation).

Recommendation #3: Advance more standardized evaluation practices at national and local levels

With 9 years of experience funding climate and health adaptation efforts at the state and local levels, CDC is positioned to advance more standardized approaches to evaluating climate and health adaptation in the U.S., at the national, state, and local levels, as called for by CRSCI grantees and the research community. First, CDC could establish a national evaluation framework for the CDC climate and health program, which provides annual benchmarking of climate and health adaptation among state and local health departments. The objective of the evaluation framework could be to:

- Enable CDC to evaluate its efforts to build adaptive capacity across the U.S.
- Provide CDC a tool to demonstrate the impact of the program to policy-makers, Congress, and other key donors, to help secure new partnerships and funding
- Provide localities and CDC with a benchmarking tool that reveals relative adaptive capacity across jurisdictions, highlighting areas of strength and best practices and areas of need

The CDC could engage in a consultative process to develop the evaluation instrument, with CRSCI grantees, non-grantee health departments, and climate and health researchers, making sure to review the common indicators already developed by CRSCI grantees. In addition to the Essential Public Health Functions that are a core organizing framework for BRACE, CDC could use standard typologies for categorizing climate and health adaptation common in the literature as a basis for categorizing activities, such as:

- *Adaptation stages*: groundwork initiatives or adaptation interventions⁸⁰
- *Adaptation categories*: capacity building, management, planning and policy; practice and behavior, information; warning and observing systems; and vulnerability assessments¹⁰⁴
- *Adaptation types*: general health, infectious diseases, heat-related risks, air quality, food security, water quality
- *Vulnerable Populations*: Examples include elderly, children, persons with disabilities¹⁹

A recommended tool for this purpose is the staged capability maturity model, which is a widely used, evidence-based tool that measures an institution or jurisdiction's incremental development of capacity in any area, from a nascent to an optimal state. This tool has been used successfully by CDC global health programs and provides analytics and a score-card that is useful for communication with stakeholders and policy-makers.^{87,107,108} The primary source of data for this scorecard would be an annual, web-based survey to state and local health department leaders, but could also take in to account indicators from the Lancet Commission annual climate and health adaptation tracking efforts, as appropriate.¹⁰⁹ The CDC should also seek to review the EU scoreboard, which is planned to measure climate and health adaptation

among EU countries in their climate and health strategy.¹¹⁰ The CDC could aim to collaborate with, and learn from, Health Canada, which has plans to establish a national evaluation framework for the national Canadian climate and health program in summer, 2018, which would be especially relevant, since the Canadian program is modelled after the BRACE model.

The national evaluation framework would inform the guidance and capacity-building that CDC provides to state and local health departments in evaluation for the next iteration of BRACE, so that local efforts can support the national evaluation. First, CDC could ensure that evaluation is explicitly part of planning stage in the revised BRACE model, and not only in a stage following implementation. Second, CDC will need to design training and capacity-building related to evaluation for new jurisdictions, with an emphasis on very simple and rapid techniques for local health departments, such as annual surveys of local health department staff. CDC could provide as guidance several templates or examples of simplified monitoring and evaluation approaches taken by state and local health departments. Given the feedback from local health departments in this study, CDC could rely more on state health department staff to be responsible for evaluation of local efforts, although monitoring would be implemented by all parties, to enable the timely learning and quality improvement of interventions (as called for by adaptive management). Lastly, it is especially important that CDC emphasize in its revised model that communication of results, and “telling the story” to stakeholders, the public, and policy-makers is a core action that needs to follow any evaluation activities.

Recommendation #4: Outsource stage 2 to academic partners through a funded agreement

CDC could advance the analytical work of stage 2 (projection of disease burden) through direct partnership with academic institutions, via a separate cooperative agreement. These academic partners could be brought together virtually and in-person to learn from one another, share progress, and advance evidence-based methods more quickly, which state and local health

departments could use in their own climate and health adaptation planning. CDC technical staff could be assigned to manage the partnerships, and directly guide the priorities and methods, helping to ensure deliverables meet the needs of health departments across the country (i.e. neglected health topics receive attention). Australia's *National Climate Change Adaptation Research Facility* (NCARF) could be examined as a model for how climate and health adaptation research can be advanced nationally. The NCARF was established to coordinate climate adaptation research across multiple research centers across Australia, under specific national priorities. The NCARF developed and implements a specific National Adaptation Research Plan for Human Health.⁹⁵

The disadvantage of this approach is that it requires a separate mechanism and funding line for universities, as well as political support for a new research agreement in this area by the federal government. This is funding that may otherwise directly support state and local health departments to sub-contract to academic institutions, which in theory offers the advantage of localized control and customized deliverables. However, this study found that the administrative process of contracting to universities by state health departments took a year or more for some CRSCI grantees, and managing the work was intensive in time and expertise of state health department staff. Moreover, by having direct relationships with universities, CDC can directly guide the research and methods, facilitate technical exchange between researchers, reduce any redundancies in research that may have occurred under the CRSCI state-based sub-contracting model, set specific goals and timelines for the production of evidence-based methods in key areas, and even encourage structured research collaboration with other federal agencies, including NWS, NOAA, and EPA.

Recommendation #5: Improvements to CDC technical assistance

CDC technical assistance in the next iteration of BRACE for new jurisdictions, particularly local health departments, could emphasize:

- Peer-to-peer learning, such as by convening jurisdictions directly (i.e. through videoconference technology), and by circulating best practices of adaptation work performed by local health departments on a routine basis.³
- Operational guidance, which provides more step-by-step illustrations that local health departments can follow (see Ontario’s climate and health adaptation workbook as an example)⁷⁷
- Supporting state health departments with tools, resources, and funds to building local health department capacity, such as through learning collaboratives, training, and technical assistance
- Simplified, rapid tools for local health departments that have been employed by other local health departments (e.g. annual survey of local health department staff with standard metrics employed by New Hampshire)
- A centralized repository of tools and resources, including up to date literature reviews, guidance documents, and best practices from other jurisdictions
- A focus on building relationships between CDC CHP staff and grantees, to assist in problem-solving and translation of science and best practices

³ The annual best practices document produced by APHA and funded by CDC is a good start, but is not categorized in a way that would help a local health department struggling with a particular issue to find a solution and comes out only on an annual basis.

Additionally, given the strong recommendations from focus group participants in the study, CDC would benefit by producing specific guidance and technical assistance in two areas. The first area is how BRACE relates to, and advances, health equity and a social determinants for health paradigm. As one option, a recent review of EU climate and health adaptation efforts demonstrates the use of a social justice framework as an evaluation metric. CDC could consider this in its design of a national evaluation approach as a means to reinforce the connection of BRACE to health equity.⁹⁰

The second area is improving state and local health department communications with external stakeholders, the public, and policy-makers on climate and health. CRSCI grantees and non-grantees in this study expressed the desire for CDC to help with the messaging and with specific communication resources (such as PowerPoint presentations) that health officials could modify for different audiences. CDC could consult CRSCI grantees on the specific topics and formats that would be the most useful, but examples given in this study include the impact of climate change and why it matters to health, and what evidence-based interventions are available and underway in other jurisdictions.

Recommendation #6: Focus adaptation planning (stage 4) on integration with local planning processes

CDC could encourage local health departments to focus their climate and health adaptation planning around producing content that is integrated in to other local planning instruments (e.g. disaster preparedness plans, city climate action plans). Stand-alone climate and health adaptation plans could continue to be allowed and even encouraged at the state-level (given that a comprehensive climate and health profile and set of adaptation objectives for the state was said to be a useful resources by several local health departments in the study). However, resource-constrained jurisdictions and local health departments, who, in this study,

reported facing pressure to implement rather than plan, and operate on a shorter plan-implementation cycle than states, should not be encouraged to undertake a long planning process to produce a stand-alone climate and health adaptation plan. Guidance could provide a menu of possible local planning instruments, categorized by topic (an example in the Canadian national public health adaptation guidance is provided in Appendix 13), and case studies of localities that effectively integrated climate and health in to local planning instruments.

The disadvantage to this approach is that local health departments consequently will not produce a comprehensive document that sets broad objectives for all climate and health adaptation issues in their jurisdiction. However, integration with other local efforts was not only strongly recommended by the focus group participants in this study, it will be an essential strategy for leveraging resources in an era of limited new federal funds for climate and health adaptation. It also supports the multiple calls for mainstreaming climate and health adaptation in the literature, and helps address the desire reported by CRSCI grantees in this study to have guidance on how to institutionalize BRACE activities.

Recommendation #7: Coordinate with other CDC units to mainstream climate in to other vertical health initiatives, in particular emergency preparedness

Directly responding to the strong recommendation by CRSCI grantees and non-grantees in this study, CDC could strengthen its coordination with other CDC operating divisions or offices (such as Asthma, infectious disease, and chronic disease) in order to mainstream climate considerations in to funding opportunities provided to states. In particular, CDC could prioritize a relationship with the CDC PHEP program, given its focus on weather and natural disaster, and its repeated identification by participants in this study. Options for this collaboration could include:

- Inserting climate change language in to Notice of Funding Availability (NOFA) to raise visibility and introduction the connection between the topic to the NOFA and climate change.
- Provide a point preference in the funding applications from jurisdictions that can demonstrate they have key climate and health adaptation capabilities- such as a climate and health adaptation plan, or taskforce.
- Enable funds to be used to support key climate and health adaptation activities, as they directly reinforce the goals of the NOFA
- Modify PHEP guidance on high level capabilities required of jurisdictions to include climate and health adaptation
- Require climate issues to be included in the mandatory risk or vulnerability assessments performed by local health departments for PHEP
- Include climate change as a priority as an eligible priority for health care coalitions applying for funds under HPP
- Make CDC CHP staff available for objective reviews of cooperative agreements from PHEP and other programs (this ostensibly helps in an operational task but also fosters dialogue between staff)
- Offer to second a portion of a CDC CHP staff person's time to the Office of Public Health Preparedness, such as to the Division of State and Local Readiness, to help assist this coordination

Recommendation #8: Add a stage / domain on stakeholder mobilization and community engagement

Given the centrality of multi-sectoral partnerships to climate and health adaptation, both in the literature and in the findings of this study, and due to the strong calls for more community-

driven models of adaptation in the literature, these two elements would benefit from being represented by their own stage or domain in the revised model, rather than discussed as subtopics under other stages. Several important global adaptation models include an explicit stage for stakeholder mobilization, such as the EU guidance for adaptation among municipalities and the UK National Health Service Climate and Health Adaptation Guidance.^{84,100} This stage could include a menu of activities, such as the following:

- Identification of partners
- Community outreach
- Partnership development
- Mapping of stakeholder activities, interests, and priorities
- Mapping of community assets (as recommended by Ebi and Semenza, 2008)⁶⁴
- Review of local plans, policies, and funding opportunity announcements for integration opportunities

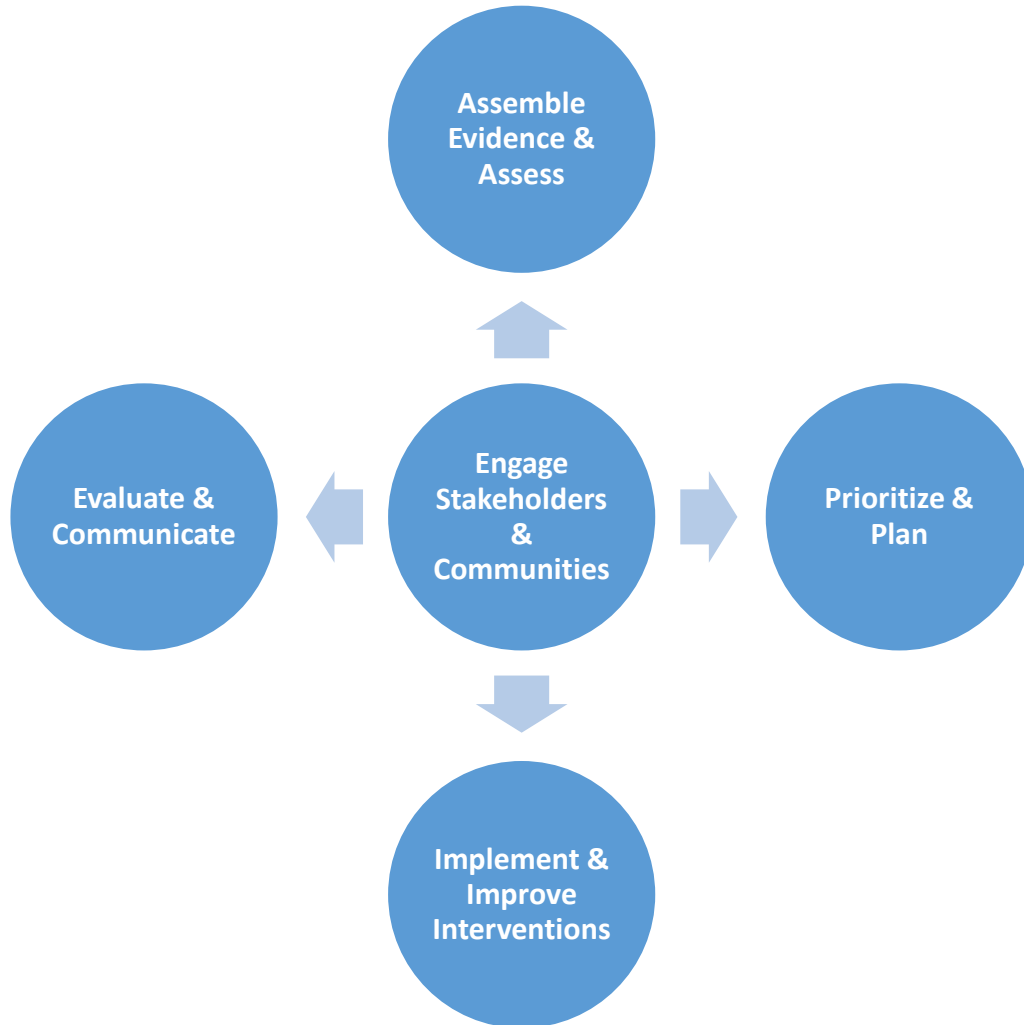
Guidance for this domain could include listing example partners across sectors and climate and health topics at the local level (for an example, see a table from the UK national climate and health adaptation guidance for health organizations in Appendix 12), case studies of effective partnerships for climate and health adaptation, theories and models from the literature regarding partnerships and community engagement, and mapping tools.

Proposed BRACE model

Figure 11 represents a revised BRACE model that is responsive to the recommendations of this study. The proposed model makes structural changes to the BRACE model: 1) the choice of a radial graphic introduces domains of climate and health adaptation in a non-linear framework, inviting local health departments to enter the domains from any point, while also

making the major stages of an evidence-based planning process clear; and 2) it places the engagement of stakeholders and communities at the center, with arrows to each major adaptation planning domain, conveying the centrality of these partnerships to all stages in adaptation. The model still retains the important steps of vulnerability assessment, collection and analysis of data to analyze climate hazards and health impacts, prioritization of health impacts and development of climate and health adaptation planning instruments, and evaluation, which are key steps in the BRACE framework and many global climate and health adaptation models. It is recommended that this framework have operational and technical guidance tailored for each major domain, accessible on the CDC website. A good model for how this could be organized is the betterevaluation.org “Rainbow Framework” webpage. This online resource presents a conceptual model for evaluation, where each domain can be clicked and opened to reveal an organized set of resources for that domain.¹¹¹ The model also maintains the adaptive management philosophy central to the BRACE model, emphasizing a deep understanding of the

Figure 11. Proposed BRACE Model for Climate and Health Adaptation among State and Local Health Departments



problem and information available, anticipating future risks and impacts, and supporting an iterative, learning process of implementation and quality improvement.

The “Assess and Assemble the Evidence” domain is the consolidation of BRACE stages 1-3, from understanding climate hazards, projecting their future trends and health impacts, to producing vulnerability assessments and reviewing the literature for evidence on suitable public health literature. As recommended in this study’s plan for change, it is inclusive of all the information needed for planning, implementation, and evaluation for climate and health

adaptation. “Prioritize and Plan” comprises the domain where jurisdictions identify a climate or health priority, and develop planning instruments to address this priority. The “Implement and Improve” domain includes all efforts to implement climate and health interventions, and explicitly includes monitoring and evaluation activities that will allow for routine program monitoring and real-time improvements to program implementation.

The “Evaluate and Communicate” domain comprises the major evaluation efforts of the jurisdiction to demonstrate progress of their climate and health program, and notably places a new and strong emphasis on communicating the results of the evaluation to stakeholders, the public, and policy-makers. This is not only due to the strong need identified in the area of communications by CRSCI grantees and non-grantees, it aims to help raise visibility of the climate and health adaptation efforts locally and thereby help secure political and public support for the effort.

Implementation strategy

For this strategy, the P.I has selected the Kotter framework for organizational change, given its strong credibility in the management literature and its simple step-wise framework.¹¹²

Kotter’s 8-fold path to organizational change includes:

1. Establish a sense of urgency
2. Form a powerful guiding coalition
3. Create a vision
4. Communicate the vision
5. Empower others to act on the vision
6. Plan for and create short-term wins

7. Consolidate improvements and produce still more change
8. Institutionalize new approaches

The table on the next page describes an implementation strategy that follows this eight-step framework.

Table 6. Implementation Strategy for this Study’s Plan for Change (adapted from R. Chiang, 2017)

Kotter Organizational Transformation Phase	Responsible Party	Steps
Create a sense of urgency	P.I.	Present study findings and recommendations to CDC Climate and Health Program team in person, Summer 2018
	P.I.	Produce short summary of study findings and circulate to all study participations, including CRSCI grantees and non-grantee health officials, Summer 2018
	CDC Climate and Health Program	Apprise Branch leadership of this dissertation study and obtain approval to plan a vision and roadmap for the next phase of BRACE, Summer, 2018
Form a powerful guiding coalition	CDC Climate and Health Program	Develop a Terms of Reference for an ad-hoc advisory board of state and local health department officials that would like to provide input in to the materials and plans for CDC’s next phase of BRACE, Summer, 2018
	CDC Climate and Health Program	Invite state and local health officials to participate in an ad-hoc advisory board to the CDC Climate and Health Program, on the topic of the next phase of BRACE, through outreach to CRSCI grantees, the APHA affiliate list serve and other networks, in Fall, 2018
	CDC Climate and Health Program	Identify CDC staff that will be responsible for coordinating the advisory board, including the program lead of the CDC Climate and Health Program (for appropriate high level leadership) and 1-2 program or scientific staff, in Fall, 2018. Launch this advisory board for the period of 6-12 months for planning and launching the next phase of BRACE, starting in Winter, 2019.

Kotter Organizational Transformation Phase	Responsible Party	Steps
Create a vision	CDC Climate and Health Program	Create a vision for the next phase of BRACE implementation, based on these study findings, and articulate in a short concept note that can be circulated internally and externally, in Fall, 2018
	CDC Climate and Health Program	Send revised BRACE model to CDC Creative Services for graphic design, in Fall, 2018 Develop 2 page guidance that explains the revised model for key stakeholders, in Fall, 2018
	CDC Climate and Health Program	Circulate vision document, as well as proposed BRACE model and guidance to ad-hoc advisory group, and manage a Zoom-based videoconference to solicit input from advisory group on the model and plans, in Spring, 2019
	CDC Climate and Health Program	Develop a template for a national evaluation framework for the climate and health adaptation, Fall, 2018, and circulate to advisory group and key international experts for input, Winter, 2019
Communicate the vision	CDC Climate and Health Program	Discuss the vision and circulate the concept note and BRACE model to key internal stakeholders at CDC to secure buy-in, including leadership at the Branch and National Center for Environmental Health, Procurement and Grants Office, and other units as needed, in Fall, 2018 (before creating ad-hoc advisory group). Meet with CDC's Division of Emergency Public Health Preparedness and other select CDC CIOs to identify opportunities for strengthening integration of climate change in funding opportunities for state and localities

Kotter Organizational Transformation Phase	Responsible Party	Steps
	P.I.	Present study findings to American Public Health Association annual conference, November, 2018, as part of an accepted, juried oral presentation
	CDC Climate and Health Program	Meet with key external stakeholders to present vision and look for synergies and areas for partnership, such as with NIH, EPA, NOAA, various foundations (Rockefeller, Kresge), Climate Reality Project, Georgetown Adaptation Clearinghouse, in Winter, 2019
	CDC Climate and Health Program	Work with CDC Procurement and Grants Office to develop new funding opportunity announcement, in Winter, 2019, for publication in 2020 for academic research (unless partnership with NIH's climate and health adaptation research grant-making can be established)
Empower others to act on the vision	CDC Climate and Health Program	<p>Develop the CDC website to serve as a user-friendly resource for guidance on the new BRACE model, and to begin a database of literature review, Winter, 2019</p> <p>Solicit input from the advisory board on the format and resources in the website, Spring, 2019</p> <p>Advertise this website to key stakeholders and subnational networks for climate change through professional meetings and through routine communication channels, to encourage state and local health departments to initiate climate and health adaptation using these technical resources, Summer, 2019</p>
	CDC Climate and Health Program	Produce a formal launch of the new CDC website in, via webinars, to introduce the new model, guidance, and technical assistance resources, in Summer, 2019

Kotter Organizational Transformation Phase	Responsible Party	Steps
Plan for and create short-term wins	CDC Climate and Health Program	Announce a new funding opportunity for academic institutions to advance climate and health adaptation research for state and local planning, 2020 Announce a few funding opportunities for states and select local health departments to advance climate and health adaptation using the new BRACE model, 2021
	CDC Climate and Health Program	Identify and pilot the new model in 1-2 local health department settings that have resources (e.g. working through the existing cooperative agreement to CRSCI grantees), to serve as field-testing of the model and also examples that can be provided in guidance to future health departments, Winter- Fall, 2019
	CDC Climate and Health Program	Publicize national evaluation framework (approved by advisory board), and make available on the CDC website (as well as making it a requirement for annual reporting by the grantees of the new funding opportunity announcement), Spring, 2019
Consolidate improvements and produce still more change	CDC Climate and Health Program	Review routine calls and annual continuing applications, as well as annual reporting on the national evaluation framework, to identify opportunities for improvements to the CDC cooperative agreement, 2020, to prepare for the 2021 cooperative agreement
	CDC Climate and Health Program	Continue to publish annual ‘best practices and lessons learned’ document that summarizes the progress to date and improvements needed in the future, 2021 onward
Institutionalize new approaches	CDC Climate and Health Program	Work with Council on Education for Public Health to integrate climate and health adaptation content in to accreditation requirements for American schools for public health, to help ensure every graduate has baseline knowledge of the BRACE planning process and key resources, to help encourage that adaptation planning be institutionalized across all health departments, 2020 onward

Role of the P.I. in the plan for change and dissemination of study results

The role of the P.I. in the Plan for Change is to advance these study findings and recommendations in several areas. First, the P.I. will present the findings to the CDC CHP team in the summer, 2018 as part of an in-person meeting. The purpose of this meeting is to directly report the study findings and recommendations, answer questions, and to advocate for change. Second, to help disseminate the results to the broader research and public health community, the P.I. submitted an abstract summarizing the study to the American Public Health Association, and that abstract was accepted for oral presentation at the next APHA annual conference in November, 2018. The P.I. also will submit a manuscript for a peer-reviewed journal in summer, 2018. Lastly, and most importantly, the P.I. will circulate a short summary of her study findings and recommendations to all participants in the study, which include 46 focus group participants as well as the CRSCI grantees.

Alternative leadership scenario: National Climate and Health Adaptation Campaign

The limitations in federal leadership to address climate change under the Trump Administration may make it difficult for CDC to lead these change efforts. At the same time, the positive groundswell of subnational action on climate change suggests that opportunities for leadership of these recommendations exist beyond CDC. Just as state and local governments and the business community have come together to drive achievement of the (former) U.S. commitment to the Paris Agreement, state and local governments, civil society, and health foundations could come together to drive achievement in climate and health adaptation. Indeed, the literature review of this study identified evidence of community-led initiatives driving adaptation forward where political constraints exist.

One proposed leadership scenario would be to forge a national, civil society-driven campaign to advance climate and health adaptation across the U.S., at the state, city, county, and

community levels. This campaign could be led by a multi-sectoral coalition, comprised of major national public health foundations (e.g. Robert Wood Johnson, Kresge, and Rockefeller Foundations), champions from state and local governments (e.g. Mayors, Governors, and health officials), and large non-profit organizations and networks in climate and health (e.g. U.S. Climate and Health Alliance). A sense of urgency would need to be created to form this coalition, and this could be established in a pre-meeting of key leaders in an upcoming national climate change conference. The Global Climate Action Summit in San Francisco, CA in September 12-14, 2018 could be explored as an early candidate, given its focus on non-state actors to drive change.

The focus of the pre-meeting could be the signing of a Memorandum of Understanding to form the coalition and campaign; this MOU could be circulated after the pre-meeting to key partners to expand the coalition. After the MOU has been signed by a sufficient number of key partners, the coalition could be formally established, with a national “taskforce” to manage the operational and executive decision-making. Ad-hoc advisory bodies representing specific stakeholder groups (such as state and local governments, tribal nations, communities, vulnerable populations) could be established to provide input. A higher level Executive Committee of politically influential and well-financed individuals could be established to help encourage visibility, funding, and networking of the campaign with other related efforts.

These bodies could then develop a “National Climate and Health Adaptation Action Plan”, with goals and recommended interventions for all state, cities, counties, and communities to take to advance adaptive capacity and resilience nation-wide. A useful example for this process of formulation of an MOU, taskforce, and action plan is the Multi-State Zero Emission Taskforce and “Multi-state Zero Emission Vehicle Action Plan (2018-2021), which brings

together 9 states under a shared plan of goals and interventions for reducing vehicle emissions (<https://www.zevstates.us/about-us/>). The plan could include a simple evaluation tool that benchmarks adaptive capacity among state and local health departments, which can be administered every year of the campaign through a web-based survey, to demonstrate the impact of the campaign over time. A staged capability maturity model, as described in this monograph, is recommended for this purpose, because of its ability to present capabilities in a score-card format that helps to easily identify gaps and successes.

Table 7. Summary of Alternative Leadership Scenario for Advancing Study Findings: National Climate and Health Adaptation Campaign

- | |
|---|
| <ul style="list-style-type: none"> ➤ Nation-wide campaign to advance climate and health adaptation among states, cities, counties, and communities ➤ Multi-sectoral coalition of public health foundations, non-profit organizations, and state and local government authorities ➤ Led by a national taskforce of members representative of key partners, and by advisory bodies of key stakeholders (e.g. vulnerable populations and communities) ➤ Governed by a national climate and health adaptation plan, with common goals, recommended interventions, and a shared evaluation and benchmarking tool that demonstrates progress each year ➤ Initial campaign and coalition design at pre-meeting during Global Climate Action Summit, Sept 12-14, 2018, San Francisco, CA, or a subsequent national climate change conference ➤ Use of social media, viral videos, and circulation of best practices and successes through annual public health conferences, networks and associations to celebrate short-term ‘wins’ and build momentum ➤ Continued engagement of U.S. C.D.C., with the possibility that the agency can provide longer-term financing and institutionalization over time |
|---|

Documenting early successes of the campaign in terms of partnerships or adaptation interventions – through viral videos, social media, annual public health conferences, and major health associations and networks- would be an important strategy to circulate short-term ‘wins’ and build momentum around the initiative over time. The U.S. CDC could be invited to participate in activities and events, as the agency is willing and able. Over time, it would be

advantageous if the CDC could resume leadership of some of the campaign for long-term institutionalization of funding and programming.

Limitations of the study and plan for change

There are important limitations in the study methodology and plan for change. First, the scope of the study was limited to CDC-related programming, restricting the degree the applicability of study findings to the work of other federal agencies and non-federal entities, such as foundations. However, efforts were made to identify themes that are relevant to all actors supporting state and local climate and health adaptation planning. Another key limitation is that the information provided in the interviews and focus group discussions is all self-reported. Public health officials may have responder bias to report more favorably regarding progress achieved or more optimistically regarding climate and health adaptation occurring in their jurisdiction. Fortunately, in both data collection efforts, there are specific questions related to challenges and barriers that helped prompt a more balanced assessment, and strict confidentiality was provided.

A third limitation comes from sampling bias in the focus groups. First, the focus group discussions included health officials that volunteered to participate, which created a participation bias in those consulted. Secondly, the sample size of focus group participants (n=46) is small compared to the universe of state and local health department authorities in the U.S., so their input is not generalizable to this population. However, interviewing a statistically significant study sample is not feasible, and their input and discussion is nonetheless valuable qualitative information that can guide adaptation efforts moving forward.

Lastly, the P.I. decided with CDC early in the process to utilize existing interviews with CRSCI grantees, rather than to conduct interviews specific to this study, because the interviews had been conducted within the year and had not yet been analyzed, and there was concern about

research fatigue among the grantees. This made it difficult at times to apply the study's conceptual framework retrospectively to the transcripts, or to have consistent feedback on key themes from all interviewees. However, the interviews ranged from 2-5 hours in length, so many topics were covered and a high volume of rich and meaningful data was identified.

In terms of the Plan for Change, the most significant limitation is that the P.I. is not an employee of CDC, and therefore not directly responsible for any activities of the CDC Climate and Health Program. The recommendations and Plan for Change are based on her research findings and informal discussions with the leadership and staff of the CDC Climate and Health Program and CRSCI grantees over time. The implementation of this Plan for Change depends upon the decisions of the CDC Climate and Health Program.

CHAPTER 8: CONCLUSION

With the current trajectory of climate change, adaptation to protect public health is only growing in importance, and the role of sub-national actors is more critical than ever. The practice and experiences of state and local health departments in the U.S. documented in this study are critical first steps towards building the requisite adaptive capacity among the U.S. public health system and vulnerable communities. It is clear, CDC's leadership has been a critical intervention, and the experiences from the first implementation of the BRACE model are important foundations for future, iterative work. Still, the field is nascent and evolving, and the peer-reviewed evidence-base is limited.

The analysis and consultation conducted by this study was an important contribution to evidence-base in this area. This study produced both an analysis of the key inputs, processes and practices, outcomes, and challenges and enablers to implementation of the CDC BRACE model, as well as conducted rigorous consultations with 46 public health professionals from 22 states to discuss unique resources, needs, and recommendations for an improved CDC BRACE model and strategy.

While the recommendations here directly aim to inform the CDC strategy to support subnational climate and health adaptation, the findings are applicable outside of CDC's sphere of influence. The findings, recommendations, and revised model in this study can inform other state and local health departments, federal agencies, national foundations, and even other countries trying to improve climate and health adaptation at the sub-national level. Indeed, this

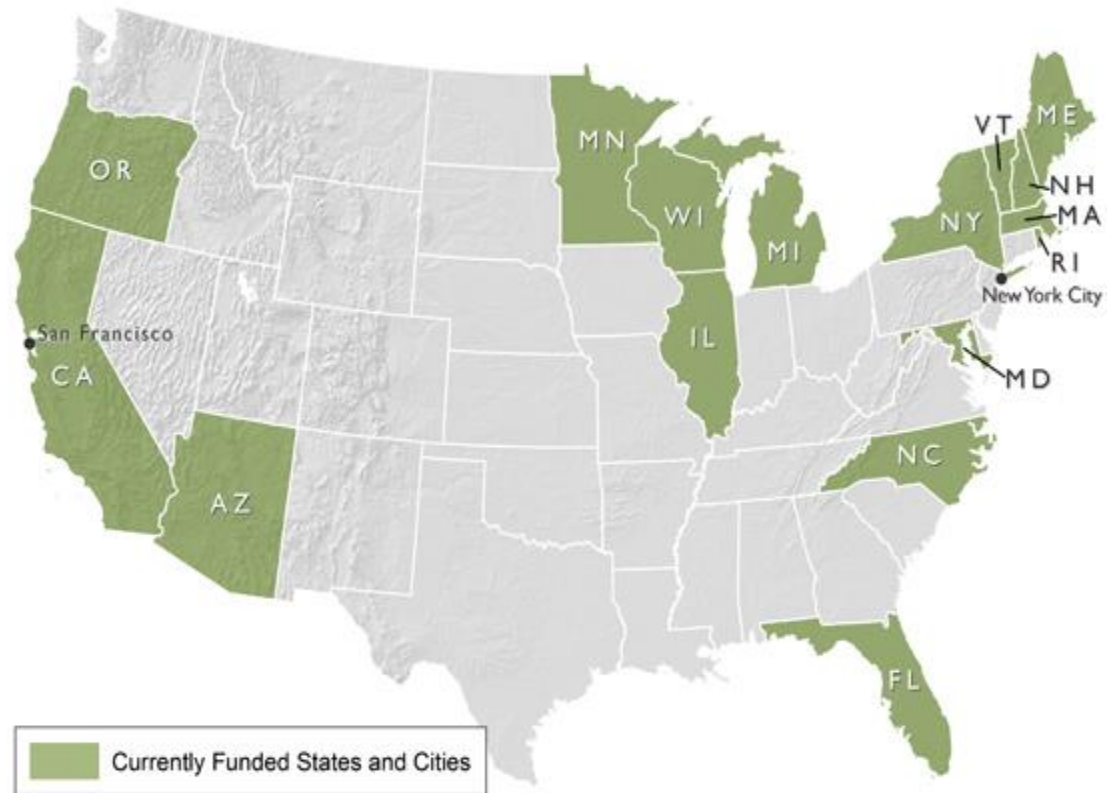
study goes as far as to propose a national climate and health adaptation campaign and coalition led by civil society as one option to advance study recommendations outside of CDC.

The study faced limitations in scope and sampling bias related to its voluntary participation. However, it also provided a novel and low-cost study methodology- including its sequencing of content from study phases and its use of videoconferencing for focus groups- which could be utilized to address other important public health program improvements. Additional research is needed that: documents the structural capabilities that enable the most effective climate and health adaptation implementation; evaluates adaptive capacity across local health departments and communities in a systematic manner, and identifies cost effective interventions in climate and health adaptation at the local level across climate hazards, all of which would give meaningful guidance to local jurisdictions wanting to make adaptation a sustained reality.

APPENDIX 1: MAP OF CDC CRSCI GRANTEES

Source: CDC Climate and Health Program Website, https://www.cdc.gov/climateandhealth/crsci_grantees.htm, Accessed May 26, 2017

“Climate Ready States and Cities Initiative Grantees”



APPENDIX 2: SUMMARY OF INCLUDED ARTICLES: STATE AND LOCAL HEALTH DEPARTMENT SURVEYS

Author	Topic	Challenges	Mediating Factors or Needs	Sample	Sampling
O'Neill, M., et al (2010)	Heat adaptation	Lack of programming to prepare for health-related events (<40%), due to lack of leadership, funding, and awareness of climate effects by public and respondents	Two key predictors of health-related programming are local leadership and awareness of heat impact by public. Need case studies and best practices from other settings.	N=70 cities and LHDs nationwide Response rate= 25%	Purposive
Carr, J., et al (2012)	Climate change adaptation	A minority (39%) felt climate change is an important LHD priority. Revealed expertise (73%) and funding (53%) is inadequate, and fragmentation of NY public health services across state and local levels hampers adaptation.	Integration with other public health programs and community engagement. Staff (80%), training (80%), funding (60%), and equipment needed (40%).	N=30 LHD officials (24 leaders) Response rate= 39%	All NY LHD staff
Maibach, E., et al (2008)	Climate change adaptation	Majority felt climate change is a priority, but a minority (19%) said it was presently a top 10 priority, due to lack of knowledge/ expertise among leadership and stakeholders and funding	77% felt additional resources needed, including funding (63%), staff (54%), training (29%), and equipment (10%)	N=133 LHD Directors nationwide Response rate= 61%	Random
Schoch-Spana, M., et al (2013)	Natural disaster resilience	Staff cut-backs, competing priorities, funding that is inconsistent and fragmented.	Disaster creates window for action. Community engagement, partnerships between agencies to leverage staff, leadership and organizational culture, training, and greater funding needed. Need case studies and best practices.	N=25 representing 7 counties in 3 regions Response rate= n/a	Purposive
Roser-Renouf, C., et al (2016)	Climate change adaptation	Adaptation prioritization and programming decreased in sample from 2008, increased budget constraints, increased polarization of views on climate change, decreased knowledge of climate change effects among colleagues	Funding was key predictor for lack of planning, but departmental expertise and awareness of climate change impact may mediate funding constraints. Needs for consistent high level message on climate change, training, funding, and evaluation of effective activities in other settings.	N=174 LHDs nationwide Response rate= 50%	Stratified random
White-Newsome, J.,	Heat adaptation	Availability and fragmentation of funding a key constraint. No lead agency to address heat and	Where political will was high, resources were higher, where political will was low,	N=73 city and NGO	Purposive snowball

Author	Topic	Challenges	Mediating Factors or Needs	Sample	Sampling
McCormick, S.; et al (2014)		properly coordinate with non-health government agencies. Hard to justify against competing priorities.	community engagement and community-driven solutions advanced adaptation. City structure defined planning. Emergency preparedness partnerships, informal evaluations, and extreme events helped catalyze action. Need best practices from other settings.	leaders in 4 cities Response rate= n/a	
White-Newsome, J., Ekwurzel, B., et al (2014)	Heat adaptation	Only 40% had local heat response plans, and 7% evaluated their response to the 2011 heat wave. Lack of funding, staff, and staff expertise contributed to this. Low number of interventions to address vulnerable populations.	Having a plan was associated with two-fold increase in heat-related interventions. Heat-related plans more likely in counties with greater population and lower poverty. Need to engage community, address vulnerable populations, cost-share with private sector, coordinate multiple levels of government, and evaluate programs	N=190 LHDs nationwide in high temperature states Response rate= 32%	Random
Eidson, M. (2016)	Climate change	LHDs and NYSDOH comparable in their perception that CC should be a priority for their institution (~60%). 55% State health departments and 22.9% of LHDs include or are considering including climate and health in their planning. LHDs much more likely to report having insufficient information to take action. Greatest barriers among LHDs are funding (27.4%), lack of staff (19.4%), and lack of education/training at 14.5%.	The follow-up assessment identified key needs: staff, funding, information, technology, communication (in that order).	N= 41 NY state staff, 36 external orgs., 62 LHDs Response rate= 75%, 53%, 60%	Purposive

APPENDIX 3: SUMMARY OF INCLUDED ARTICLES: EXAMPLES OF STATE AND LOCAL HEALTH DEPARTMENT CLIMATE AND HEALTH ADAPTATION PLANNING FOR HEALTH

Author	Topic	Jurisdiction	Overview
Brubaker, M. et al (2011)	Climate change health assessment	Alaska city and tribal government	The project team created and implemented a novel climate health assessment tool that relies on direct observation and community engagement, and successfully facilitated development of local adaptation priorities and plans. The tool was found effective at engaging the community and more timely than other approaches as it relies on direct observation. It has been used in 3 additional communities in Alaska.
Conlon, K. et al (2016)	Climate modelling	Florida State DOH	The Florida BRACE program participated in capacity-building in climate modelling and disease projection over a two year period, and a project team assisted them in the formulation of 3 case studies using Florida-specific data to calculate baseline disease burden estimates and exposure response functions. The case studies serve as an input to the Florida climate and health adaptation plan.
Driscoll, D. et al (2013)	Climate change health assessment	Colloquium of government, academic, and tribal authority representatives	The project team piloted a community-based surveillance system to project disease burden and health outcomes related to climate change, and used finding to help the community plan adaptation responses. A sentinel survey administered across Alaska determined high occurrence health outcomes and analysis associated these with climate related indicators to determine priority climate-related effects. The approach was also useful to determine mediating factors that formed part of the adaptation measures developed.
Eidson, M. (2016)	Climate change adaptation planning	New York State and local health departments	The project team conducted a robust process of needs assessment and adaptation prioritization, including 7 surveys among state and local health officials and stakeholders organizations. Priority climate health effects and strategies were determined, the surveillance systems across the state were evaluated, and findings were provided as input to the New York State climate and health adaptation plan.
Schmeltz, M. (2013)	Natural disaster planning	New York City (Red Hook public housing community)	This case study reports that the city response to Hurricane Sandy in two public housing complexes was fragmented and poorly coordinated, due to disaster preparedness plans that failed to map community adaptation strategies or assess vulnerabilities. Recommendations for future plans include making coordination between government and community organizations explicit and provided meaningful community input, as well considering long-term power outages and its effects on health services/ sanitation.
Michigan Dept. of Community Health (2011)	Climate and health adaptation plan	Michigan State DOH	A project team of Michigan State DOH staff coordinated a year-long planning process to establish a shared vision for climate change adaptation. They conducted a robust needs assessment process with state and local health department officials and external stakeholders, conducted stakeholder workshops to determine priority climate-related health effects and priorities, and developed a state climate and health adaptation plan.
Minnesota Dept. of Health (2010)	Climate and health adaptation plan	Minnesota DOH	A climate change workgroup of Minnesota state health and elected officials was established to coordinate a planning process over spring-summer, 2010, which included stakeholder workshops, needs assessment, and the formulation of technical teams for strategy formulation. The product was a state climate and health adaptation plan.
Oregon Health Authority (2014)	Climate and Health Profile	Oregon State DOH	The Oregon State DOH facilitated a process to produce a state CHP, to describe the likely impacts of climate change on health outcomes, and to present a broad, statewide assessment of demographic, geographic, and occupational vulnerability to climate change risk. This profile serves as an input to the Oregon state climate and health adaptation plan.

APPENDIX 4: CDC CHP INTERVIEW PROTOCOL FOR CRSCRI GRANTEES

(Developed by the CDC CHP Team, 2016)

Purpose

The purpose of the grantee interviews is to learn about the grantees' experience with implementing the BRACE framework; specifically, to what extent the BRACE framework, or work done outside of the framework, helped the grantees prepare for the health effects of climate change. We are also interested in the extent to which the grantees were able to complete the framework during the funding period and identify barriers to completing the framework. Finally, we are interested in assessing the value of the CHP's technical assistance during the funding period.

Use of Evaluation Results

The Climate and Health Program will use these results to improve the applicability of the BRACE framework for state and city health departments. Some improvements may include but are not limited to: updating or changing the BRACE Steps one to four logic models, informing the CHP technical assistance to the grantees during the EH16-1602 FOA funding period, updating the overarching BRACE logic model, and informing the development of any future FOAs which will involve awardees implementing the BRACE framework.

Goals

- 1.) Identify the extent to which each grantee was able to complete the BRACE framework during the funding period
- 2.) Identify barriers experienced by the grantees to completing the BRACE framework during the funding period
- 3.) Identify facilitators experienced by the grantees to reaching BRACE milestones/goals
- 4.) Identify any differences between state and city health departments in implementing the BRACE framework
- 5.) Identify ways in which the political climate of each jurisdiction affected the grantees' implementation of BRACE
- 6.) Identify grantee perspectives on the CHP's technical assistance during the funding period by assessing the CHP's ability to leverage resources and partnerships within and outside of the CDC

Evaluation Questions

To what extent were grantees able to complete the BRACE framework?

What were the barriers to completing all 5 BRACE Steps?

To what extent has the BRACE framework helped the grantees prepare for the health effects of climate change?

What kinds of work did the grantees do outside of the BRACE framework that helped them prepare for the health effects of climate change?

How well did the BRACE framework in work in each jurisdiction? State vs City?

How did the political climate affect implementation of BRACE?

How well did the CHP leverage resources and partnerships to help the BRACE grantees?

To what extent is CDC engaging with other agencies within a funded jurisdiction?

Interview Protocol

For interviewer: Please read the below italicized paragraph to the participant before beginning.

Thank you for agreeing to participate in this interview. Please remember that your participation is completely voluntary and will have no effect on your current or future CDC funding. You may choose to stop participating at any time. The purpose of this interview is to gather information on your experience with implementing the BRACE framework, identify barriers to completing the framework during the funding period, and assess the value of the Climate and Health Program's technical assistance during the funding period. As you can see, there is a note-taker for this group. The purpose of taking notes is so that we can compile responses and analyze the data for common themes at a later date. Although we are writing down your name and the name of your agency, this is for tracking purposes only. Your name or any identifying information will not be disclosed when the results of this interview are written up in a report. The notes will be deleted after the report is written. The information we collect during this interview will be grouped with 17 other interviews in a compilation of common and unique themes. If there is something you would like to say, but do not feel comfortable saying it during this interview, you may contact me via email at a later date. Additionally, if you think of something at a later date that you would like to add to this interview, please email or call me. The interview will take approximately one hour. The interview is "semi-structured", in that you will be asked a series of predetermined questions, but are free to add any information at any time, including information not specifically asked about during the interview. Do you have any questions before we begin? Ok, let's begin the interview.

Questions

For the interviewer: Please ask the below questions exactly as they are written. Please remember to follow-up each question and response with probes as appropriate, and ask the participant to give examples as often as possible.

- **To what extent were grantees able to complete the BRACE framework?**

1.) *Please describe where your agency was in completing the BRACE framework at the time your funding officially ended (give as much detail as possible).*

- **What were the barriers to completing all 5 BRACE Steps?**

2.) *Please describe why you think your agency was unable to complete all 5 steps of the BRACE framework during the funding period.*

- **To what extent has the BRACE framework helped the grantees prepare for the health effects of climate change?**

3.) *What aspects of the BRACE framework increased your agency's preparedness to reduce death and disease associated with climate change in your jurisdiction? (give as much detail as possible)*

- *How do you define 'preparedness'? What do you think preparedness might look like/looks like for your jurisdiction?*

4.) *How would you change the BRACE framework to increase its effectiveness in helping agencies prepare to address the health effects associated with climate change?*

- *This question can be answered broadly and/or broken down by the individual BRACE steps (e.g. do you agree with the step-process, the order? What about the activities within each step—do they lead logically and sequentially to the next steps? If not, what would improvements look like? Etc.)*

- **How well did the BRACE framework in perform/work in your jurisdiction?**

5.) *What are the benefits implementing the BRACE framework has brought to your jurisdiction?*

- 6.) *What are the challenges or problems implementing this framework has brought to your jurisdiction?*
- 7.) *Discuss your strategies for engaging other units in the health department that are focused on other health outcomes of interest (vector-borne disease, waterborne-disease, etc.)?*
- **How well did the CHP leverage resources and partnerships to help the BRACE grantees?**
- 8.) *Please tell me how well you think the Climate and Health Program leveraged the following resources and partnerships to help your agency implement BRACE...*
- *C.O.Ps such as regional CoPs, Waterborne, Vector, Methods, Communication, the Vulnerability Assessment*
 - *Resources such as the “Climate Change and Human Health Bibliography,” “Temperature and Precipitation data,” and the CHPTechAssistance mailbox.*
 - *Guidance documents such as the “Climate and Health Profile Report Suggested Reporting Format,” “Climate Models and the Use of Climate Projection,” (other docs to name: “Assessing health vulnerability to climate change: A guide for health departments,” “Projecting Climate-Related Disease Burden: A Guide for Health Departments,” “Projecting Climate-Related Disease Burden: A Case Study on Methods for Projecting Respiratory Health Impacts”)*
 - *Partnerships such as NOAA, ASTHO, NAACHO, and APHA*
- 9.) *How much collaboration did you have with other CDC programs during your funding period?*
- *Please describe the extent to which this collaboration helped your agency implement the BRACE framework.*
- 10.) *How can the Climate and Health program at the CDC facilitate partnerships and collaborations with organizations outside of the CDC?*
- *What are the local, state, and/or national organizations/groups that you could see helping you implement the BRACE framework?*

11.) *What kinds of resources did you need to implement the BRACE framework that were not provided through CDC or partners?*

- **What kinds of work did the grantees do outside of the BRACE framework that helped them prepare for the health effects of climate change?**

12.) *Please describe any work your agency did outside of the BRACE framework that helped you prepare for the health effects of climate change.*

- **How did the political climate affect implementation of BRACE?**

13.) *How would you describe the political climate in your jurisdiction?*

- a. How do you think this political climate affected your agency's ability to implement the BRACE framework?*

- **Additional thoughts**

14.) *What additional thoughts, questions, or concerns would you like to share about your experience with BRACE that we have not already covered?*

APPENDIX 5: FOCUS GROUP DISCUSSION GUIDE

Expanding climate change adaptation planning for health in small U.S. states, municipalities, and tribal nations: what are the needs?

Focus Group Discussion Guide

Principal Investigator: Alexandra Zuber

Phone: +1 (617) 680-3950; Email: azuber15@live.unc.edu

Completed as part of a Dissertation for the University of North Carolina- Chapel Hill

Study Background:

The objective of this study is to improve the expansion of climate and health adaptation planning in the U.S., by identifying changes needed to the CDC “Building Resilience Against Climate Effects (BRACE)” model for its effective use by non-grantee state and local health departments and tribal nations. The BRACE model is a five stage approach to climate and health adaptation planning that was used among 16 states and 2 cities as part of the first phase of the CDC Climate Resilient States and Cities Initiative (CRSCI).

As part of this study, I am analyzing key informant interviews with 15 of the 18 CRSCI grantees, as well as conducting focus group discussions with health representatives of non-grantee state and local health departments and tribal nations. This is the focus group discussion for _____(insert one: Non-grantee State/ County/ City/ or Tribal Nation).

This study is being conducted entirely by the P.I., who is a candidate for a Doctorate for Public Health at the University of North Carolina- Chapel Hill. This study is not funded or managed by CDC. This study has been reviewed and approved by the UNC IRB.

Your participation is completely voluntary and you can elect to withdraw at any time throughout the discussion. You can also take breaks if needed. Your name and position will be kept confidential, and will not appear in any final report or papers. Data will be presented in the aggregate, by jurisdictional type (e.g. small state, city, or tribal territory). If I intend to use a quote from you, I will seek your permission first. I will send around a participant list for you to populate your name, title, and contact information, in the event I need to contact you to clarify any comment made in today’s discussion. This information will be protected and viewed only by me, the P.I., and will be destroyed at completion of the study. I will audio record this interview, for my use in data analysis. Tapes and transcriptions will be destroyed at the end of the study.

If you have any questions regarding this study after our interview, please do not hesitate to contact me, Alexandra Zuber, Principal Investigator, +1 (617) 680-3950, azuber15@live.unc.edu.

Introduction (10 min)

P.I. reviews purpose of study, voluntary consent information, and BRACE reference sheet. By way of introductions, let's go around the room, and I'd like each person to say your name, the jurisdiction you represent, and a word or phrase that comes to mind when you think of climate change planning for health in your jurisdiction.

Transition (10 min)

(To the group) Have you observed any successful examples of climate change adaptation planning for health in your jurisdiction? Or any failed examples? *(Probe: Any forecasting or disease burden modelling? Any interventions undertaken? Who have been the key actors/ stakeholders? What were the enablers or constraints?)*

Which federal agency (or other non-federal entity) has been most helpful to you in any climate and health adaptation work to date?

Focus (1 hour)

Let's walk through each stage of the BRACE Model. For each stage, I'd like you to discuss:

- who you think would be responsible for leading each stage for your jurisdiction and does that person(s) have the capacity and interest?
- what inputs would be needed (e.g. funds, staff, leadership, prioritization, political support)?
- could this phase could leverage existing resources or be integrated with other activities?
- what partnerships would be needed, new or existing?
- how the requirements for each stage could be scaled down for smaller states, municipalities, and tribal nations?
- What implementation challenges you might anticipate that are specific to your jurisdiction type, and any potential strategies to address them?

STAGE 1: Forecasting Climate Impacts and Assessing Vulnerabilities;

STAGE 2: Projecting the Disease Burden;

STAGE 3: Assessing Public Health Interventions;

STAGE 4: Developing and Implementing a Climate and Health Adaptation Plan; and

STAGE 5: Evaluating Impact and Improving Quality of Interventions.

Summary (10 minutes)

In its first phase, CDC recommended that state and city grantees pursue these phases sequentially. When expanding BRACE to jurisdictions like yours, should CDC encourage that

these phases be done sequentially, or should jurisdictions be encouraged to complete these in any order? Why or why not?

Are there any other important considerations that affect your particular jurisdiction that would help me in advising CDC on an adapted model for climate and health adaptation planning for your jurisdiction?

APPENDIX 6: FOCUS GROUP CONSENT FORM

University of North Carolina-Chapel Hill

Consent to Participate in a Research Study

IRB Study # 16-2858

Consent Form Version Date: March 14, 2017

Title of Study: Expanding climate change adaptation planning to small states, municipalities, and tribal nations: What is needed?

Principal Investigator: **Alexandra Zuber**

UNC-Chapel Hill Department: **Health Policy and Management**

Co-Investigators: n/a

Funding Source: n/a

Study Contact: Alexandra Zuber, email: alexandrazuber@gmail.com, phone: (617) 680-3950

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is voluntary. You may choose not to participate, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to inform the expansion of climate and health adaptation planning in the U.S., by identifying changes needed to the CDC Building Resilience Against Climate Effects (BRACE) model for its effective use by non-grantee state and local health departments and tribal nations.

How many people will take part in this study?

If you decide to be in this study, you will be one of up to 56 people in this research study, which is being conducted across the nation. All participants were selected based on their participation in the CDC Climate Resilient States and Cities Initiative, or because they represent non-grantee states that are members of the Association of State and Territorial Health Officials, city and county health departments that are members of the National Association of County and City Health Officials, and tribal nations that are recipients of CDC climate and health funding.

How long will your part in this study last?

Your participation in this focus group will last approximately 90 to 120 minutes.

What will happen if you take part in the study?

The group will be asked to discuss how climate change adaptation planning for health has occurred to date in their jurisdiction, and how the BRACE five-stage model may be adapted to be more effective in their jurisdiction. No questions will be directed to you individually, but instead will be posed to the group. You may choose to respond or not respond at any point during the discussion. The focus group discussion will be audiotaped so we can capture comments in a transcript for analysis.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. You may not benefit personally from being in this research study.

What are the possible risks or discomforts involved from being in this study?

We do not anticipate any risks or discomfort to you from being in this study. Even though we will emphasize to all participants that comments made during the focus group session should be kept confidential, it is possible that participants may repeat comments outside of the group at some time in the future. Therefore, we encourage you to be as honest and open as you can, but remain aware of our limits in protecting confidentiality.

How will information about you be protected?

Every effort will be taken to protect your identity as a participant in this study. You will not be identified in any report or publication of this study or its results. Your name will not appear on any transcripts of this focus group discussion. After the focus group tape has been transcribed, the tape will be destroyed, and the list of names and numbers will also be destroyed. Any comment you make will be attributed in final materials as “a health official from small states/ cities/ tribal territory focus group”.

Will you receive anything for being in this study?

You will not receive anything for taking part in this study.

Will it cost you anything to be in this study?

There will be no costs for being in the study

What if you are a UNC employee?

Taking part in this research is not a part of your University duties, and refusing to participate will not affect your job. You will not be offered or receive any special job-related consideration if you take part in this research.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu. You can also contact the Principal Investigator, Alexandra Zuber, with any questions regarding this study.

Participant’s Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

Signature of Research Participant

Date

Printed Name of Research Participant

Signature of Research Team Member Obtaining Consent

Date

Printed Name of Research Team Member Obtaining Consent

APPENDIX 7: CODEBOOK CRSCI INTERVIEWS

The following is one of three codebooks produced for the reduction phase of this study's qualitative analysis. A codebook is "a set of codes, definitions, and examples used as a guide to help analyze interview data". They are important to analyzing qualitative research because "they provide a formalized operationalization of the codes".

Codebook A is the manual that guided Phase 2 of the dissertation study, which comprised secondary data analysis of 15 key informant interviews with CRSCI grantees. The purpose of this codebook to this study phase is to systematically record each code used in the qualitative analysis process, clarify its relationship to other codes, and to provide definitions and examples for each code that helped the Principal Investigator (P.I.) to consistently apply the codes throughout the analysis process. This codebook was produced manually, in Microsoft Word.

To validate this codebook, the P.I. received a draft coding hierarchy from the evaluator from the CDC Climate and Health Program, which was created after review of three of the transcripts. The P.I. consolidated a new codebook based on this manual, with deductive codes (drawn a priori from the literature) and "structural" codes (codes selected due to specific goals and objectives of the study, per Decuir-Gunby, 2010). The P.I. then conducted coding on all 11 transcripts independently.

The P.I. conducted qualitative analysis through the NVIVO qualitative analysis software platform. Any questions or changes to the application of codes during the analysis process was documented in the form of an electronic "memo" linked to the source document (i.e. transcript), and tracked in the codebook. The P.I. used an 'inclusive' coding process; if there was ambiguity or doubt over whether a code should be applied to a particular portion of text, she opted to apply the code.

Additionally, because the qualitative analysis process is inductive and iterative, the P.I. allowed in-vivo codes to emerge, and tracked changes in NVIVO and this coding manual. All content that was coded that did not meet the a priori sub-codes was coded to the parent code. As the P.I. continued coding, in-vivo sub-codes were established, and new content was applied to these in-vivo sub-codes. To ensure that all transcripts were analyzed systematically for these in-vivo sub-codes, in a separate step after completion of the first analysis of all transcripts, the P.I. reviewed all the content of each parent code, and coded the content according to the in-vivo sub-codes. Additional in-vivo sub-codes were also identified in this step of reviewing the parent coded information, and all passages from the parent codes were reclassified with these in-vivo sub-codes.

Both content from the interview subjects and interviewers were included in coding. The following four codes were drawn from a conceptual model adapted by Schoch-Spana, in 2013, for use in examining local health system capacity for emergency preparedness: Macro-level Environment, Inputs ("Structural Capacity"), Outputs ("Processes/ Practices"), and Outcomes.

MACRO-LEVEL ENVIRONMENT

The macro-level environment comprises the “social, cultural, economic and political forces that directly or indirectly influence the existence and functioning of the public health system” (Schoch-Spana, 2013). In this study, these forces are those factors that influenced the implementation of the BRACE model among CRSCI grantees in their state or local context.

Code Nickname: Macro-level

Use when interviewees comment on:

- Political support for BRACE activities or products (favorable or unfavorable) and how the interviewee navigated those forces
- Economic factors that make up the general funding environment of the state or local health department, such as funding priorities or changes to funding, and how those factors influenced the BRACE process or outputs
- Cultural factors (i.e. organizational) that influenced the progress or process of institutions or working groups involved in BRACE. The concept of transparency of information should be coded under this factor.
- Social forces, such as norms or traits that influence collaboration or lack of collaboration, that influenced the progress or process of BRACE implementation

Do not use when interviewees comment on:

- The existence of partnerships, working groups, committees, and other infrastructure that forms part of the “inputs (structural capacity)” of the health system (a separate code)
- The specific use of CRSCI or non-CRSCI funding for BRACE implementation, which should be coded as “inputs/ (structural capacity)” (a separate code)
- Individual traits, such as leadership, that influenced the progress or the process of BRACE implementation (which should be coded under ‘enabler’)

Examples of text coded to this node:

“There was not enough buy-in with the state leadership in Florida and that was an ongoing issue and honestly, I think if they had tried harder in the beginning we might not have been able to apply, but, I’m not sure if that would have been a bad thing or not, frankly. Like, not having that buy-in and support was incredibly detrimental and an ongoing challenge.”

Code Progress Notes:

October 26, 2017

Created a code family with Macro-level Environment as the parent code, with the following hierarchy of sub-codes:

- **Macro-level Environment**
 - **Political forces**
 - **Favorable**
 - **Unfavorable**
 - **How the grantees navigated political forces**
 - **Fiscal conditions**

November, 15, 2017

Deleted fiscal conditions, because insufficient data was available on the topic. Added additional in-vivo codes through deductive analysis of transcripts:

- **Macro-level Environment**
 - **Holding up climate reports**
 - **Mandate or legislation**
 - **Political change**

INPUTS (“STRUCTURAL CAPACITY”)

Inputs are the “information, organizational, physical, human, and fiscal resources that fuel public health practice”. Public health practice in this study comprises the implementation of the BRACE model. Inputs for this practice represent the “structural capacity” of the state, local, or tribal health system in which the CRSCI grantees operate (Schoch-Spana, 2013). Inputs are all of the major categories of resources utilized in BRACE implementation by each CRSCI grantee, regardless of their impact or value on the outcome. Additionally, the term “organizational resources” was borrowed as an input category from the original Handler, A. framework for measuring health systems performance (Handler, A et al, 2001).

Code Nickname: Inputs

Use this code when interviewees comment on:

- The application of CRSCI funding or non-CRSCI funding to support any aspect of BRACE implementation
- Type, volume, and source of staff applied to BRACE implementation
- The use of interns and/or students to implement BRACE activities
- Key sources and type of information or information technology that served as inputs to the BRACE process
- The use of technology as an input to BRACE activities
- Other climate and/or health activities they engaged in outside of BRACE or previous to BRACE

Do not use this code when interviewees comment on:

- Formulation of new partnerships to conduct BRACE activities, which should be coded separately under “Partnerships”
- Leveraging existing partnerships, committees, working groups or other fora to conduct BRACE activities, which should be coded under “Leveraging/ Integration”

Examples of text coded to this node:

“So our current funding structure right now I'm about half funded right on here <X person> is about five or 10 percent funded. And then we did have we have epidemiologists that helps 10 percent of time that we've done but yeah most of the work is done by our contractors at the <the state> university.”

“The other thing we wanted to highlight was our partnership with the interagency climate and adaptation team this has reps from all state agencies that come together to talk about climate adaptation. The benefits are to coordinate our efforts and make sure we are not doing duplicate work and efforts, also a lot of synergy work that we can build upon and help that.”

Code Progress Notes:

October 26, 2017

Created a code family led by the parent code “Inputs”, with the following hierarchy of sub-codes (some of which are a priori codes drawn from the Spoch-Spana model, such as funding, staff, and information, and some of which are deductive codes drawn from the data, including other non-BRACE activities):

- **Inputs:**
 - **Funding**
 - **Application of non-BRACE funding**
 - **Staff**
 - **Existing staff** (new sub-node created February, 2018)
 - **Interns/ Students**
 - **New hires** (new sub-node created February, 2018)
 - **Information**
 - **Type** (e.g. temperature, radiation, emergency room visits) (new sub-code created February, 2018)
 - **Source** (e.g. national, regional, local) (new sub-code created February, 2018)
 - **Organizational Resources** (new sub-code created February, 2018)
 - **Other related work activities** (sub-node moved under sub-node Organizational Resources, February, 2018)
 - **Existing partnerships** (new sub-node created February, 2018 from parent node “Partnerships”)

OUTPUTS (PROCESSES/PRACTICES)

Outputs are those “modes of identifying and prioritizing population health issues as well as designing, executing, and evaluating interventions to address them” (Schoch-Spana, 2013). The outputs in this study are any major category of activity that formed part of implementation of BRACE in that jurisdiction, as reported by the interviewee. While processes are defined in the original Handler framework as the ten essential health services, due to the study’s focus on operational requirements, the processes of focus in this study were the operational processes that were undertaken to implement the BRACE cooperative agreement, for example, partnerships and community engagement.

Code Nickname: Processes

Use this code when the interviewee comments on:

- The formation of any new partnerships by the jurisdiction to conduct BRACE activities
- How the jurisdiction integrated BRACE activities in to local planning processes or documents
- How the responsible unit conducted community engagement (i.e. partnerships or consultations with community organizations or populations)
- The sequence of BRACE stages, i.e. was BRACE conducted in a linear or non-linear fashion
- Engagement with local health departments, such as through partnerships or solicitation of feedback, including examples of collaboration, challenges with collaboration, and any needs that arose from LHDs regarding the process
- Novel practices that are unique to a jurisdiction but have possible implication for lower level jurisdictions
- The process jurisdictions took to conduct BRACE

Do not use when the interviewee comments on:

- Specific deliverables of processes or practices (e.g. the completion of a climate health profile) which should be coded separately as an “outcome”
- Specific meetings or minor steps that do not constitute a major category of activity that can be comparable across jurisdictions

Examples of text coded to this node:

“Every month I meet with all the county health directors. They have a monthly meeting the fourth Wednesday of the month and I have a half hour where I talk to them about what's going on in the world. And every time I talk about climate and health and I keep them informed about the progress made with climate and health.”

Example: “Our approach is to empower the county health department from there they can talk to their own cities and supervisor there are so many players in this so we feel like we get all the

information to counties and give them talking points and tips on where to look for interventions that help them to work with their counties their city planners things like that.”

Code Progress Notes:

October 26, 2017

- Created a code family led by the parent code “Outputs”, which includes the following hierarchy of sub-codes (which represent: a priori codes drawn from the literature, including community engagement, leveraging, and integration; and structural codes based on the specific questions and goals of the study, such as linearity of BRACE stage implementation, and novel practice):
 - **Outputs:**
 - **Community engagement (nickname: community)**
 - **Leveraging and integration**
 - **New partnerships** (new sub-node created February, 2018 from parent node “Partnerships)
 - **Novel practices**
 - **Process of BRACE implementation (nickname: process description)**
 - This code was removed in December, 2017 after recognizing that content could not be meaningfully coded due to the wide diversity of approaches for each stage
 - **Linearity of BRACE stage implementation**
 - **Linear**
 - **Non-linear**
 - **Engagement with LHDs or Tribal Authorities** (sub-node created February, 2018 by converting the parent node “LHDs or Tribal Authorities to this sub-node)

December, 2017

Sub-nodes added through deductive analysis of the following node:

- **Processes**
 - **Engagement with LHDs or Tribal Authorities**
 - **Examples of LHD collaboration**
 - **Needs of LHDs**
 - **Lack of engagement**
 - **City-specific issues**

OUTCOMES

In the Schoch-Spana conceptual framework, outcomes are “short and long-term changes to population health”. However, because the first phase of BRACE implementation under CRSCI concluded with a planning document, no outcomes on public health can be documented through these interviews. Instead, this term for the purposes of this study will signify all products, impacts, and benefits identified by interviewees to the public, the health department, or other stakeholders as a result of BRACE implementation.

Code Nickname: Outcomes

Use when interviewees comment on:

- Any documents, plans, technical briefs, training, media releases, or any other written or physical deliverable produced through BRACE implementation
- Concerns over usability of any documents, plans, technical briefs, or other deliverables produced through BRACE implementation
- Other benefits of BRACE implementation on the public or stakeholders, such as improved awareness, development of capacity, behavior change, and enhanced collaboration.
- The specific BRACE stage accomplished within the CRSCI grant period

Do not use when interviewees comment on:

- Products or deliverables produced through non-BRACE activities
- Challenges faced in the *development* of key deliverables, which should be coded under “Challenges”.

Examples of text coded to this node:

“It was very effective of building capacities across agencies, across universities, anywhere, anybody I needed to get information from, data from. And then it immediately launched me into climate-projections.”

Code Progress Note

October 26, 2017

Created a code family with the parent code “Outcomes” and the following hierarchy for sub-codes (which represent in-vivo codes, including products and other benefits, and a structural code, including BRACE stage achieved):

- **Outcomes**
 - **Products**
 - **Creating shorter or web-based formats for usability** (in-vivo code developed December, 2017)

- **Other Benefits**
- **BRACE Stage Achieved**
 - This code was removed in December, 2017 when it was determined that the interviews could not be meaningfully coded to determine BRACE stage achieved. Interviewees did not consistently report whether a stage was completed or in progress, and progress through the stages was not linear, so that stage 5 may be underway, while stage 2 was not yet completed.

December, 2017

Additional sub-codes identified deductively through analysis of the “other benefits” sub-node:

- **Products**
 - **Other Benefits**
 - **Built capacity**
 - **Concrete holistic framework**
 - **Elevation of health**
 - **Expanded collaboration**
 - **Political cover**

CRSCI GRANTEE CHALLENGES AND CONSTRAINTS

Challenges in this study are any difficulties or impediments faced by interviewees in achieving their activities and objectives with BRACE implementation. Challenges may be general, such as poor collaboration, or may be the result of specific constraints, which are factors internal or external to the organization that pose a barrier to achievement of the organization’s goals (e.g. limited funding). Taken together, challenges and constraints represent the barriers and impediments the grantees faced in implementation of the BRACE model.

Code Nickname: Challenges

Use this code when interviewees comment on:

- Challenges experience with BRACE implementation as a whole, such as limited funding, shortages of staff, lack of requisite expertise, turf issues, or competing priorities. This may include challenges internal or external to the organization (including in the macro-level environment)
- Challenges experienced specific to an individual BRACE stages (1-5), such as lack of adequate modelling expertise

Do not use this code when interviewees comment on:

- Challenges related to CDC CHP technical assistance, which should be coded under the applicable sub-node under the parent code “CHP Technical Assistance”

Examples of text coded to this node:

“Not that it wasn’t needed we just didn’t have the capacity or resources to do it in the time allotted”

“I would say all of the steps the one that was the most difficult and I’m sure that this is the common theme is step number 2- projecting the burden of disease. I think that has been sort of the most difficult to understand, how much capacity we should be putting toward that versus the planning and the assessing, implementing and evaluating it.”

Code Progress Note:

October 26, 2017

Created a code family with the parent code “Challenges” and the following hierarchy for sub-codes. Challenges with each BRACE Stage were determined as deductive codes.

- **Challenges**
 - **Challenges with BRACE Stage 1 (nickname: Stage 1)**
 - **Historical vs. future temperature trends** (sub-code identified in-vivo December, 2017)
 - **Challenges with BRACE Stage 2 (nickname: Stage 2)**
 - **Quantitative vs. qualitative** (sub-code identified in-vivo December, 2017)
 - **Resource intensive** (sub-code identified in-vivo December, 2017)
 - **Time consuming** (sub-code identified in-vivo December, 2017)
 - **Uncertainty in results** (sub-code identified in-vivo December, 2017)
 - **Utility** (sub-code identified in-vivo December, 2017)
 - **Challenges with BRACE Stage 4 (nickname: Stage 4)**
 - **Usability concerns** (sub-code identified in-vivo December, 2017)
 - **Timing of plan v. action** (sub-code identified in-vivo December, 2017)

November, 2017

Additional in-vivo sub-codes created through deductive analysis of the coded material under the sub-codes above.

- **Too little funding (nickname: funding shortfall)**- sub-code determined in November, 2017
- **Staff shortages or turn-over (nickname: staff shortages)**- sub-code determined in November, 2017
- **Insufficient staff expertise (nickname: expertise)**- sub-code determined in November, 2017
- **Length or usability issues due to report format**- sub-code determined in November, 2017

- **Use of historical vs. future projections-** sub-code determined in November, 2017
- **Turf issues between health departments and/or other stakeholders (nickname: turf)-** sub-code determined in November, 2017
- **Unclear role of climate team (nickname: role clarity)-** sub-code determined in November, 2017

ENABLERS

Businessdictionary.com defines enablers as “capabilities, forces, and resources that contribute to the success of an entity, program, or project”. Enablers in this study are those factors in the internal or external environment of the grantees that facilitated the successful achievement of BRACE activities and objectives in that jurisdiction, without which, the achievement may not have occurred. Enablers can be inputs, factors in the macro-environment, or practices or processes. An enabler may be identified explicitly by the interviewee his/herself or through the judgement of the P.I. in review of the data.

Code Nickname: Enablers

Use this code when the interviewee makes comments on:

- The existence of partnerships or working groups that enabled the work to be completed
- The participation of academic researchers that volunteered time or offered time at reduced cost to support BRACE activities
- The existence of data sources (e.g. monitoring stations) that enabled quick assembly of historic climate trends
- The usefulness of CDC’s Climate Health Program Communities of Practice or technical assistance
- The existence of strong leadership or a culture of collaboration

Do not use this code when the interviewee makes comments on:

- Inputs, factors, processes or practices to BRACE implementation that were not significant to, or had little impact on, the successful achievement of BRACE implementation

Examples of text coded to this node:

“So I think the climate and health program was really helpful in organizing those communities of practice to leverage talking with other states. I feel that without having that information on the interventions from those other grantees we would have been WAY further behind BRACE Step 3.”

Code Progress Note:

October 26, 2017

A code family was established with “Enablers” as the parent code, and the following hierarchy of sub-codes (developed from the BRACE conceptual model).

- **Enablers**
 - **Enablers for BRACE Stage 1 (nickname: Stage 1)**
 - **Enablers for BRACE Stage 2 (nickname: Stage 2)**
 - **Enablers for BRACE Stage 3 (nickname: Stage 3)**
 - **Enablers for BRACE Stage 4 (nickname: Stage 4)**
 - **Enablers for BRACE Stage 5 (nickname: Stage 5)**

January, 2018

Created a new, deductive categorization of enablers that crossed BRACE stages, because of the cross-cutting nature of the enabler factors.

- **Enablers**
 - **Communities of practice**
 - **Existing programs or practices**
 - **Existing staff of expertise**
 - **Flexibility of the process**
 - **Partnerships**
 - **Setting a priori priorities**

RECOMMENDATIONS

A parent code was established to capture any recommendations or suggestions for improvement that CRSCI interview subjects made pertaining to the BRACE model.

Moved communications to CHP Assistance communications. March 14, 2018

Code Nickname: Recommendations

Use this code when the interviewee makes comments on:

- Changes they recommend CDC make to the BRACE model to improve its usability or effectiveness
- Changes or improvement to the way states and localities undertake the BRACE model

Examples of text coded at this node:

“When I look at the BRACE report our focus is on outreach and education and we are trying to funnel all of these things down to the local health departments. One of the things that is challenging for my work is to try to plug in for the local perspective how to take the information that is in that report and actually implement it there. If there was some framework that form a state perspective we could be building into this report to help the local health departments”

Do not use this code when the interviewee makes comments on:

- Changes they recommend to CDC assistance, technical guidance, or communities of practice, which should be coded to another parent code, “CDC CHP Technical Assistance”
- Changes they recommend for other federal, state or non-profit entities that are not CDC

Code Progress Note:

October 26, 2017

A code family was established with “Recommendations” as the parent code. In-vivo sub-codes were determined deductively through analysis of the transcripts, and are listed below.

- **Recommendations**
 - **Add a stakeholder mapping section**
 - **Adding historical trends and analysis (emphasis)**
 - **Communications assistance (removed this node, January, 2018 and relocated to CDC CHP Technical Assistance parent node)**
 - **Consolidation of stage 1-3**
 - **Framework for LHD engagement**
 - **Integrate with other health programs**
 - **Integrate evaluation throughout BRACE**
 - **Need for vulnerability assessment at the intervention level**
 - **Outsourcing BRACE stages**
 - **Time scales for planning and adaptation**

CDC CLIMATE AND HEALTH PROGRAM (CHP) TECHNICAL ASSISTANCE

This category includes all the technical resources and assistance the CDC CHP team provides to CRSCRI grantees to implement the BRACE model, including technical assistance (advising and collaboration), technical guidance materials, and Communities of Practice (regional collaboratives between CRSCI grantees managed by the CHP team).

Code Nickname: CHP Assistance

Use this code when interviewees comment on:

- Experiences with CDC technical assistance (technical advising or collaboration), technical guidance, or Communities of Practice
- Challenges faced with CHP assistance
- Helpful aspects of CHP assistance
- New recommendations by CRSCI grantees for assistance that could be provided by the CDC CHP team to help with future BRACE implementation

Do not use this code when interviewees comment on:

- Specific CDC staff or personnel
- CDC funding

Examples of text coded at this node:

There was some frustration on our part in terms of guidance being issued after we began or not even began, but were substantively underway on grant deliverables

We felt like our program officer didn't really communicate a lot of the stuff that was going on I felt like we missed out on a lot. We would have these phone calls and they would focus highly on administrative issues not on what the CDC was doing."

Code Progress Note:

October 26, 2017

Created a code family with "CHP Assistance" with a hierarchy of sub-codes as follows (which are in-vivo codes based on the data):

- **CHP**
 - **Communities of Practice (nickname: CoP)**
 - **Technical Assistance/ Advising (nickname: TA)**
 - **Technical Guidance (nickname: Guidance)**
 - **Recommendations for CDC Assistance (nickname: Recommendations)**
 - **Other**

November, 2017

Created in-vivo sub-codes based on deductive analysis of the text coded to the sub-codes above.

- **CHP**
 - **Communities of Practice (nickname: CoP)**
 - **Technical Assistance/ Advising (nickname: TA)**
 - **Communication between administrative and science staff**
 - **Different starting points affecting use of TA**

- **Insufficient response from CDC staff**
- **Lack of awareness**
- **Technical Guidance (nickname: Guidance)**
 - **Grantee PowerPoints**
 - **Inadequate guidance**
 - **Late publication**
- **Recommendations for CDC Assistance (nickname: Recommendations)**
 - **Communications**
 - **Connection to other federal efforts**
 - **Providing more data or evidence**
 - **Staffing communities of practice**

LOCAL HEALTH DEPARTMENTS AND TRIBAL HEALTH AUTHORITIES

Local health departments are city and county health departments. Together with tribal health authorities, these public health institutions represent the key focus of inquiry for this dissertation study. For this analysis, this code will capture any discussion, issues, or themes that emerge that explicitly involve these constituents.

Code Nickname: LHD

Use this code when interviewees comment on:

- The needs of local health departments or tribal health authorities
- The unique resources or capabilities of local health department or tribal health authorities
- Constraints or limitations faced by local health departments or tribal health authorities
- Examples of collaboration or work between CRSCI grantees and local health departments and tribal health authorities
- Products or deliverables that were specifically created for local health departments and tribal health authorities

Do not use this code when interviewees comment on:

- Engagement with community organizations at the local level, which should be coded as “community engagement” sub-node under the “inputs” parent code.
- Engagement with tribal members or tribal civil society organizations, and not through tribal health authorities, which should be coded as “community engagement” sub-node under “inputs” parent code.

Examples of text coded to this node:

“Being a city rather than a state like most other grantees you do things a lot differently so in terms of your geographic scale how did you break it down I mean you’re not going to do counties obviously.”

“I think that was the thing that struck me the most that a lot of the data you get is at the county level so if we were going to pursue that we would get the disease burden projection of our entire city...A lot of our work looks at which neighborhoods are vulnerable so we can allocate resources and develop programs. So if we have this broad overarching county wide assessments it doesn't help us develop interventions as directly as other steps.”

Code Progress Note:

October 26, 2017

Created a code family with “LHDS” as the parent code, and the following hierarchy of sub-codes (based on in-vivo codes from the data):

- **LHDs**
 - **Needs**
 - **Examples of collaboration or products (nickname: collaboration)**
 - **Lack of engagement in BRACE**
 - **City factors**

February, 2018

- This was placed under “Processes” Parent code due to its function as an operational process of interest to the study

PARTNERSHIPS

While it may be conceptually considered an “input” or a “process”, because of its important significance in the implementation of BRACE and public health generally, it has been determined to be its own parent code.

Use when interviewees comment on:

- Examples of any partnership employed as part of any BRACE stage between the BRACE-funded health department and any other organization, agency, or institution, for the purposes of advancing BRACE activities
- Challenges faced in any partnership employed as part of any BRACE stage
- Factors or considerations affecting partnerships for the purpose of implementing BRACE stages or climate and health activities in general
- Engagement with organizations that represent vulnerable groups, such as tribes, homeless shelters, long-term care facilities

Don't use when interviewees comment on:

- Direct engagement with communities, such as tribes, or vulnerable groups (such as through a Liaison), which should be coded under “community engagement” sub-node under “Processes” parent code

- Formal partnerships with local health departments or tribal health authorities, which should be coded under “LHDs or tribal health authorities” sub-node under “Processes” parent code

December 12, 2017

- Created “shorter format for usability” on Dec 12.

February 7, 2018

- This was subdivided and moved to two parent nodes:
 - 1) existing partnerships were moved to “inputs” as an organizational resource
 - 2) new partnerships were moved to “processes” as a key operational process undertaken by BRACE grantees

MEMORABLE QUOTES

This code pertains to any quote by a grantee regarding any topic of the interview that the P.I. deemed illustrative of key themes emergent from the study. These could include challenges, enablers, recommendations, or important consideration regarding state or local health department needs. This code is for the purpose of retaining useful quotes that may be used in the dissertation monograph to illustrate any results or recommendations.

APPENDIX 8: CODEBOOK B (CRSCI GRANTEES)

Codebooks B and C were produced for the two categories of focus group discussions, CRSCI Grantees and Non-Grantee Local Health Departments. For both codebooks, the P.I. entered code names, descriptions, hierarchies, and use examples in NVIVO, and produced an auto-generated codebook through NVIVO for both sets of focus groups (CRSCI grantees and

Non-CRSCI grantee local health departments), available in Appendices 7 and 8. This format was selected because it is easier to understand the coding hierarchy and to see the definitions and use examples. It also automatically tallies the number of sources coded to that node and the number of textual references that were coded to that node. This format was not known to the P.I. in the production of codebook A.

Name of Node and Hierarchy	Description	Sources	References
Benefits	Include comments by respondents that indicate benefits or positive experiences with the BRACE model or CRSCI. Example: I think the greatest benefit is that there is no other funding I believe that works in this realm. Do not code benefits of investment, assistance, or work outside of BRACE or the CRSCI program.	5	69
Dedicated resources	Include comments from grantees that state a key benefit of BRACE was its dedicated resources for climate work, including funding, staff time, and other resources. Example "I think the greatest benefit is that there is no other funding that works in this realm" and "it was really helpful to have dedicated time to produce publications and reports".	3	11
Funding		3	7
Gave mandate		3	9
Seat at the table		1	2

Name of Node and Hierarchy	Description	Sources	References
Navigating politics		2	4
Networking and Collaboration		4	8
New Tools and Data		4	9
Structured Planning Process		3	5
Challenges	Include comments regarding any challenges that respondents faced implementing the BRACE model or CRSCI program. Example: "(BRACE)" is not simple. It is very time consuming. And heat requires a lot of expertise to do those projections in the right way. Do not code challenges articulated with CDC TA, which should be coded in a separate parent code.	5	140
BRACE Stage 1		4	14
Lack of data		2	2
Time and resource intensive		1	3
BRACE Stage 2		2	9
Data not compelling for action		2	2
Did not complete		1	2
Overly technical		2	2

Name of Node and Hierarchy	Description	Sources	References
Resource intensive		1	2
BRACE Stage 3		4	14
BRACE Stage 4		3	7
BRACE Stage 5		4	13
Capacity or expertise		2	5
CDC technical assistance		3	10
Collaboration with other health department units		4	4
Communicating with stakeholders		3	7
academic partners		1	3
local stakeholders		1	3
LHD specific issues		3	4
Model		1	3
Community engagement not included		1	1
Mitigation not in framework		1	1
Overemphasis on quantitative		3	10

Name of Node and Hierarchy	Description	Sources	References
Sequence of stages or process		3	5
Social determinants or equity not included		2	2
Time consuming		3	9
Time horizon		2	4
Too academic or technical		3	9
Weather data analysis not state health dept. role		1	1
Political climate		3	14
Resource Shortages		3	13
Staffing shortages or expertise		3	3
Sustainability		1	3
Too siloed		3	9
Enablers	Include comments by respondents that identify any capabilities, forces, and resources that contribute to the success of BRACE or CRSCI. Example: "we had the right people in place and I think finding your champions in other agencies is a good lesson learned for other people." Do not include factors or resources that	2	2

Name of Node and Hierarchy	Description	Sources	References
	did not have a meaningful impact on BRACE or CRSCI.		
Federal or other entities that have been helpful	Include comments that identify federal agencies, non-profit organizations, foundations or other entities that have been "helpful" or useful in local climate and health adaptation planning. Example: "We worked with the national weather service office, our emergency management and mayoral folks, to really improve messaging". Do not include comments on institutions that were not helpful to BRACE or CRSCI.	3	5
Integration	Include comments by respondents on any issues, challenges, or advantages to integration of climate and health adaptation with local planning processes or other health or non-health programs. Also include specific integration opportunities they identify. Example: In order for a climate health adaptation plan to mean something, it has to be embedded with larger city or state efforts. It cannot stand alone. It is extended to make an impact.	4	28
Integration Opportunities and Examples	Include comments recommending or citing specific areas of integration of BRACE or climate and health work with other health or non-health sectors at their jurisdictional level. Do not include general integration issues or recommendations, which	3	11

Name of Node and Hierarchy	Description	Sources	References
	<p>should be coded at the parent code "Integration". Example: "We found that for extreme heat, local municipalities' urban planning departments were really helpful".</p>		
LHD experiences	<p>Include an examples of any respondent experiences working with (or as) local health departments in climate and health adaptation, including planning, implementation or evaluation, as part of CDC CRSCI or outside of it. Example: "They used the state wide projections and sort of looked at it for their context. They didn't do any specific kind of modelling (truncated)..." Do not include future plans for work with LHDs, or needs by LHDs, or recommendations for LHDs, which should be coded separately.</p>	3	20
Recommendations for improvement	<p>Include any recommendations or ideas for improvement of the BRACE model, CDC strategy, or actions on the part of local health departments to improve climate and health adaptation. Example: "Even though there is some kind of incentive for them through their emergency CDC funding, that might be more effective." Do not include recommendations for other federal or national entities that are not CDC.</p>	4	51
CDC intra-agency collaboration		3	8

Name of Node and Hierarchy	Description	Sources	References
Funding		3	4
CDC Technical Assistance		5	8
Repository of tools and information		1	1
CDC to conduct literature review		3	7
CDC to do hazard assessment		1	1
Cluster jurisdictions		1	2
Integration with local planning processes		3	4
Integration with non-health sectors		3	4
Model		1	5
Adding mitigation		1	1
Adding stakeholder mobilization as a stage		4	11
Collapse VA and CHP		1	2
Guidance on iteration		3	5
Make non linear		1	1

Name of Node and Hierarchy	Description	Sources	References
Revise planning time horizon		1	2
Simplify evaluation for LHDs		2	6
Social determinants		3	9
Streamline Stages 1 and 2		4	13
Make data available to LHDs		3	3
Web based tools		1	2
Starting model with a priori health priorities		3	9
local stakeholders		1	3
Use other language		1	1
Respondent Characteristics	Include any reference to the respondent's professional training and background, title, or role in climate and health adaptation, most often identified in the introductions portion of the discussion. Example: "I work in the Tri-County Health Department in Central Oregon. My primary role here is doing the communicable disease investigations and surveillance." Do not include	5	6

Name of Node and Hierarchy	Description	Sources	References
	discussions of their personal or professional interests in climate and health adaptation.		
Role of State	Include any comments on the suggested role of the states in supporting local health department climate and health adaptation, which may include recommendations or issues or concerns. Also includes examples mentioned of states supporting localities. Example: "Technical support and keeping locals informed about potential funding opportunities is also always appreciated as well." Do not include recommendations for CDC support of states, which should be coded under the parent code "Recommendations".	5	21
CoP for LHDs		2	3
Data, tools, research		3	6
Funding for local planning and interventions		2	5
Mandate and priorities		2	2
Policy and regulations		2	2
Technical Assistance and Capacity-building		4	13
Evaluation		1	2

Name of Node and Hierarchy	Description	Sources	References
Integration to local planning processes		1	2
Simplified VA and CHP		2	2
Tension between state and local		2	3

APPENDIX 9: CODEBOOK C (NON-CRSCI GRANTEE LOCAL HEALTH DEPARTMENT FOCUS GROUPS)

Codebooks B and C were produced for the two categories of focus group discussions, CRSCI Grantees and Non-Grantee Local Health Departments. For both codebooks, the P.I. entered code names, descriptions, hierarchies, and use examples in NVIVO, and produced an auto-generated codebook through NVIVO for both sets of focus groups (CRSCI grantees and

Non-CRSCI grantee local health departments), available in Appendices 7 and 8. This format was selected because it is easier to understand the coding hierarchy and to see the definitions and use examples. It also automatically tallies the number of sources coded to that node and the number of textual references that were coded to that node. This format was not known to the P.I. in the production of codebook A.

Node Name and Hierarchy	Description	Sources	References
Capacity and TA needs	Include respondent references to any needs for capacity-building, training, and technical assistance, which may include webinars, staff support (e.g. fellows), communities of practice, site visits, and more. Example "we really need training in GIS and could benefit from having a fellow dedicated to us".	6	67
Collaborating with other disciplines and stakeholders		2	5
Guidance on stakeholder mapping	Comments in response to the idea that CDC should add a stage dedicated to mapping and engaging stakeholders for climate and health planning. May include positive or negative reactions, or discussions of stakeholder mapping at the state or local level. Example "I don't think mapping is necessary at the local level, since we already know our partners. But it would be helpful if the state provided a map of state level partners that could be a resource".	4	7

Node Name and Hierarchy	Description	Sources	References
Communicating with the public about CC and health		4	12
Data analysis		4	4
Examples from other jurisdictions	A sub-theme that includes respondent comments on their desire to have examples of climate and health adaptation planning activities and achievements of other jurisdictions, such as best practices, to inform their work. Do not include actual examples of other jurisdiction work. Example: "We really need to learn from what other jurisdictions are doing; if someone could provide that, it would be great".	3	12
Networking with other jurisdictions		2	3
Targeted towards similar size jurisdictions		1	1
Rural capacity needs		2	8
How to advance without funding		1	1
Tiered guidance		1	2
Challenges to adaptation planning	Comments from respondents that describe any operational, technical, or other challenges they presently experience in climate and health activities OR that they anticipate in the future implementation of BRACE	6	62

Node Name and Hierarchy	Description	Sources	References
	climate and health adaptation planning. Examples: "The political will (to implement BRACE) is here; I think the hardest part is would be the shortage of staff". "We don't really have any access to climate-related data".		
Competing Priorities		2	7
Support from Decision makers		1	2
Politics		2	2
Complexity of topics		2	3
Coordinating with regional planning commission		1	2
Data Availability and Use		1	4
Expertise		2	2
Material resource shortages		6	17
Staffing challenges or needs		3	10
Need the right partners		2	3
Need community engagement		1	3

Node Name and Hierarchy	Description	Sources	References
Solutions are upstream or outside of health sector		1	1
No central coordination		2	2
Climate and Health Adaptation Priorities	Include any comments by respondents that identify climate or adaptation priorities for their jurisdiction, such as agriculture or flooding. Example: In Kansas City, while we are not a bike friendly community, we are working towards being/ integrating all the environmental predetermination into park city strategic plan. Do not include the personal priorities of the respondent that do not reflect the priorities of the jurisdiction or department.	0	0
Agriculture		1	2
Built Environment		3	5
Emergency Preparedness		1	3
Extreme temperature		4	6
Flooding		4	7
Health Equity Social Determinants		4	9
Infrastructure		2	2

Node Name and Hierarchy	Description	Sources	References
Mitigation		2	2
Mosquitos		4	7
Natural disasters		1	1
Resilience		1	2
Sea-level rise		2	2
Storms		3	5
Water quality		3	3
Wildfire		3	4
Climate and Health Priorities	Comments that reference current climate and health priorities for the jurisdiction, including climate hazards of concern, health conditions of concern, and vulnerable populations or other communities of concern. Do not include examples of how jurisdictions have set priorities or challenges faced therein. Example "Our county is really focused on the built environment, and how to develop green infrastructure". And "we are especially concerned about the tourism industry and how extreme heat may affect it".	6	54
Climate Hazards of Concern	References by respondents of specific climate hazards of concern for their jurisdiction, for example, flood, drought, built environment, natural disasters, etc. Concern may be expressed as an interest, focus, need, priority, or otherwise. Example: "Our county is really focused	6	34

Node Name and Hierarchy	Description	Sources	References
	on heat and heat-related illness, since our area sees such extremes".		
Emergency Preparedness		1	3
Extreme temperature		4	6
Flooding		4	7
Mosquitos		4	7
Natural disasters		1	1
Sea-level rise		2	2
Storms		3	5
Water quality		3	3
Wildfire		3	4
Communities of Concern	Respondent comments related to vulnerable populations or communities of specific concern for their jurisdiction, such as the elderly, those of low socioeconomic status, or racialized communities. Do not include geographic communities. Example: "our work has focused on communities of low socio-economic status. And we've also done a lot of work with our federally recognized tribes".	3	4
Health Conditions of Concern	Comments by respondents that reflect specific health conditions or areas of concern for their jurisdiction, such as	3	11

Node Name and Hierarchy	Description	Sources	References
	asthma, heat-related illness, deaths/ injury due to natural disasters and more. Concern may be indicated by describing these as an interest, focus, or priority area. Example "our county is really focused on asthma related to wildfires".		
Other Priorities		0	0
Agriculture		1	2
Built Environment		3	5
Health Equity Social Determinants		4	9
Infrastructure		2	2
Mitigation		2	2
Resilience		1	2
Experience with climate activities	Includes comments by respondents that describe any work related to climate and/or climate and health in their jurisdictions. This can be work that is ongoing or is in the past. Do not include activities respondents hope or plan to undertake in the future. Example "our city has a climate action plan, and we have organized a sub-group to develop the health section".	6	43
Climate and health adaptation partnerships		3	9

Node Name and Hierarchy	Description	Sources	References
Community-led initiatives		1	3
Federal agency or other entity that has been a resource		6	36
CDC		6	12
CSTE		1	3
EPA		1	2
NACHHO		1	4
NASA		2	2
NOAA		1	2
NWS		2	4
Fragmented efforts		1	1
Integrating with city climate planning		3	13
Intra health department		2	3
Singular issue collaboration		5	9
Funding	Comments by respondents that describe any funding opportunities in their jurisdiction that could be leveraged for climate and health adaptation planning work, such as from public, private, or non-profit sources. Do not include	5	19

Node Name and Hierarchy	Description	Sources	References
	challenges cited due to funding shortages or experiences receiving funding to date. Example "our state disaster mitigation program has a lot of funds we could try to target".		
City business plan		1	1
City healthy levy		1	1
City resiliency funding		1	1
City Safety Net Providers		1	1
Emergency Preparedness Planning		1	1
Incorporate CC in other CDC funding		3	10
Coordination with other federal agencies		1	1
Leveraging PHA program		2	2
Private foundations		3	9
Ryan White		1	1
Information Sources	Include references by respondents to any sources of climate-related data (e.g. temperature data, air quality) they have and how they used it. Or references to the absence of data. Do not include references to challenges with data	6	51

Node Name and Hierarchy	Description	Sources	References
	availability, collection, or analysis as a "challenge" in this code, which should be coded under the parent code "Challenges". Example: "Climate Central has been helpful to gauge what is to come in our region as well".		
Area academic research and tools		3	6
Climate Central		1	1
Community weather monitoring collaborative		1	1
Environmental Health Tracking		1	1
Federal		5	7
Local reports		2	4
Resolution problem		1	1
Routine administrative health data		2	3
State		2	2
Syndromic surveillance		1	1
Integration	Includes suggested opportunities for, or issues related to, integrating climate and health adaptation in to local planning processes, such as disaster mitigation plans, or city-wide climate action plans.	6	40

Node Name and Hierarchy	Description	Sources	References
	Do not include recommendations for improved integration by CDC CHP with other CDC divisions or programs, which should be coded under the parent code "Recommendations". Example: "I think we should integrate more with the regional disaster mitigation plans".		
Built Environment		3	3
City Business Plan		1	2
City Climate Plan		2	2
City Health Plan		1	1
Community and civil society organizations		3	3
Community coalitions		1	1
Community Health Improvement Plan		3	5
Comprehensive Planning		1	4
Emergency Preparedness		5	10
PHEP		2	2
Hazard Mitigation Planning		3	3
Health Equity		2	3

Node Name and Hierarchy	Description	Sources	References
Regional Planning		3	9
Resiliency Planning		3	4
School based Sustainability Coordinator		1	1
Social determinants		1	1
Transit and Infrastructure Planning		3	4
Interest in Adaptation Planning	Includes responses by each respondent regarding positive or negative interest in having BRACE climate and health adaptation planning process in their jurisdiction, and whether this would be politically viable in their jurisdiction. May include their specific topical interests in climate and health. Do not include inferred interests or generic statements of interest. Example "our county would be very interested, but the challenge would be getting it past the commissioners".	6	17
Political viability	Includes any commentary by respondents regarding the political viability, or acceptability, of having BRACE climate and health adaptation planning occur formally in their jurisdiction. This viability may be positive or negative, and may include discussion of the use of language as a key influencing factor in the acceptability of the work. Do not include general references to the political	6	51

Node Name and Hierarchy	Description	Sources	References
	climate in the jurisdiction. Example "(BRACE) could work in our jurisdiction, if we call it something else".		
Use of language		6	20
Viability concerns		6	14
Public awareness of CC impacts on health		1	2
Partnerships	Includes references to any partnerships that the jurisdiction maintains, which they consider to be a resource to climate and health adaptation planning. Also includes discussion of which partnerships the respondents feel would need to be established to support BRACE planning. Do not include partnerships with federal agencies, which should be coded as sub-code "federal agencies that were helpful". Example "our partnership with GSU is really critical and would be important".	6	88
Academic		4	12
City agencies		4	6
Community engagement		5	12
Counties		2	2
Federal or national		1	2

Node Name and Hierarchy	Description	Sources	References
Health care coalitions		1	1
Non profits		5	9
Other		1	2
Precincts		1	1
State		2	2
Governor		1	1
Recommendations for CDC	Include any discussant comments that respond to the question regarding recommendations to CDC, or that refer to an action the discussant is recommending CDC take to support climate and health adaptation planning in their jurisdiction. Do not include recommendations to other entities that are not CDC. Example "If CDC could help ensure that public health preparedness FOAs include reference to climate and health that would help us coordinate on the ground".	6	77
A priori priority vs. mapping universe of hazards	Comments and discussion regarding whether respondents believe that starting the BRACE framework with a singular priority determined in advance (i.e. "a priori") of the BRACE process is optimal, or if rather mapping the universe of hazards and health conditions as a means to determine priorities is optimal. Do not include references to how the jurisdictions have presently formed priorities. Example: "I think we'd prefer to have the help to review all	2	5

Node Name and Hierarchy	Description	Sources	References
	the climate hazards, so we can determine priorities".		
Central repository		1	2
Climate as health in all policy		1	1
Collaboration between jurisdictions		2	5
Cluster jurisdictions by shared interests or stage		1	1
Collaboration with other initiatives		1	1
Data		1	1
Examining cost implications		1	1
Funding		3	7
Direct LHD support		1	4
Integrate with resiliency efforts		1	2
Offer Cont. Ed. credits		1	1
Regionalize BRACE		1	2
Rural guidance		1	3

Node Name and Hierarchy	Description	Sources	References
Shared vision and mission		2	3
Use of language		1	2
Respondent Characteristics	Includes references by respondents to their job title, role, training or background, or professional discipline. Example: "I am the emergency preparedness manager for my district and I focus on disaster mitigation".	5	6
Responsible Authorities	Include comments and discussion by discussants related to the question where the BRACE program should sit organizationally in their jurisdiction, and whether these units have the requisite capacity, staff, and time to conduct the work. Example: "I think the department, our department, would be able to participate in some capacity. But in our city, it has to be the resiliency officer".	6	19
Examples of successful capacity-building models		2	3
Health Department		5	10
Resiliency Office		3	5
Staffing resources		5	14
University		1	2
Role of State in Supporting Local Adaptation Planning	Include comments and discussion by discussants regarding what they think should be the role of the state to support	6	49

Node Name and Hierarchy	Description	Sources	References
	local climate and health adaptation planning in their jurisdiction. May also include references to what the state is presently doing in their jurisdictions. Example "In our case, I think the state should just stay out of our way". "The state is facilitating what we are doing".		
Collaboration between LHDs		3	4
Sharing best practices		1	1
Funding		3	3
Limitations		6	12
Centralized vs. decentralized systems		1	1
Mapping resources		1	1
Providing new data and tools		2	2
Providing the mandate		4	5
Taking regional approach		1	1

APPENDIX 10: RECOMMENDATIONS FROM CRSCI GRANTEE INTERVIEWS

Grantees were routinely asked in the interviews how the BRACE model or CDC CHP technical assistance could be improved. Grantee responses to these questions are summarized in the tables below.

Appendix Table 1. Recommendations for the BRACE Model of CRSCI Grantees by Frequency of Citation

Most reported recommendations (3 or more grantees)	
<ul style="list-style-type: none"> • View stages 1-3 as one phase of information collection for decision-making • Diminish and outsource grantee responsibilities in stages 2 and 3 • Foster greater integration of BRACE activities and funds with other local health programs • Encourage grantees to start BRACE planning with ‘a priori’ climate hazard or health priorities 	
Less reported recommendations (2 grantees only)	Once reported recommendations (1 grantee only)
<ul style="list-style-type: none"> • Vulnerability assessments should be conducted at the outset of every adaptation intervention • States need a framework for engaging LHDs in developing and operationalizing the adaptation plan 	<ul style="list-style-type: none"> • Stakeholder / partner engagement and coordination should be a stage in BRACE • Grantees should establish adaptation interventions and measures for different time scales (i.e. current, 1 year, 5-10 years) • Evaluation should be integrated throughout the BRACE model as a “theme”

Most commonly reported CRSCI recommendations for the BRACE model

View stages 1-3 as one phase of information collection for decision-making

Several grantees noted that stages 1-3 should be viewed together as one stage, with the objective to produce a cohesive set of materials for decision-making, and not as discrete, sequential stages. One rationale given for this recommendation is that conducting these stages in sequence led to the use of different methodologies and even different units of analysis or topics of focus between the vulnerability assessment, climate and health profile, and disease burden projections.

We were like going step 1, step 2, step 3, step 4, until my colleague and I stepped back and agreed it would have been good at the onset if we had looked at the stages as a series of reports and tools for can planners and policymakers rather than report step 1, report step 2... we didn’t really conceptualize it that way and I don’t know that it was framed that way.

In general the steps were logical however the problem that we ran across is that we didn't think about steps 1 and 2 together, which we should have in planning what we were going to do. This is because we did our vulnerability assessment then we decided to do things differently, with different metrics, for our exposure response functions and our disease burden projections. I think we should have thought more cohesively instead of thinking about them in silos... we made reasonable choices in each one of those three steps but they didn't end up being the same thing.

Two grantees recommended that the climate and health profile and the vulnerability assessment should be conducted and produced in one document. This was recommended to save time and resources involved in having the final deliverables reviewed, cleared, and published.

We discovered after the fact that the Climate and Health Profile Report and the Vulnerability Report could have been one document and it would have really saved us a lot of time and work because there was a little overlap in the data work that was done.... to publish things is very time-consuming for all the approvals and graphic design...having one document would be time saving and expedite the process to getting a usable product you know for the planners.

Diminish and outsource grantee responsibilities in Stages 2 and 3

Grantees commonly recommended that the next iteration of BRACE diminish the activities required of grantees in stages 2 and 3. In stage 2, grantees recommended that the phase be more "practical" and "less academic", and several grantees specifically recommended that the disease burden projections be outsourced to academic centers, and even "academic centers of excellence".

Can we, maybe, have step number 1 looking at climate projections for our region and our vulnerabilities and assessing evidence based interventions, and have that be enough? And maybe projecting the burden of disease is something that we continue to do but on the parallel track as we can partner with academic partners

Stage 2 could be a lot less modeling exercise, and could be made more practical...I mean you know what the priorities are- you don't need to do step 2 to figure out what your problem is. You already know what the problem is.

One option for stage 2 would be to encourage more academic partnerships and actually provide funds for academics to provide research for the states and local jurisdictions...I could see you having an academic center of excellence in climate change and health that could provide assistance to health departments.

One grantee suggested that stage 2 could be bifurcated to enable grantees to look at the relationship between historic climate trends and health separately from futuristic projections and modelling, to avoid the complexity and delays posed by the latter. Another grantee felt that CDC could simplify these two stages by encouraging grantees to use national data for BRACE

planning, such as from CDC and EPA, coupled with local vulnerability assessments, as opposed to attempting to generate local data and projections themselves.

Similarly, grantees reported that work required in stage 3 should diminish now that the initial literature reviews have been conducted. As one grantee noted: “now we will have these lit reviews done and step 3 will fade a little bit in terms of its importance.” One grantee recommended that CDC itself maintain a list of evidence-based interventions that it could provide to grantees by topic area.

Integrate BRACE activities with other state and local health programs and activities

Several grantees recommended that CDC help future grantees to better integrate BRACE-related activities in to other health programs at the federal, state, or city levels, as a means to leverage resources and maximize impact. One grantee reported that BRACE climate and health activities could be seen and implemented as another “silo”, and that redundancy and overlap should be avoided with other environmental health efforts on the ground. Several grantees recommended more explicit collaboration with environmental tracking in general, and three specifically encouraged CDC BRACE funds to be used to strengthen tracking systems- and other routine surveillance- in particular.

How do we make BRACE a part of what (state and local health departments) are already doing and not ask them to do more ...or to spend more money? How can we just make it part of the good public health work they are already doing... and tie it to what’s already happening?

For BRACE Step 2, what might be more practical is to institutionalize better surveillance of climate impacts on health, such as from heat, wildfire smoke, and other things that currently aren’t really (being tracked).

From a sustainability perspective, grantees are discussing ways to integrate this work into other public health grants... (CDC should) encourage that, and (encourage) providing resources for those that want to incorporate climate as one of their grant deliverables for another program...I wish that there were more ways to provide support to the preparedness people or communicable disease people or chronic disease people who want to incorporate climate change. It may be only 10% of the work but (should be) an active component.

Start the BRACE planning process with a priori climate hazard or health priorities

Three grantees recommended jurisdictions select priority climate hazards or health impacts as a means to complete BRACE activities. Most grantees reported selecting priority health outcomes of concern, and then identifying the climate drivers, while one reported picking the climate hazard of greatest concern. This strategy was deemed essential for helping jurisdictions- especially local health departments- to successfully complete the BRACE model. One grantee suggested that local health departments may find it necessary to select priorities that have local

political support- such as natural disasters- to ensure they have buy-in to pursue BRACE activities.

The first two to three steps for each grantee or jurisdiction is to figure out what their top three priorities are for their area and they're not going to be the same for each area or county....Some may be interested in wildfires and heat...others in drought and floods. Once you identify what those key problems or issues are for your jurisdiction, then you get your materials ready and your interventions.

I don't think you can be successful without identifying 'what are your biggest concerns from a health perspective' and then tying those to what actually matters, chronologically, for those concerns.... And then you can say: if I'm concerned about this then I really need to just look at these couple of climate variables and see how they are projected to change. I don't need to have a whole fleet of every piece of information that's available'. I think it really simplifies.

Less Reported Recommendations by CRSCRI Grantees for the BRACE Model

Other grantee recommendations included additions to the BRACE model and changes to timing and structure of key deliverables. Two state grantees felt the BRACE model needs a framework for engaging local health departments more directly in the design of the climate and health adaptation plan, and, in particular, in its operationalization.

When I look at the BRACE report, our focus is on outreach and education and we are trying to funnel all of these things down to the local health departments. One of the things that is challenging for my work is to try to plug in for the local perspective how to take the information that is in that report and actually implement it there. If there was some framework that form a state perspective we could be building in to this report to help the local health departments, because now we are trying to do outreach mechanism on the backend of it.... Because it is local projections, local capacity, local political framework, and local interests, which are all needed in order to help interventions.

One grantee suggested that the engagement of partners was such a critical step in the process of BRACE implementation, that it should be its own stage, perhaps replacing stage 2. Another grantee suggested that evaluation should be integrated throughout BRACE more explicitly as a 'theme' rather than as a final stage in the model. In terms of changes to key deliverables, two grantees stated strongly that vulnerability assessments should be conducted at the outset of every adaptation intervention, and not just at the jurisdictional level at the start of the framework. Lastly, one grantee recommended that the adaptation plan specifically ask grantees to establish adaptation interventions and measures for different time horizons, for example, current activities (or those already underway), and also 1 year, 5 year, and 10 year activities. This is to account for the different time horizon for impact of the interventions.

Appendix Table 2. CRSCI Grantee Recommendations for Future CHP Assistance by Frequency of Citation

Most reported recommendations (3 or more grantees)	
<ul style="list-style-type: none"> • CDC should provide more data and evidence for grantees as inputs to BRACE planning • CDC should provide grantees more assistance on communicating with policy-makers and communities • CDC should foster more peer-to-peer learning between grantees 	
Less reported recommendations (2 grantees only)	Solo reported recommendations (1 grantee only)
<ul style="list-style-type: none"> • CDC national programs outside of climate should incentivize collaboration between climate and other health teams at the state and local levels • CDC should have one of its scientific staff responsible and participating in the Community of Practice • CDC technical guidance should more clearly state the requirements and boundaries of expected deliverables • CDC should connect grantees with other related federal efforts and partners 	<ul style="list-style-type: none"> • CDC should solicit grantee input on all technical guidance before publication • CDC should produce tiered guidance for BRACE planning, based on the time available for grantees for the planning process • CDC should create a special journal issue of BRACE activities in published articles • Allow the CDC evaluator to spend more time with the grantees

Most-reported Recommendations for Future CHP Assistance

CDC should provide more ready-to-use data and information to grantees for BRACE planning

Grantees commonly recommended that CDC provide more data and information to grantees that could be readily used as an input to BRACE planning, rather than depending on grantees to generate all the information used. Two grantees in particular said that information on the cost-benefit of adaptation interventions, or how to cost climate hazards, would be especially useful to convince policymakers and their communities to conduct a risk assessment and take action. Other data requested included algorithms (based on meta-analysis of the literature) for projecting disease burden of climate hazards, county-level data from other CDC health programs (e.g. Asthma, stroke), and a list of climate and health interventions that have been assessed in the public health literature.

There's definitely an interest from the communities that we're working with for more information on the cost of these mitigation and adaptation strategies, and what would be the relative benefit both short-term and long-term to their populations.... understanding the triple bottom line and understanding the importance of, you know, the social, environmental and economic impact of their decisions.

CDC could actually come up with more methodologies.... algorithms that predict, with heat for instance, you know at certain temperatures you will see certain x increase in emergency room visits...If those algorithms could be summarized with a meta-analysis from the literature and if you could find local data to also plug in, it would be an extra bonus. So you know there could be standard algorithms that CDC could provide to each state...and local jurisdictions...that would probably simplify things.

CDC should provide more assistance to grantees on communications with policy-makers and communities

Several grantees reported the need for more tools, strategies, and advising from CDC on how to communicate the activities of BRACE and the impact of climate change and why it matters, to the general public, policy-makers across the political spectrum, and local health departments. One grantee mentioned the need to consider important development in climate change communications research (e.g. Maibach, et al) in the development of climate and health communication messages and strategies.

Skipping (stage 2) altogether and having a focus more on communications probably would have been helpful...no matter how great the information and content we create, if we're not able to communicate it to our stakeholders, it's not going to have a meaningful impact...So figuring out what is the best way to communicate this information to policy-makers or residents, having a stronger communication framework would have been helpful.

Having graphics, resources, educational materials and tools to give to local jurisdictions and to the public to explain to them what this is all about, how this all matters, and how to implement these interventions, and why they need to do it, is really important and...is lacking at the moment...some suggested CDC take a larger role in providing these tools and materials.

CDC should encourage more peer-to-peer learning between grantees

When grantees were asked how to improve CDC technical assistance, they frequently mentioned the value of peer-to-peer learning from other grantees who are implementing the same activities. They frequently recommended approaches that CDC could continue this learning, such as creating a new Community of Practice for city grantees, circulating a monthly newsletter among grantees that summarizes the work of grantees in a routine and succinct manner, and providing more example of actual adaptation plans and best practices as guidance to new grantees. Indeed,

grantees seemed to place more value on personal interactions in general- even with CDC staff- than on written guidance.

Recommendations reported by two grantees or less

Other less reported recommendations call upon CDC to partner more closely with other CDC divisions responsible for funding agreements with states, in order to build in language and even funding that would incentivize grantees at the state and local levels to work with the climate and health teams in their jurisdictions. Likewise, two grantees also noted it would be helpful for CDC to help grantees to make connections and build relationships with other federal and national actors in climate and health, such as the U.S. Global Change Research Program and Georgetown Climate Center. This would help to better understand other work underway and to even identify new funding opportunities.

One recommendation calls upon CDC to ensure the Communities of Practice each have a CDC CHP scientific advisor who is staffed to the group and who participates routinely in its calls and meetings, to provide more direct interaction between grantees and CDC staff. One grantee reported that this personal interaction would have been helpful just to “bounce ideas off of”, which cannot be done with the written guidance alone.

While grantees appreciated the flexibility of the guidance in terms of expected deliverables, two grantees reported that they would have “saved time” and improved their products if the guidance more clearly explained what was “in and out of scope” and even what the basic format or template for the deliverable should look like. Additionally, one grantee recommended that CDC seek input from grantees on technical guidance before it is published, to ensure it comprises the most helpful content in the most constructive format. Another grantee recommended that, because state and local health departments may have different time and funding constraints, CDC could tailor its guidance, such as “if you have a year, three months, or six months” available.

Grantees largely praised the utility of the CDC evaluator, and one grantee recommended that this staff person be enabled to spend more time with grantees in future phases of BRACE implementation, because: “(evaluation) is such an important component for (BRACE implementation) and different grantees have different levels of capacity”. One grantee also recommended that CDC could raise visibility of its BRACE activities by supporting a special journal edition focused on BRACE achievements.

APPENDIX 11: EXAMPLE OF DATASETS THAT COULD BE PROVIDED IN ADAPTATION GUIDANCE

Information sources to support adaptation and resilience planning:

Information source	Application
Strategic Health Asset Planning and Evaluation Application (SHAPE)	<ul style="list-style-type: none"> - Locate health and social care facilities - Mapping clinical activity, public health and health inequalities, demographics.
Climate change, justice and vulnerability study, Joseph Rowntree Foundation	<ul style="list-style-type: none"> - Locate parts of the UK where the population is vulnerable to heat wave and flood hazards.
BIOPICCC Research Briefing 1: Mapping future risks of extreme weather and growth in older populations in England	<ul style="list-style-type: none"> - Locate areas in England projected to experience increases in flood and heat wave hazards along with increases in the older population (aged 65 years and over).
Demographic data including demographic projections, datasets on ethnicity and deprivation: (Office for National Statistics).	<ul style="list-style-type: none"> - Locate potentially vulnerable groups to climate change across the UK.
Specific Local knowledge of a given area, not recorded in routine data sources including Local Climate Impacts Profiles (LCLIPs -a UKCIP tool): http://www.ukcip.org.uk/lclip/ For local climate projections, which have recently been set out in UKCP09 (UK Climate Projections 2009) see http://www.defra.gov.uk/publications/files/pb13274-uk-climate-projections-090617.pdf	<ul style="list-style-type: none"> - Identification of particular issues and priorities in a given area e.g. particular community groups and their needs/vulnerabilities; crucial parts of local infrastructure and their susceptibility to climate change effects - Many local authorities have completed a LCLIP and have information about weather/climate related events that have affected the locality in the recent past.
UK Climate Impacts: http://www.ukcip.org.uk/uk-impacts/ UKCIP Adaptation Wizard – UKCIP	<ul style="list-style-type: none"> - UKCIP
www.environment-agency.gov.uk/climateready	Climate Ready is a support service run by the Environment Agency to help businesses, public sector and other organisations in adapting to a changing climate. Their website hosts a number of useful, easy to use tools to help you take action.

Source: Appendix 2. *Adaptation to Climate Change for Health and Social Care Organizations*. Sustainable Development Unit. National Health Services. January, 2014.

<https://www.sduhealth.org.uk>

APPENDIX 12: EXAMPLE OF GUIDANCE ON STAKEHOLDERS FOR ADAPTATION PLANNING

Identifying key stakeholders to involve in adaptation and resilience planning

<p>Council</p> <ul style="list-style-type: none"> • Adult Social Care (leads in the following areas: social work, residential care, day care, domiciliary care, telecare, personalisation, learning and physical disabilities, mental health) • Emergency and resilience planning • Spatial planning/development control • Infrastructure planning • Climate change adaptation • Neighbourhood management • Community services (e.g. CVS liaison and leisure facilities) <p>Coordinating bodies</p> <ul style="list-style-type: none"> • Local Strategic Partnership • Local Resilience Forum • Health and Wellbeing Boards • Sustainability Forums 	<p>CCG and HWBB</p> <ul style="list-style-type: none"> • Public Health Intelligence • Join Planning and Commissioning • Community care representative • GP representative <p>Acute Trust</p> <ul style="list-style-type: none"> • General Acute Inpatient Services • Geriatric Inpatient Care • Inpatient Dementia and Mental Health Care • Accident and Emergency • NHS Estates <p>Community Trust (where applicable)</p> <p>Mental Health Trust</p>
<p>Utilities</p> <ul style="list-style-type: none"> • Water company • Electricity company • Gas company • Telecommunications 	<p>Emergency Services</p> <ul style="list-style-type: none"> • Fire and Rescue Service • Police Force • Ambulance Service
<p>Independent Sector</p> <p>Community and Voluntary Sector</p> <ul style="list-style-type: none"> • Age UK • WRVS • NCVS • Older People's Forum • Carers' advisory groups • Alzheimer's Society • 'Other' local user-led groups • Older people's charter groups • British Red Cross • National and local flood forums <p>Private Care Providers</p> <ul style="list-style-type: none"> • Private care companies • Care homes • Care in the community schemes <p>Social Housing Corporation/Major Housing Associations</p>	<p>Other</p> <p>Government Departments</p> <ul style="list-style-type: none"> • Department for Environment and Rural Affairs • Department of Health • Department of Communities and Local Government <p>Inspection and Regulation</p> <ul style="list-style-type: none"> • Environment Agency • Care Quality Commission <p>Transport</p> <ul style="list-style-type: none"> • Rail service providers • Network Rail • Local bus companies • Dial-a-ride schemes <p>Advocacy and Brokerage Groups</p> <ul style="list-style-type: none"> • Health-Watch • Climate Change Partnerships

Source: Appendix 2. *Adaptation to Climate Change for Health and Social Care Organizations*. Sustainable Development Unit. National Health Services. January, 2014.

<https://www.sduhealth.org.uk>

APPENDIX 13: EXAMPLE GUIDANCE ON LOCAL PLANNING INSTRUMENTS FOR ADAPTATION PLANNING

LOCAL GOVERNMENT ACTION MECHANISMS

Land Use and Urban Planning	A key role of local government is to manage local places in a coordinated, planned way that reflects a community's shared vision of adapting to climate change.
Licensing and Regulation	Local governments can use the local regulatory environment through assessment and approval processes, the use of surcharges and rebates, and through the enforcement of local laws, to implement and enforce climate change policies.
Facilitation, Advocacy, and Leadership	Local governments are in close contact with community organizations, businesses, residents and other stakeholders at the local level. This influence can be used to develop shared understandings and encourage whole community responses to climate change.
Community Service Delivery, Development, and Civic Engagement	Local governments are committed to preserving the safety, health and wellbeing of residents and visitors, and to ensuring active civic participation.
Workforce Development	As responsible corporate citizens, local governments can lead the way in ensuring good occupational health and safety systems including the reduction of workplace risks.

Source: *Finding the Nexus: Exploring Climate Change Adaptation and Mitigation*. Nexus Series. ICLEI: Local Governments for Sustainability. Pages 1-8. 2012.

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