

# Community-Based Adaptation to the Health Impacts of Climate Change

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**Abstract:** The effects of and responses to the health impacts of climate change will affect individuals, communities, and societies. Effectively preparing for and responding to current and projected climate change requires ongoing assessment and action, not a one-time assessment of risks and interventions. To promote resilience to climate change and other community stressors, a stepwise course of action is proposed for community-based adaptation that engages stakeholders in a proactive problem solving process to enhance social capital across local and national levels. In addition to grassroots actions undertaken at the community level, reducing vulnerability to current and projected climate change will require top-down interventions implemented by public health organizations and agencies. (Am J Prev Med 2008;35(5):501-507) © 2008 American Journal of Preventive Medicine

## Introduction

As succinctly stated by Yogi Berra, “The future ain’t what it used to be” ([www.quotationspage.com/quote/27223.html](http://www.quotationspage.com/quote/27223.html)). Climate change is changing the landscape of people’s lives in ways that can be beneficial, detrimental, or neutral. As such, climate change is challenging the mission of public health to promote physical and mental health, and prevent disease, injury, and disability. Recent reviews of public health responses to climate change in the U.S. identified, for selected health outcomes, interventions either known or highly likely to be effective in reducing climate change–related morbidity and mortality, and the responsible parties.<sup>1-4</sup> The focus has been on interventions that are the responsibility of national and state public health agencies. Although these interventions are critical, they will not be sufficient, even with optimal resources and engagement. Additional activities will need to be taken by individuals within their communities.

Preparing for and effectively responding to climate change will be a process, not a one-time assessment of risks and likely effective interventions. Considerable attention has focused on the importance of reducing emissions of greenhouse gases, with many communities and states developing and implementing mitigation initiatives (e.g., U.S. Mayors’ Climate Protection Agreement; [www.usmayors.org/climateprotection/agreement](http://www.usmayors.org/climateprotection/agreement)).

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However, failing to address adaptation will leave communities poorly prepared for the climatic changes expected over the next few decades. There is a “climate change commitment” that arises because carbon dioxide (CO<sub>2</sub>), the main anthropogenic greenhouse gas, remains in the atmosphere for decades to centuries.<sup>5</sup> Global average surface temperature increased 0.8°C (1.4°F) over the past century, with most of the warming occurring in the past 3 decades, and at least that much additional climate change will occur before effective mitigation policies affect atmospheric CO<sub>2</sub> concentrations. Failure to cope with the climate change that has already occurred and to anticipate and prevent the consequences of projected climate change over the next few decades are expected to affect human health and security.<sup>6</sup>

Public health adaptation to climate change is briefly reviewed here. Community-based adaptation is discussed next, as an approach to proactive implementation of programs and activities necessary to cope with a changing climate, including using storylines to facilitate community preparedness.

## Public Health Adaptation to Climate Change

The climate change community uses the term *adaptation* to refer to the process of designing, implementing, monitoring, and evaluating strategies, policies, and measures intended to reduce climate change–related impacts and to take advantage of opportunities.<sup>7</sup> In public health, the analogous term is *prevention*. Adaptation can be actions taken in advance of climate change impacts or reactions in response to perceived or real health risks. The capacity of local communities to minimize adverse health effects through adaptation is

in part a function of social capital as discussed below, but also of such factors as socioeconomic conditions, infrastructure, government accountability, and institutional responsiveness. Thus, adaptation can encompass both spontaneous responses by affected individuals and communities and planned responses by governments and institutions.

Public health interventions are generally classified into primary, secondary, or tertiary prevention. In the context of climate change, mitigation of greenhouse gas emissions can be considered *zero order prevention*.<sup>8</sup> Primary prevention aims to reduce exposures projected to occur with climate change, such as redesigning cities to reduce urban heat islands, thereby increasing resilience to rising temperatures and more frequent and intense heatwaves. Secondary prevention aims to prevent the onset of adverse health outcomes, including approaches such as strengthening disease surveillance programs to provide early intelligence of the emergence or re-emergence of vector-borne disease (e.g., Lyme disease along the northern edges of its current range). Tertiary prevention consists of measures (often treatment) to reduce long-term impairment and disability and to minimize suffering caused by existing disease. For each health outcome, there may be multiple possible primary, secondary, and tertiary interventions.<sup>1-4</sup>

### Community-Based Adaptation to Climate Change

Adaptation to climate change risks will need to take place at the individual, family, community, and government levels. Top-down interventions include programs and activities implemented by local, state, or national public health and environmental agencies. Stakeholder engagement in the design, implementation, and monitoring of these interventions is needed because the potential health impacts of climate change, and therefore the actions to reduce these impacts, are intimately interwoven with specific population and regional vulnerabilities. These actions may receive financial and/or technical assistance from state and national agencies. A largely uninformed and unengaged public, unresponsive government, and other hurdles hamper efforts.<sup>9</sup>

Public health interventions generally have been less effective in populations with a lower SES.<sup>10</sup> Stakeholder engagement is needed to ensure that messages designed to reach vulnerable groups provide the information and motivation necessary for individuals to make appropriate choices. For example, obesity, in addition to its other health implications, increases the likelihood of suffering adverse health consequences during a heatwave.<sup>11</sup> Therefore, public service announcements and other interventions during heatwaves should be developed and tested specif-

ically for the obese; single messages will not serve all vulnerable groups equally. Working with stakeholders can help ensure individual and community acceptance of the intervention, along with reducing constraints to implementation.<sup>12</sup>

To be successful, interventions often need to address the societal, cultural, environmental, political, and economic contexts that increase vulnerability.<sup>13,14</sup> Tackling these broader determinants of public health might be daunting, but necessary and potentially very effective.<sup>15</sup> Engaging communities in this broader process of adaptation will not only enhance their resilience to climate stressors, but will likely increase their ability to cope with a wide range of other societal issues.

Community organizing is a process of bringing people together to advance the common good and increase their direct representation in the decision-making process.<sup>16</sup> Community empowerment encourages neighborhood stewardship that can be translated into concrete action, such as physical improvements of the urban environment.<sup>17</sup> Factors that influence community organizing efforts include sense of social connectedness and sense of community among neighborhood residents.<sup>18,19</sup> Although engagement and funding remain challenges for community organizing, strategies are available to overcome these obstacles.<sup>14</sup>

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The theoretic underpinning of community-based adaptation lies in the concept of *social capital*, which is the potential embedded in social relationships that enables residents to coordinate community action to achieve shared goals, such as adaptation to climate change.<sup>20-22</sup> It includes two complementary components. *Structural social capital*, described through social networks, is intrinsic to the social organization of communities. *Cognitive social capital* consists of the norms, values, attitudes, and beliefs that emerge, for example, during community meetings, and thus can be described as peoples' perception of the level of interpersonal trust, sharing, and reciprocity. This two-dimensional construct can be further categorized into bonding (localized), bridging, and linking social capital.<sup>23,24</sup>

*Bonding social capital* is the normative content of homogeneous groupings, such as religious, cultural, professional, racial, or ethnic groups. Bonding social capital is necessary but not sufficient to address the threats from climate change. Homogeneous groups, even with rich social capital, may not have sufficient problem-solving capacity because they lack the expertise, authority, and financial resources to enact necessary changes.<sup>25</sup>

*Bridging social capital* arises from connecting socially heterogeneous groups and can provide a host of benefits to community groups. Different societal groups

vary in skills and talents and can generate new strategies for addressing risks. For example, lessons learned from adaptation actions in one community may prove helpful to other communities.

In the context of adaptation to climate change, *linking social capital* is particularly important because it connects people at different levels of power, such as community members and government officials.<sup>24</sup> Responding to the challenges of climate change relies on a wide range of expertise, not all of which can be found within the communities themselves; to ensure effective interventions, a wide variety of government agencies and scientific experts should engage with communities. For example, effectively addressing the possible health impacts of increases in the frequency and intensity of floods will require not only community engagement, but also coordination across many agencies, including those responsible for public health and infrastructure planning.

Social capital is based on connections across multiple systems, including the *microsystem* (individual), the *mesosystem* (interrelation among individuals and higher social contexts), the *exosystem* (settings in which the person does not actively participate but in which significant decisions are made that affect the individual), and the *macrosystem* (“blueprints” for defining and organizing the institutional life of society, including overarching patterns of culture, politics, economy, and the environment).<sup>26,27</sup> Social capital can be enhanced by organizing individuals into neighborhood groups, connecting different groups, and eventually linking these groups with government officials when implementing interventions to prepare for and respond to the challenges posed by climate change.

### Framework for Community-Based Adaptation to Climate Change

Because the effects of and responses to climate change will depend on the local context, including geographic, demographic, social, economic, infrastructural, and other factors, many adaptation options will be more effective if designed, implemented, and monitored with strong community engagement. Although some adaptations will require a more top-down approach (e.g., standards to ensure safe air and drinking water), putting the community at the center of other adaptation activities will facilitate their effectiveness (e.g., disaster response plans). Figure 1 shows a framework for facilitating community-based adaptation to the health impacts of climate change, with each step designed to enhance components of social capital. Ideally, individuals, communities, and government will work together to ensure the broadest support for adaptation activities.

The first step is community outreach, to determine the broad project outline based on concerns of the

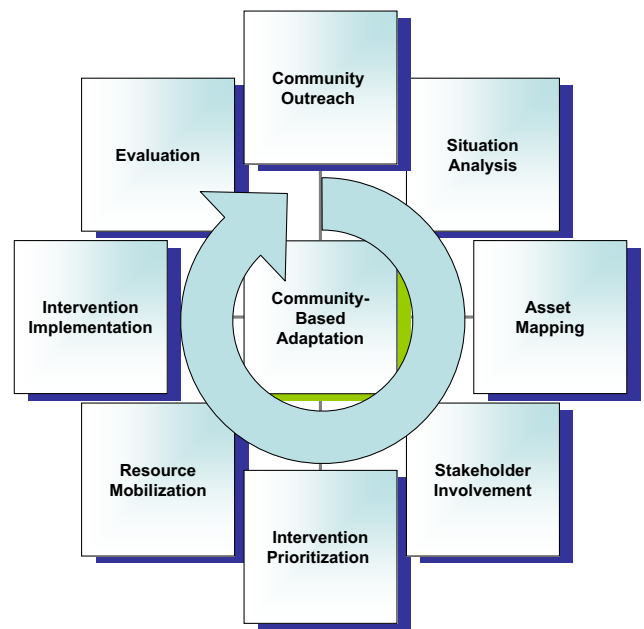


Figure 1. Framework for community-based adaptation

possible health impacts of climate change. Community organizations or activists, city managers or leaders, state or national organizations, or agencies aiming to increase local adaptive capacity may initiate community-based adaptation. Broad management decisions will need to be made, such as which health outcomes of concern to include, geographic boundaries for the analysis, and other relevant issues. A management structure will need to be established to facilitate the process.

The second step is a situational analysis, to describe community needs and constraints to adaptation. This step describes the health consequences of climate change to identify any current adaptation deficit and highlight potential future problems. The characterization can be qualitative (e.g., the health burdens are small, intermediate, or large based on simple climate scenarios, such as a 1°F increase in temperature over the next few decades) or quantitative (e.g., based on model projections of the health impacts of climate change). A situational analysis also assesses factors that could influence vulnerability, such as land use and demographic characteristics.

One product of the situational analysis can be storylines of possible local climate change impacts. Storylines, as opposed to quantitative projections that focus on impacts in one sector over long time frames, can enhance community engagement in discussing shorter- and longer-term risks and possible interventions, including where, when, and how interventions could be implemented. Taking a future perspective, these storylines can highlight compound vulnerabilities, such as the possibility of an extended heatwave during which the power grid fails, or a continuing increase in the

number of cases of salmonella affecting older adults and small children.

The third step is mapping the community assets, including financial and human resources, actors whose expertise and talent could support adaptation activities (e.g., colleges and universities; national, state, and local agencies; nongovernmental organizations), and other relevant factors. For example, if heatwaves and urban heat islands are an issue, then one solution may be installing green roofs, and assets would include individuals with the technical knowledge to design, install, and maintain such roofs. People from other communities may also have experience in installation. As more communities engage in adaptation, opportunities for enhancing adaptation through sharing of best practices and case studies will increase; support by state and federal agencies would enhance linking social capital across levels.

With a project design and an understanding of the available assets, the fourth step is to engage with a broader range of stakeholders to identify possible interventions for enhancing the management of climate change–related health risks. Engaging multiple sectors will advance the bridging and linking social capital of the community, and help ensure that the project addresses community concerns, thus facilitating stakeholder engagement. One approach is to invite neighborhood residents to open meetings to discuss the storylines and seek their ideas on possible solutions. Community members are likely to identify options that reflect their observations and concerns. One important outcome of this step is facilitating social networks and personal connections between individuals and organizations within the neighborhood, with the aim of advancing structural social capital.

The catalog of possible interventions then needs to be prioritized using criteria agreed upon by the stakeholders. At a minimum, the benefits of the interventions should exceed their cost, with the stakeholders agreeing on the metrics for measuring benefit. It would be helpful at this point if experts with knowledge of climate change projections reviewed the priority options, to ensure those likely to be implemented will also be wise choices under projected future climates (e.g., that interventions won't increase future vulnerability).<sup>28</sup> The prioritization process needs to be transparent, so that all community members can understand the criteria used for the ranking and can understand which interventions are the highest priorities, even if they don't all agree with the final decisions.

Having identified the highest priority interventions, a detailed plan for implementation can then be created and widely published. In preparation for implementation, resources (human and financial) will need to be mobilized. The project team may take actions, such as applying for funding, working with

private industry to obtain donations of materials and other resources, and engaging with actors in other communities.

The fifth step is to implement the intervention. By this point in the process, the community will have built considerable social capital to ensure effective implementation by using a wide range of stakeholders, with each contributing on the basis of specific talents and interests. Community involvement in the implementation will further increase social capital, as illustrated by the two examples below.

The final step is to establish monitoring and evaluation processes that allow for early identification of problems, to enable midcourse corrections when needed.

### **Examples of Community-Based Adaptation An Urban Intervention**

A community-based strategy to expand social capital was developed by a nonprofit organization (The City Repair Project) in Portland OR, field-tested in several settings, and evaluated.<sup>29,30</sup> The intervention was not designed to address climate change, but was a primary prevention effort to retrofit the urban environment to reduce urban heat islands. Metropolitan areas tend to be at higher risk during heatwaves because urban climates are often warmer than the unbuilt surroundings.<sup>31,32</sup> Characteristics of the urban environment can have a significant effect on concentrations of air pollutants, urban energy consumption, human comfort, and incidence of heat- and air pollution–related mortality and morbidity.<sup>33</sup> The City Repair Project reached out to community members and mobilized neighborhood stakeholders in a discussion of potential interventions.<sup>31</sup> Plans were developed and implemented with the participation of residents and volunteers, aided by experts. Activities included installing green roofs, increasing urban vegetation, planting trees in parking strips or abandoned lots, and constructing trellises for hanging gardens. A pre–post panel study, using a validated instrument, evaluated three intervention sites where communities built hanging gardens, fountains, green roofs, planter boxes on the street corners, and made other changes.<sup>30</sup> Residents ( $n=265$ ) within a 2-block radius of the intervention sites were interviewed before and after project completion. Multivariate analysis documented improvements in mental health ( $p=0.03$ ); increased sense of community ( $p<0.01$ ); expansion of social interactions ( $p=0.06$ ); and an overall expansion of social capital ( $p=0.04$ ). This grassroots effort also triggered a strong sense of ownership and community empowerment that was documented through open-ended interviews.<sup>34</sup>

Top-down approaches also can be effective; for example, empirical data from Sweden indicate that membership in associations, interpersonal trust, informal interactions, and other social capital indicators are associated with higher cooperation and participation in the democratic process.<sup>35</sup>

## **A Rural Intervention**

In response to growing concern in the Canadian North about observed environmental changes, the national Inuit organization initiated a project in cooperation with regional Inuit organizations and Canadian research institutions to document changes and impacts experienced in communities and begin discussing integrated and comprehensive adaptation policies and measures.<sup>36</sup> Aboriginal communities throughout the Canadian Arctic have been very articulate about the climate and other environmental changes they have observed, the challenges they face as a result, and the possible solutions.<sup>37</sup> Participants at a workshop dealing with climate change and health in Northern Canada reviewed current health issues, including those that may be exacerbated by climate change, identified new concerns, and discussed the public health interventions and community support needed.<sup>38</sup> Issues included challenges related to Northern home design and a lack of ventilation causing heat stress among elderly on increasingly warmer days; impacts on food security because of changes in sea ice access routes to hunting areas, and the consequences of ice road stability on reliable transport of food stuffs; and mental health impacts due to the reduced ability of individuals to practice aspects of traditional activities, and to disruption or relocation caused by damage to infrastructure. In the Inuvialuit Settlement Region, residents noticed an increasing number of biting flies and insects, including bees, whose arrival was believed to be related to the warmer summer weather.<sup>36</sup> Many residents were concerned because of the potential for spread of disease by airborne vectors and allergic reactions to bee stings, never seen before in this region. One recommendation was that public education programs be designed to inform people about actions to minimize the risks.

## **Storylines As a Tool to Facilitate Adaptation to Climate Change**

Storylines of possible local health risks that are due to climate change can be compelling narratives that foster community-based adaptation. They can communicate the breadth of possible vulnerabilities in a form that helps stakeholders visualize the dimensions of the potential risks, and identify adaptive responses to enhance current and future adaptive capacity. Storylines can be more effective than, for example, informing a community that the number of heatwave days could

increase by some amount; such statements of likely increases in risks may not clearly communicate the breadth of possible impacts on human and animal health, water availability, power generation, infrastructure, organized outdoor activities, and other aspects of community life. Community leaders, experts from sectoral agencies and organizations, researchers, and others can jointly develop the storylines based on likely consequences of projected changes in weather variables and patterns in a particular place and time. Engaging all potentially affected sectors will provide a more realistic and nuanced description of possible futures. Disaster preparedness training exercises often use simple storylines.

Two examples are provided, one a national-level assessment that used storylines to estimate the impacts of climate change on the spread of vectorborne diseases, and the other a hypothetical storyline to illustrate compound local risks.

Qualitative storylines were used during the assessment of health risks and responses in the first Portuguese national assessment.<sup>39</sup> Included was an assessment of the possible impacts of climate change on vectorborne diseases, including malaria, West Nile virus, schistosomiasis, Mediterranean spotted fever, and leishmaniasis; the last two are endemic to Portugal.<sup>40</sup> Although human cases of vectorborne diseases have generally decreased over recent decades, many competent vectors are still present. Disease transmission risk was categorized qualitatively on the basis of vector distribution and abundance and pathogen prevalence. Four brief storylines were constructed using current climate and projected climate change, and assuming either the current distribution and prevalence of vectors and parasites, or the introduction of focal populations of parasite-infected vectors. These storylines were discussed with experts to estimate transmission risk levels. For Mediterranean spotted fever, the risk of transmission was high under all storylines, suggesting a limited impact of climate change. For the other diseases, the risk level varied across the storylines. For example, the risk of leishmaniasis varied from medium under current climate to high under both climate change storylines. The risk of schistosomiasis varied from very low (current climate and current vector distributions) to medium (climate change and focal introduction).

An example of a storyline developed to illustrate issues that a community may face in a changing climate is a hypothetical city in the midwestern U.S., that has a river running through downtown and a hospital complex located along the river's edge. The city is located in a region where heatwaves are rarely a problem. Projections for the Midwest suggest that heatwaves could increase approximately 36% in frequency and 27% in duration; the combined effect is an overall increase of about 70% in the annual number of heat-

wave days by the late twenty-first century.<sup>41</sup> There has been a 20% increase in heavy precipitation events over the past half century, with further increases expected.<sup>42</sup> In addition, the population is ageing, putting more people at risk during heatwaves and flooding events.

This information can be used to create several storylines. For example, spring rains in 2020 result in major flooding along the river for the first time in more than 50 years. Key hospital equipment located in the basement and on the first floor is under water, affecting hospital services. People in some of the poorer areas of the city are displaced by the floodwaters. Early in the summer, the city experiences an intense 2-week heatwave, with hundreds of excess deaths, many among the people still repairing houses damaged by the flood. The aging electric grid limits availability of air conditioning; combined with high nighttime temperatures, this increases the risk of heat-related illnesses for many residents. The city heatwave early warning system is implemented, but it has not had adequate testing, resulting in operational difficulties. The hospital struggles with additional admissions and reduced availability of critical equipment. Select shopping malls provide places for people to cool down during the heat of the day, but few at-risk people are willing or able to travel there. The mayor and other city officials are blamed for the increasing number of deaths.

More complex storylines can be created through discussions with public health professionals, hospital administrators, building managers, and others. These storylines then can be used to develop better emergency response plans, as well as plans on how to begin moving critical equipment and information to less vulnerable locations as opportunities arise (such as during hospital repairs).

## Conclusion

Although public health programs designed to reduce the current burdens of climate-sensitive health outcomes are largely successful, recent events highlight an adaptation deficit to current climate variability, suggesting that climate change is likely to challenge the ability of programs and activities to control climate-sensitive health determinants and outcomes in some regions and populations.<sup>43,44</sup> One solution may be to incorporate the risks of climate change into all hazards approaches. The federal *Pandemic and All-Hazards Preparedness Act* (PAHPA) was signed into law (No. 109-417) in December 2006, with the goal of improving emergency preparedness efforts by centralizing government responsibilities. The purpose of PAHPA is “to improve the Nation’s public health and medical preparedness and response capabilities for emergencies, whether deliberate, accidental, or natural” ([www.hhs.gov/aspr/opsp/pahpa/index.html](http://www.hhs.gov/aspr/opsp/pahpa/index.html)). Although there is certainly room for improving central emergency plans, in

light of the suboptimal government response to Hurricane Katrina, these efforts should also aim to increase community capacity. A key constraint is that funding for community development is needed to strengthen grassroots adaptation capacity.

Adaptation activities must involve the full range of stakeholders, including businesses, community leaders, organizations, the public, and governments.<sup>12</sup> Survey data indicate that the American public is willing to engage in climate change issues<sup>45–47</sup>; thus, stakeholder input is needed to make the difficult choices facing public health programs, in terms of how much of their scarce resources to spend to increase monitoring and surveillance for climate-sensitive health outcomes.<sup>48</sup> Investing human and financial resources in these prevention activities could mean fewer resources to address other problems.<sup>49</sup>

Advancing community adaptation capacity to climate change is challenging but achievable. Cooperation and participation among different groups advances common goals, and the benefits of public participation extend beyond the individual to the society at large. The framework for community-based adaptation presented here can increase local adaptive and social capacity, and, as a result, help communities better prepare for and respond to the health risks of climate change.

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No financial disclosures were reported by the authors of this paper.

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