Chapter 10
Lateral Public Health: A Comprehensive Approach to Adaptation in Urban Environments

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Abstract The unpredictable nature of climate change poses considerable challenges to public health because it acts as a multiplier on existing exposure pathways and thus exacerbates existing vulnerabilities. Urban settings are particularly susceptible to the impacts of extreme weather events due to high population densities with shared exposure pathways. Moreover, metropolitan areas tend to be at increased risk from heat waves because urban climates are often warmer than un-built surroundings. Three aspects of urban adaptation to climate change are addressed here: (1) social interventions that advance bonding, bridging, and linking social capital in order to enhance community capacity and resilience; (2) interventions that attenuate the negative consequences of climatic events by physically improving the built environment; and (3) social services interventions that integrate multiple sectors through emergency plans for risk reduction of vulnerable populations.

These adaptation strategies in urban environments illustrate the concept of lateral public health based on transdisciplinary cooperation and community-based participation. In order to mount an effective response, public health practitioners need to transcend the traditional disciplinary boundaries and embrace lateral public health. This framework farms out public health action to other sectors of society, as well as community members of at-risk populations, in order to promote sustainable adaptation.

Keywords Climate change • Public health • Heat waves • Heat-related mortality • Adaptation • Social capital • Urban • City • Vulnerability • Extreme weather events

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Introduction

The hallmark of traditional public health lies in the prevention of disease, extension of life expectancy, and promotion of health through the concerted effort of state and local public health departments. Government public health agencies or ministries of health aim to implement public health interventions that prevent rather than treat disease. This approach has proven remarkably successful in reducing infectious diseases and controlling many of the chronic diseases (Omran 1971). However, the unpredictable nature of climate change poses new challenges to the discipline of public health. These long-term threats require a paradigm shift in the thinking of public health practitioners. In order to respond effectively to the predicament of climate change, an expanded view of public health needs to be adopted that lies outside the traditional confines of the discipline. Practicing public health "outside the box" requires lateral thinking (Fig. 10.1). The traditional discipline of public health operates within the boundaries of government and vertically administers programs to susceptible populations (Fig. 10.1a). In contrast, lateral public health aims to expand those boundaries; rather than operating within the traditional constituents, lateral public health aims to alter the dynamics between them. It is a transdisciplinary, grassroots approach to public health, grounded in community-based participation in the decision-making process (Fig. 10.1b). Since the frequency and intensity of climatic events are on the rise and mitigation efforts are slow acting at best, urban adaptation strategies require such a new approach with rapid implementation.

Today, half of the world's population lives in urban areas (UNDESA Population Division 2007). While in 1800, only 3% of the population lived in cities, this proportion has steadily increased over time (Galea and Vlahov 2005). In the middle of the last century, New York was the first city with a population surpassing ten million (Satterthaite 2000). The proportion of urban dwellers is the highest in North America and Europe where in 2000, 79% and 73% lived in cities, respectively. The number and size of cities has grown, particularly in developing countries, where the absolute number of urban dwellers far exceeds the number in developed countries, and in many cases city populations have exceeded 20 million. Metropolitan areas are large population centers with agglomerations that are economically and environmentally connected to the urban core through transportation corridors. Thus, multiple cities are now interconnected such as: the BosWash "megalopolis" comprising Boston, Providence, Hartford, New York City, Newark, Philadelphia, Wilmington, Baltimore, Washington, and vicinity; Los Angeles–San Diego–Tijuana; or Chicago–Milwaukee. In Europe, the concept of the "Blue Banana" was coined to denote the "megalopolis" that extends from London, through Paris, to Milan and includes approximately 70 million inhabitants.

The expansion and merging of highly urbanized zones creates challenges to public health practitioners charged with protecting the health and welfare of the public. The complexity of this phenomenon became painfully apparent when over 700 people died in Chicago during the record setting heat wave in 1995 or when

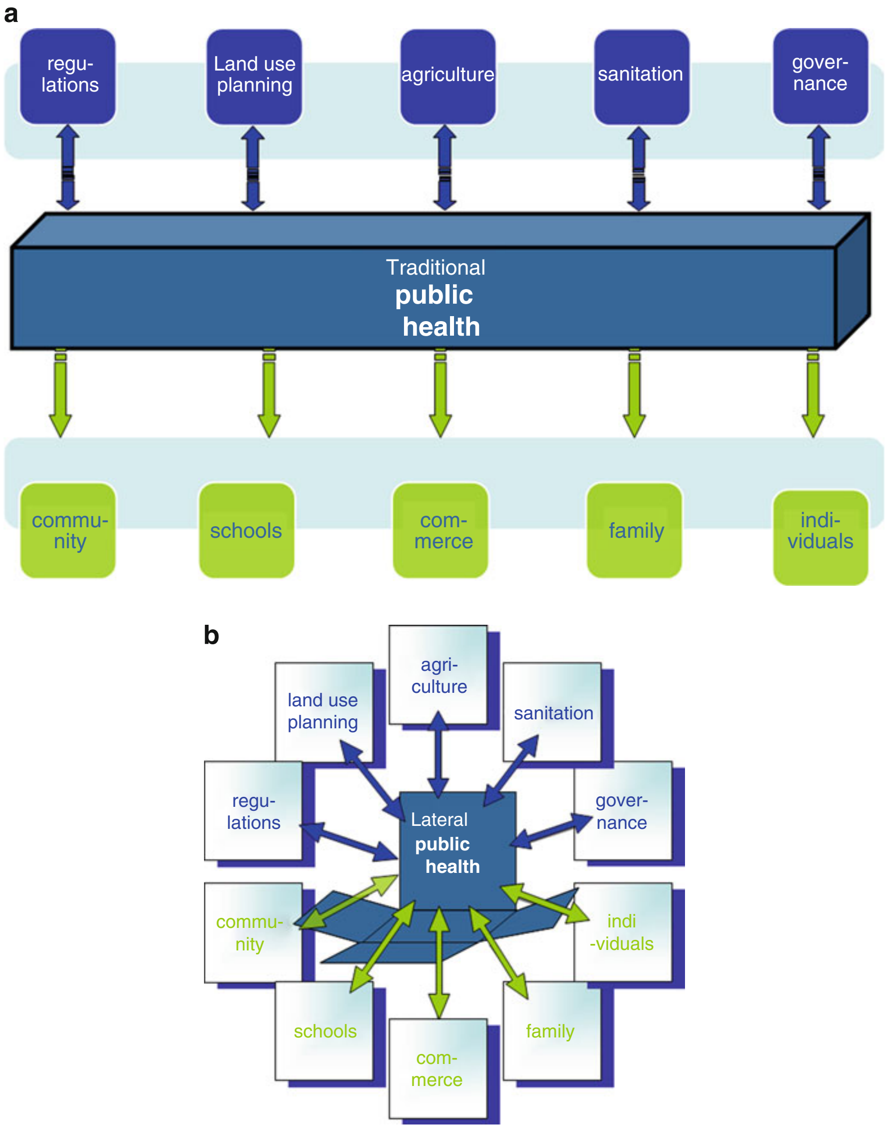

Fig. 10.1 (**a**) Traditional public health and (**b**) lateral public health. Public health aims at preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities, and individuals. The boxes in this diagram represent selected examples of different sectors of society involved in public health activities. Traditional public health (Fig. 10.1a) executes vertical functions while lateral public health (Fig. 10.1b) is based on interactive relationships. Thus, lateral public health aims to transcend the boundaries of traditional public health by acting outside the box and connecting directly with communities and other sectors of society

up to 70,000 people died in Europe during the 2003 heat wave (Semenza et al. 1996; Vandentorren et al. 2004; Conti et al. 2005; Johnson et al. 2005; Robine et al. 2008). Since the majority of individuals today live in urban environments, special consideration needs to be given to this particular form of living. Urbanization per se is a determinant of health that defines the conditions of living, working, and leisure time. Living in urban environments can thus impact health through three distinct pathways: the social environment, the physical environment, and access to social services (Galea and Vlahov 2005). The concept of lateral public health is applied here to urban interventions targeting these three pathways.

Social Environment

Adaptation to climate change can be enhanced by engaging urban communities in neighborhood renewal. Such community-based efforts have a twofold benefit: on one hand, they advance the adaptation capacity in urban settings by infrastructure improvements (see section below on physical environment) and on the other hand, they augment civic capacity which is beneficial to the overall well-being of the community. The bases for these adaptation efforts build social networks, which form a web of connections between people with different skills and backgrounds. These communal associations provide support and resources for problem solving and allow social engagement that advances social capital. The concept of social capital is the theoretical underpinning of the adaptation interventions in the social environment presented here.

Social capital, as detailed in Fig. 10.2, is defined as the potential embedded in social relationships that enable residents to coordinate community action to achieve shared goals (Bourdieu 1986; Coleman 1988; Putnam 1995). Social capital has two complementary facets: cognitive and structural social capital. Cognitive social capital includes norms, values, attitudes, and beliefs that emerge during community meetings and is defined as peoples' perception of level of interpersonal trust, sharing, and reciprocity. Community meetings and block parties, for example, increase cognitive social capital. In the process, social networks emerge, which is the basis for structural social capital. Structural social capital is inherent in social organizations of communities and can be described through these social nodes. Social capital relies on such networks for collaboration between residents to collectively address adaptation issues in the urban environment (Ziersch et al. 2005). These social relationships promote community participation and mutual cooperation in adaptation projects and are therefore not a characteristic of one particular individual, but rather a collective characteristic.

Social capital is a two-dimensional construct as described above and can also be portrayed as bonding (localized) and bridging/linking social capital (Hawe and Shiell 2000; Szreter 2002). Bonding social capital refers to the value assigned to social networks between homogeneous groups of people, and is inherent in existing social or religious groups; it is essential but not sufficient for neighborhood

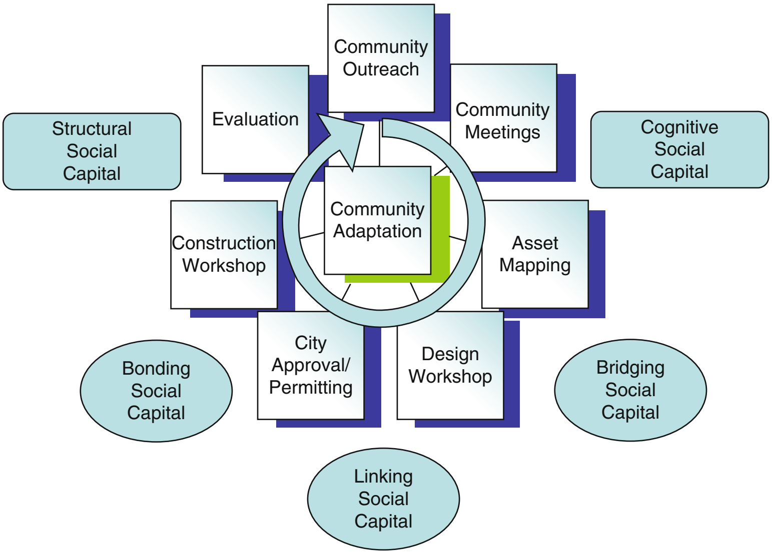

Fig. 10.2 The process of community-based adaptation to climate change. Cognitive social capital emerges as norms, values, attitudes, and beliefs during community meetings and is defined as peoples' perception of level of interpersonal trust, sharing, and reciprocity. Bridging social capital comes to light during asset mapping, when professional skills and talents are mapped and connected in the neighborhood. Linking social capital is developed after construction plans from the design workshop are submitted to city engineers for permitting. During the construction and installation of the projects, community members create friendship ties and increase bonding social capital. Extended social networks and civic engagement for the common good is part of structural social capital (Adopted with permission from Semenza and March 2009)

adaptation to climate change, because it may produce redundant information not applicable to adapting neighborhoods. Bridging social capital, on the other hand, connects different organizations and individuals and can reveal new information for problem solving and the creation of new opportunities. Linking social capital, an extension of bridging social capital, can connect parties unequal in power and access, such as residents with city officials (Szreter 2002).

Climate Change Adaptation of the Social Environment

Community-based adaptation to climate change can build on collective capacity inherent in social networks in order to increase resilience to extreme weather events (Keim 2008). Social networks and limited social support may predispose urban residents to poorer coping and adverse health outcomes (Crooks et al. 2008; Giles et al. 2005; Kawachi et al. 1999; Kawachi and Berkman 2001; McLeod and Kessler 1990). Conversely, social networks are important for positive health behaviors, including those related to climatic events such as heat waves (Semenza et al. 1996). Participating in group activities such as clubs, support groups, churches, etc. or having a friend close by is protective against heat-related mortality; conversely, those that live alone or do not have a pet to care for are at increased risk of succumbing to the heat during extreme weather events (Semenza et al. 1996).

In light of this close relationship between the social environment and climatic events, an intervention is presented here that aims to promote social interactions. These social interactions seem to advance collective efficacy that engage residents in direct social action, and in turn augment social capital in a sustainable manner. In Portland, Oregon a nonprofit organization entitled engages communities in a number of activities in order to strengthen social ties (http://www.cityrepair.org). Through a number of community events such as block parties, fairs and festivals, the organization fosters social interactions among urban residents. The City Repair Project is renowned for supporting communities in implementing urban renewal projects. In a collective effort, community members in Portland have created a number of green roofs, urban gardens, bioswales (water catchments designed to drain surface runoff to remove silt and pollution) and other features to counteract the urban heat island effect (see Table 10.1 and section on the physical environment) (Bradley 1995). By physically adapting and preparing the neighborhood for climate change, this process builds social networks among urban residents.

Staff members of The City Repair Project start with community outreach and organize community meetings as illustrated in Fig. 10.2 (Semenza and Krishnasamy 2007). These communal events among urban residents facilitate interpersonal trust, sharing and reciprocity and help to advance cognitive social capital (Semenza and March 2009). This proven strategy can be applied to the climate change field by informing residents about the challenges and threats from climate change and, in the process, building a common vision for the neighborhood (Ebi and Semenza 2008). Community organizers of The City Repair Project assist in the identification of resources in the neighborhood available to the interventions. These assets can be mapped out and made available to the project. As part of this process, bridging social capital is advanced by linking individuals with different talents and skill sets. During design workshops, urban features are developed with the support of landscape designers and other local talents, and subsequently circulated among residents for approval and signature. In Portland, this process has been institutionalized through city ordinances and has gained support from urban planners, politicians, and citizens (Semenza 2003). Construction plans are subject to review by engineers and architects prior to permitting by city engineers. This process is initiated by community members but encouraged and supported by a number of government officials. This grassroots effort is an example of lateral public health, which improves linking social capital in the community since it forces community members to interact with city administration (Fig. 10.1b). By bringing together the community with expert builders during construction workshops, the design plans are then realized in a collective effort, which builds bonding social capital (Fig. 10.2). Adaptation projects built by community members include green roofs to reduce rooftop temperatures,

Table 10.1 Community building strategies to advance community adaptation capacity

Interventions	Activities	Adaptation benefits
Urban forestry	Plant trees in parking strips or abandoned lots; adopt Friends of Trees programs (neighborhood tree plantings, restoration of green spaces, etc.)	Shading (preventing solar radiation from being absorbed by building materials) Ambient cooling from evapotranspiration
Urban vegetation	Build trellises for hanging gardens; planter boxes on street corners; plant in abandoned lots	Decreasing air-conditioning demand and peak energy consumption for cooling by shading buildings from solar radiation Ambient cooling from evapotranspiration Increasing property values through aesthetic enhancement Enhancing air quality by removing particulate pollutants from the air and by decreasing the emissions associated with air-conditioning energy demand
Urban gardens	Create community gardens in urban neighborhoods with elevated planter boxes if no soil available	Shading Ambient cooling from evapotranspiration Producing local food
Green roofs	Install green roofs on small structures (bike sheds, information kiosks, bus stops, etc.) or bigger public buildings as demonstration projects	Reducing rooftop temperatures and heat transfer to the surrounding air Decreasing summertime indoor temperatures, which reduces air-conditioning demand and peak energy consumption for cooling Lessening pressure on sewer systems through the absorption of rainwater Filtering pollution – including heavy metals and excess nutrients – through bio- and phytoremediation Protecting underlying roof material, reducing noise, providing a habitat for birds and other small animals, and improving the quality of life for building inhabitants Reducing the urban heat island effect by decreasing rooftop temperatures through evapotranspiration, which cools the surrounding air

(continued)

Table 10.1 (continued)

Interventions	Activities	Adaptation benefits
Cool roofs	Install roofs with high solar reflectance on houses in low socioeconomic status (SES) neighborhoods	Saving money on energy bills Reducing peak energy demand Reducing power plant emissions of air pollution and greenhouse gases Increasing indoor occupant comfort by lowering top-floor temperatures Contributing to urban heat island mitigation
Cool pavement	Install light-colored or permeable pavements in parking lots or school yards	Allowing water to percolate and evaporate through porous pavements Cooling the pavement surface and surrounding air
Window screens	Repair and install insect screens on houses	Protecting against emerging vector-borne diseases
Vector abatement	Eliminate standing water in depressions or objects	Preventing propagation of vector-borne diseases
Flood control	Restore barriers/dunes at river/beaches (e.g., with vegetation) to increase their resilience	Preventing flood waters from inundating inhabited areas
Habitat restoration	Plant native species and eliminate invasive plants	Decreasing dispersion of zoonoses through increased biodiversity
Rainwater storage	Increase rainwater storage (domestic water butts, unpaved gardens, etc.)	Preventing overflows in peak periods to avoid river contamination
Brown field development	Plant trees, gardens, vegetation, etc.	Shading Ambient cooling from evapotranspiration Local food production

Sources: http://www.epa.gov/heatisland/resources/faq.html#6
http://www.epa.gov/heatisland/strategies/community.html
http://www.friendsoftrees.org/about/index.php
http://www.growing-gardens.org/
http://www.permaculture.org/nm/index.php/site/index/

urban gardens to cool the air through transpiration, urban vegetation to increase shading of buildings, cool pavements to reduce heat absorbance of streets, etc. (Semenza 2005).

These interventions were subjected to program and process evaluation in 2003 (Semenza and Krishnasamy 2007; Semenza and March 2009). Portland residents were systematically sampled within a two-block radius of three intervention sites and interviewed before ($N = 325$) and after ($N = 349$) the interventions, of which, 265 individuals completed both surveys of a panel study. There was a significant change of sense of community between the first and the second survey ($p < 0.01$). For example, these data indicate that the participants appreciated their neighborhood as a good place to live and a good place for children to grow up significantly more after the improvements in the urban landscape had been implemented. Social interaction also displayed a consistent increase at all three sites, although the change was not statistically significant ($p = 0.06$). Social capital displayed a statistically significant increase after the intervention ($p = 0.04$). These data indicate that these community actions to improve the built urban environment led to an increase in social capital. In the context of climate change in urban settings, these findings are important in that they demonstrate that it is possible to improve the social environment, which augments the resilience of its residents. In summary, advancing community-based urban improvements can enhance the resilience of urban populations to climatic events.

Physical Environment

High population densities in urban centers where people work, live, and spend leisure time is the setting of a number of exposures with potential health consequences; urban dwellers are collectively exposed to the built environment, green spaces, drinking water, air quality, and weather conditions and are potentially at risk to be affected from climatic changes (Younger et al. 2008). For example, during hot summer days, metropolitan areas tend to heat up disproportionately compared to the surrounding areas, creating an urban heat island (Frumkin 2002). The thermal radiation of buildings and streets is determined by the heat capacity of concrete and asphalt, which can be responsible for up to 13°C higher temperatures in the urban core (Watkins et al. 2007). Furthermore, a limited number of trees and vegetation in urban areas limits the capacity to cool the air through transpiration (Table 10.1) (Jo 2002). At night, surface areas radiate the heat absorbed during the day, increasing the minimum temperatures. Elevated temperatures can increase the magnitude and duration of heat waves. Heat-related mortality and morbidity increase exponentially and peak 2 days after the maximum temperature surpasses a location-specific threshold (Semenza et al. 1996; Semenza et al. 1999). The heat island effect can exacerbate the impact of heat waves by escalating and prolonging heat exposure. This phenomenon can be particularly harmful when the relentless night-time exposure results in cumulative heat exposure. Residents of southern cities tend to be acclimated to warmer weather conditions and thus are less vulnerable; in contrast, urban populations living in mid and high latitudes with significant annual temperature variation are particularly at risk for illness and death.

We found Chicago residents living on the top floors of buildings to be at a fivefold increased risk for heat-related mortality during the 1995 heat wave. Living in a house with a flat roof or living in an apartment building were also risk factors. In order to save on energy bills, many of the roofs in Chicago are painted black to attract the sunlight during the cold winter months; however, during a heat wave this practice can pose a considerable risk for individuals living on the top floor. Furthermore, many of the windows had storm windows installed and were nailed shut, preventing aeration of hot residences. In this context, adaptation is defined as initiatives and measures to reduce the vulnerability of susceptible individuals to the effects of climate change, specifically the elderly, poor, and socially isolated. The interconnected nature of lateral public health is illustrated with urban interventions to adapt to climate change (Fig. 10.1b).

Climate Change Adaptation of the Physical Environment

Adaptation strategies in the urban environment can be combined with the community building interventions discussed above. These interventions are based on the notion that humans exhibit a strong sense of place (Altman and Low 1992; Brown and Perkins 1992; Stedman 2002), which increases with length of residence (Hay 1998). Attachment to place is rooted in culture, identity and history and is derived from psychological processes (Fullilove 1996). Sense of place is fundamental for adaptation to climate change because it is associated with sustainable practices and environmental conservation (Vorkinn and Riese 2001; Uzzell et al. 2002). Since local climatic conditions are fundamental to this sense of place, extreme weather events linked to climate change can disturb the psychological conception of place (Knez 2005). These events can do so by impacting the economic, societal, environmental, or cultural base and can have devastating consequences for the community, as documented by Hurricane Katrina. By disrupting the bonds people have with their physical environment, community health can be severely impacted with direct consequences to their sense of cultural identity (Kirsch 2001). Disrupting this sense of place can also impact community engagement and adaptation capacity (Adger et al. 2005; Hess et al. 2008). Conversely, if sense of place is linked to social networks, neighborhood attachment can motivate residents to take action in the interest of the common good (Lewicka 2005).

The interventions described above can help to decrease the heat island effect. Portland residents designed and built a number of urban projects with sustainable features that address this goal. For example, these community members have installed over 20 eco-roofs since 2001. An eco-roof is a lightweight, vegetated roof system that helps to reduce air temperatures and smog, captures and evaporates between 10 and 100% of precipitation and provides insulation. Through eco-roofs, urban temperatures are reduced through shading and transpiration; this in turn decreases cooling costs (Table 10.1) (Gill et al. 2007) and offers a number of other health benefits (Louv 2005). City parks can be up to 13°C cooler than the surrounding built urban environment and provide reprieve to overheated individuals during a heat wave (Watkins et al. 2007; Sponken-Smith and Oke 1998). Beyond these measures addressing the heat island effect, climate change adaptation in the physical environment of cities should also include vector abatement, flood control, urban habitat restoration, etc. A number of other steps can be taken as well to prepare households for an emergency or for gradual climatic change: increasing shading around the house, installing window screens, clearing out the gutters, etc. These efforts can further be enhanced through community efforts to advance adaptation in the neighborhood. For example urban agriculture in community gardens, vacant lots, or schoolyards is a local, small-scale and sustainable way of food production with a number of health benefits such as physical activity (Dixon et al. 2009). Through community-based efforts, these interventions also have multiple co-benefits for the social environment since building stronger relationships builds social capital.

However, many of these adaptation strategies are time consuming and might not yield immediate benefits to urban dwellers. Thus implementing short-term measures is an equally important aspect of public health practice. In the case of heat waves, the most effective way to reduce the risk of heat-related mortality is to have access to an air-conditioned environment. Interestingly, we found a fivefold decreased risk if there was an air conditioner in the household but an air-conditioned lobby of an apartment complex was equally protective (Semenza et al. 1996). Individuals with access to cooling shelters or other air-conditioned places are also at substantially reduced risk. Thus, in Europe or other parts of the world where the air conditioner penetration is relatively low, strategies need to be put in place to remove susceptible individuals from their homes with high ambient temperatures and provide access to cool churches, shopping centers, cinemas, etc.

Exacerbations of urban heat islands are not the only effects of climate change in metropolitan settings. Heavy precipitation can cause cryptosporidium outbreaks due to contamination of water treatment plants, but community water boil notices can contain the risk of infection (Semenza and Nichols 2007). Wildfires can threaten urban settings, and community-based risk assessments are crucial for hazard identification. Work parties to remove flammable brush in close proximity to buildings, implementing emergency plans, establishing evacuation routes, etc. can potentially attenuate the public health impact of wildfires. Communities should also prepare for floods by increasing awareness of flood zones, evacuation routes, and response plans; particular attention needs to be placed on vulnerable populations in hospitals, nursing homes, schools, and prisons. Landslides are another threat to communities that requires special emergency warning with evacuation plans. Elevated ambient temperatures have been linked to food-borne diseases (Kovats et al. 2004); health education/promotion interventions for safe food handling and storage during hot weather episodes can reduce this risk to communities. Changing environmental conditions has altered the distribution of vector-borne diseases, but bed nets, protective clothing, vaccination, etc. can minimize these risks (Semenza and Menne 2009). These examples illustrate the complexity of intervening in urban settings and the difficulty of orchestrating a comprehensive approach to climate change adaptation.

Social Services

Breaking the traditional confines of public health, lateral public health aims to reach out to different sectors in society not traditionally associated with health (Fig. 10.1b). As documented above, connecting community members with urban planners, architects, engineers, meteorologists, and government can have multiple co-benefits (Capon et al. 2009). Similarly, working with social workers on adaptation issues can be particularly beneficial for vulnerable groups such as the elderly and the poor. In many cities, wealth inequalities between groups exist in close proximity, and these groups differ also significantly in health indicators (Wilkinson 1992). These inequalities manifest as systematic discrepancies in morbidity and mortality, in which individuals with lower levels of education or socio-economic status die at earlier ages and suffer more illnesses (Semenza and Maty 2007). These vulnerable groups are also more susceptible to adverse weather events, and while erratic but recurrent heat waves cannot be avoided, the public health consequences of such extreme events on susceptible populations are entirely preventable. These groups suffer from inadequate access to health services compared to more affluent groups in society (Andrulis 2000). In light of these inequalities, an adaptation strategy targeting vulnerable populations is described below.

Climate Change Adaptation of Social Services

The institutional memories of the 1995 heat wave in Chicago led to a proactive strategy of attenuating the public health consequences of excessive environmental heat. Results from the field investigation identified political, mass media, environmental, societal, and behavioral risk factors for heat-related mortality (Semenza et al. 1996). Based on the epidemiological evidence, a macrosocial intervention was developed with a number of specific steps, including: meteorological monitoring of the weather conditions, defining the roles of agencies and organizations, preparing for a heat emergency, initiating emergency procedures during the heat wave, media engagement and outreach, and evaluation (Box 10.1) (Luber and McGeehin 2008). This comprehensive heat emergency response plan incorporated the findings from the field investigation in order to assure evidence-based action (Bernard and McGeehin 2004). Twenty-four hour hotlines were developed to provide information on the nearest cooling shelter, transportation and recommended treatment for heat stroke in the case of an emergency. "Heat Outlook" databases were compiled to facilitate contact of vulnerable individuals during a crisis, such as the elderly and the very isolated, either by phone or in person.

In 1999, a public health response was mounted at the dawn of a heat wave in Milwaukee, Wisconsin. Early dissemination of information through hotlines and media as well as regular status checks of family members, particularly the socially

Box 10.1 Components of a Proposed Model Heat Wave Emergency Response Plan

Measurements and monitoring:

1. Identify the recording station where meteorological factors will be monitored.
2. Establish heat index (or other measure) criteria for heat warning levels. The local sector of the National Weather Service may have designated indices that can be adopted.
3. Define heat-related outcomes for physicians and medical examiners.
4. Develop methods for monitoring heat-related outcomes.

Participating organizations:

5. Define the role and response of each participating organization. Designate and coordinate the response at each organization.
6. Establish an emergency communication system. Include all organization contacts (up-to-date telephone numbers and fax numbers).
7. Maintain a list of resources (e.g., potable water, air conditioners, fans) that should be available during a heat wave (specify quantity, who to contact, etc.).
8. Ensure that utility (power and water) companies have contingency plans and communication mechanisms in case of problems.

Preparations prior to the onset of excessive heat:

9. Identify at-risk populations.
10. Organize informative material for the public, media, health care workers, and volunteers.
11. Verify collaboration of participating agencies.
12. Procure resources necessary for a heat emergency (e.g., equipment, supplies, personnel, cooling sites).
13. Maintain and update a database of at-risk populations.
14. Identify temporary cooling centers (air-conditioned areas available for public use). Some should be wheelchair accessible.
15. Locate swimming pools and public sprinklers for public use.

During a heat wave:

16. Communicate with participating organizations and agencies to activate response plans.
17. Open temporary cooling centers.
18. Contact at-risk populations using the established database.

(continued)

Box 10.1 (continued)

19. Initiate communication of emergency information through the media and other organizations with public interaction.
20. Establish a telephone hotline for information on heat-related illnesses and relief tips.
21. Arrange transportation to and from cooling centers.
22. Arrange distribution of resources (fans, potable water).
23. Ensure that utility companies do not suspend services during the heat wave.

Following a heat wave:

24. Terminate the emergency response. Notify media and all other participating agencies.
25. Return unused resources and replenish resource stocks.
26. Evaluate emergency procedures and improve them if necessary.
27. Assess damage to municipal infrastructure.
28. Evaluate data.

Source: Heat Wave Emergency Response: A review by the National Center for Environmental Health of the Centers for Disease Control and Prevention, Atlanta, Georgia (Bernard and McGeehin 2004).

isolated, proved to be crucial in saving lives. Improved public health response in 1999 resulted in fewer heat-related deaths than expected (Weisskopf et al. 2002). There were 17% and 51% reductions in heat-related deaths and emergency medical service runs, respectively, compared to 1995, and those adverse health outcomes that did arise were not the result of differences in heat levels alone.

The absence of extreme temperature alert systems and prevention measures became evident during the historic European heat wave of 2003 that resulted in tens of thousands of excess deaths (Vandentorren et al. 2004; Conti et al. 2005; Johnson et al. 2005; Robine et al. 2008). At the time, only two cities in Europe, Rome and Lisbon, had sophisticated heat wave alert plans (Koppe et al. 2004). However, now virtually all European cities have prevention plans in place in the eventuality of hot weather that direct messages through the most effective channels to vulnerable groups. Chicago's public health calamity was the starting point in the development and execution of heat preparedness plans, which proved to be effective at reducing heat-related deaths. Thus, multi-sectoral preparedness and response activities are essential to reduce vulnerability and increase resilience to climatic hazards (Keim 2008).

Conclusion

Lateral public health aims to transcend the boundaries of traditional public health by connecting directly with communities and reaching out to other sectors in society. This approach is particularly important in urban settings where high population densities and multiple exposures threaten vulnerable populations. Moreover, funding for adaptation to climate change has been limited, and this lateral public health strategy offers an effective approach to meet some of the impending challenges by empowering officials, agencies, and local communities (Bouwer and Aerts 2006; Dovers 2009). Engaging different actors in lateral public health will help the process of mainstreaming adaptation to climate change into a range of other programs and sectors with co-benefits for the health of the public (Halsnæs and Trærup 2009; Mertz et al. 2009; St Louis and Hess 2008). Public health practitioners can mount an effective adaptation response to climate change if they reach out to all stakeholders, including those not traditionally associated with their discipline, such as urban planners, and integrate governmental with community activities.

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