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Climate Change and California's Public Health Institutions

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Summary

A changing climate will exacerbate many of the problems currently faced by California's public health institutions. The primary impact of climate change will be an increase in extreme heat events and associated increases in heat-related morbidity and mortality. Other effects of a changing climate include potential increases in the frequency and severity of air pollution episodes, shifts in the range and incidence of vector-borne diseases, and increases in the severity of wildfire.

This report assesses the readiness of California's public health institutions to cope with the changes that will accompany a changing climate. While many agencies in the state have the protection of public health as a goal, this report focuses on agencies that provide direct services to residents, namely the California Department of Public Health and the network of local health agencies. The assessment is based in part on results from an original survey of the state's local health officers. The survey results show that the health officers believe that climate change poses a large risk to human health, but that they lack the information and resources necessary to manage that risk.

Nevertheless, the survey and interviews revealed that many existing tools can help the public health sector cope with the impacts associated with a changing climate. These tools include heat emergency plans, illness tracking and surveillance programs, and vector control programs. While none were developed with climate change as their impetus, they lay a good foundation for programs that help agencies cope with climate change. Evaluating and refining these tools in light of a changing climate will be important to help agencies feel more prepared.

The newly-formed California Department of Public Health (CDPH) can play an important role in refining these tools and in defining the public health sector's role in climate policy more generally. To date, the CDPH has not taken an active role in the state's climate change policy process. By taking a leadership role on climate change issues, the CDPH can make several important contributions: (i) help guide the development of climate-related information that will be useful for the public health community, (ii) provide a means to refine and evaluate existing adaptation tools for public health agencies, (iii) increase involvement in climate-related decisionmaking by the public health community, and (iv) maximize the public health co-benefits associated with policy decisions (e.g., well-planned walkable communities can provide public health benefits associated with increased exercise and reduce emissions associated with traditional transportation sources). All of these contributions will help the public health sector be best prepared to cope with the public health impacts associated with a changing climate.

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Acronyms

CDPH	California Department of Public Health
OEHHA	Office of Environmental Health Hazard Assessment
OES	Office of Emergency Services
PM	particulate matter

Introduction

A changing climate will pose a number of risks to human health. The primary impact will be an increase in extreme heat events and associated increases in heat-related morbidity and mortality. Other potential health effects of a changing climate include increases in the frequency and severity of air pollution episodes, shifts in the range and incidence of vector-borne diseases, and increases in the severity of wildfire. These changes will exacerbate many of the challenges currently faced by the state's public health institutions.

While many agencies within the state have public health as a priority, this report focuses primarily on the state and local agencies with direct responsibility for improving public health and providing public health services. Therefore, the adaptation discussion focuses on the practices and information and resource needs for the California Department of Public Health (CDPH) and local public health agencies.

Results from a survey of local health officers show that they believe climate change poses a serious risk to human health but that they lack the resources and information to respond to that risk. Yet, many existing programs can help the public health sector prepare for the impacts of a changing climate. While climate change was generally not the impetus for these programs, they can play an important role in responding to and reducing the potential health impacts of climate change. A key for preparing for a changing climate is to evaluate and refine these programs in light of potential climate impacts.

Another important step to increase the readiness of the public health sector to cope with the changing climate is to define a leadership role for CDPH. CDPH can provide guidance to local health agencies on coping with climate change. It can also provide input to the development of broader state climate change policies and programs, to improve the potential for co-benefits for public health through synergies with other agencies.

The report begins with a review of recent findings on how climate change could adversely affect public health in California and which adaptive measures can be undertaken to lessen these effects. Results from an original survey of local public health officials are used to assess the current state of readiness to employ these adaptive measures.[1] This review is followed by a discussion of the constraints and opportunities state and local public health agencies face in coping with the impacts of a changing climate. An Appendix provides an overview of the roles of various state and local agencies operating in the public health arena.

[1] The survey was distributed to all 61 local health officers in the state. We received 34 responses, for a 56 percent response rate. For more detailed information see Bedsworth, 2008b.

1. **The Climate Challenge for the Public Health Sector**

Daily maximum summertime temperatures in California are predicted to increase by 2.2°F to 7.6°F by mid-century (2035-2065) and 3.2°F to 12.8 °F by the end of the century (2070-2099), with the range depending both on the trajectory that emissions take in the future and the sensitivity of the model used to generate the prediction (Drechsler et al., 2006). Even under the most optimistic scenario, temperatures are expected to increase. This increase in temperatures will have both direct and indirect impacts on public health (Patz et al., 2005; Ebi et al., 2006). The direct effect will be an increase in heat-related morbidity and mortality. Indirect effects include increased health risks associated with changes in air pollution, the occurrence of vector- and water-borne diseases, wildfire regimes, and other factors.

The challenge to the public health community will be to respond to the various effects of increases in average temperatures, as well as to potential increases in the incidence of extreme events such as heat waves or wildfires. In both cases, climate-related changes could amplify health problems that this community is already addressing in one way or another. Climate change could also bring new challenges, such as the emergence of new diseases.

Heat-Related Morbidity and Mortality

Analysis of future climate change in California shows that even under an optimistic emission reduction scenario, the incidence of extreme heat events is likely to increase over the course of this century (Hayhoe et al., 2004; Drechsler et al., 2006). Hayhoe, et al. (2004) examined extreme heat occurrence in four locations in the state under both higher and lower emission scenarios. These results are summarized in Table 1. The range in the estimates reflects the uncertainty in climate sensitivity, or the extent to which temperatures will change as a result of increasing concentrations of greenhouse gases.[2]

Table 1: Predicted Changes in Heatwave Days per Year, Mid- and Late 21st Century

		Mid-century (2020-2049)		End of century (2070-2099)	
	Baseline (1961-1990)	Lower emissions	Higher emissions	Lower emissions	Higher emissions
Los Angeles	12	24-28	35-36	44-47	76-95
Sacramento	58	91-93	101-104	109-115	134-138
Fresno	92	111-113	116-120	126-126	147-149
El Centro	162	176-185	180-185	149-162	178-204

Source: Hayhoe et al., 2004

Notes: For this table, heatwave days are defined as days when the temperature exceeds 89.6°F (32°C) for three or more consecutive days. This differs from the extreme heat definition in which temperature exceeds a given threshold (T90). The lower emission scenario is B1 and the higher A1fi.

[2] (see Luers and Mastrandrea, 2008 for more information on climate projections)

According to these estimates, there is not a large difference in the number of heatwave days predicted for the middle of the century under a high versus low emissions scenario. Therefore, regardless of the path that greenhouse gas emissions take for the first part of the century, some increase in the incidence of heatwaves is likely to occur. By the end of the century, heatwaves are expected to be considerably more prevalent under the higher emission scenario.

The direct impact of extreme heat on mortality is the onset of heat exhaustion and stroke. Cardiovascular disease, respiratory disease, and cerebrovascular disease can increase the risk of mortality due to extreme heat (Greene et al., 1999; Basu and Samet, 2002). Heat-related mortality increases above a given temperature threshold (Greene et al., 1999; Curriero et al., 2002). However, this threshold is not uniform across regions: it tends to be lower where average temperatures are lower, and where people are less used to hot spells (Curriero et al., 2002).[3] These differences in susceptibility across regions are likely to result not only from better physical acclimatization of people living in hotter regions, but also better technological adaptation; in hotter regions, many more buildings and residences have air conditioning. Therefore, populations in cooler coastal regions could be at greater risk than those in typically warmer inland areas (see supplemental material for Hayhoe et al., 2004).

Regional differences aside, there are also differences in susceptibility among different segments of the population. In particular, the elderly are among the most vulnerable to heat-related mortality. In 2000, just over 10 percent of California's population was aged 65 or over. With the aging of the population, this vulnerable group is projected to account for almost 20 percent of the total population by 2050 (Figure 1). In addition, urban areas tend to experience higher heat indices, a combination of temperature and humidity, than surrounding areas, placing urban populations at greater risk. Other demographic and behavioral characteristics associated with higher sensitivity to extreme heat include mental illness, substance abuse, poverty, living alone, living in urban areas, living on upper stories of multistory buildings, jobs requiring heavy labor, not leaving home daily, and being confined to bed (Basu and Samet, 2002).

[3] The opposite is observed for increases in cold-related deaths, with the threshold temperature being higher in cities at lower latitudes.

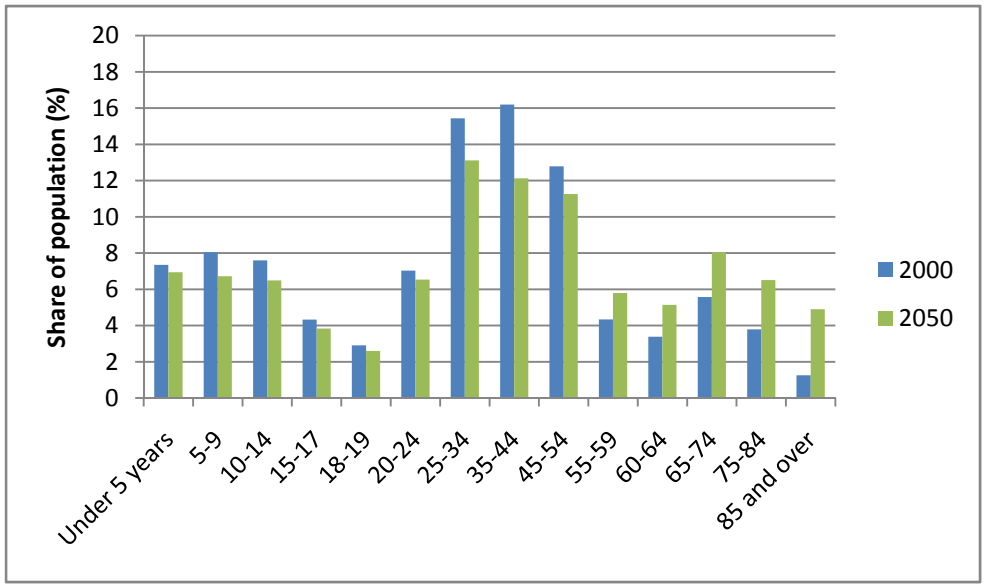

Figure 1 - Population Distribution by Age, 2000 and 2050

Source: California Department of Finance, 2007

Note: 2050 figures are projections.

Heat waves occurring early in the summer often result in a higher number of deaths than those occurring later in the summer (Basu and Samet, 2002). In addition, extreme heat can result in a slightly earlier death of an individual who was set to die soon. In the public health literature, this is often referred to as mortality advancement or "harvesting." Estimates of the magnitude of the harvesting effect generally range from about 20 to 40 percent of all heat-related mortality (Greene et al., 1999; McMichael et al., 2006). However, one analysis estimates that the increase in mortality following an extreme heat event is almost entirely due to mortality advancement (Deschênes and Moretti, 2007).

The most effective factor for protecting against heat-related mortality is having access to air conditioning (at home and in other locations).[4] In California, air conditioner ownership is concentrated in the Central Valley and Inland Empire regions. Lower income households are less likely to have air conditioning (Climate Change Public Health Impacts and Response Collaborative, 2008).

Under the scenarios shown in Table 1, heat-related deaths in Los Angeles are predicted to increase two- to three-fold relative to the historic base of approximately 165 per year under a low emission scenario and up to seven-fold under a high emission scenario by the end of the century (Hayhoe, et al, 2004).

[4] Other factors include having access to transportation, living in a residence surrounded by trees and shrubs, being able to care for oneself, being physically active, and drinking extra fluids (Basu and Samet, 2002).

Recent experience points to the potential for spikes in heat-related deaths among vulnerable groups under summer weather extremes. In July 2006, California endured an extended heat wave. Between July 15 and August 1, 2006, the deaths of 140 people were classified as heat-related by coroners and medical examiners. Most of the deaths occurred after the heat wave had been underway for several days, and 90 percent of the victims lived in socioeconomically depressed areas (Trent, 2007).[5] Of those who died, 46 percent lived alone (compared to 19% of Californians according to the 2000 Census) and, of those living alone, only 19 percent were contacted or seen by social contacts within 24 hours of death (Trent, 2007). Roughly 65 percent of the deaths occurred in people aged 60 or older. This same heat event also resulted in an increase in heat related morbidity (i.e., illness). Analysis of patient discharge data and emergency department visit files shows that during the heat wave, there were over 16,000 excess hospitalizations and over 1,100 excess emergency room visits statewide (Knowlton et al., 2008).

In addition to the risks associated with extreme heat events as discussed above, increases in average summer temperatures can also result in an increase in mortality. A recent analysis of temperature mortality in nine California counties between 1999 and 2003 showed that a 10°F increase in the heat index was associated with a 2.6 to 3.7 percent increase in mortality (Basu and Ostro, 2008). Therefore, even in the absence of a heatwave, increasing average temperatures can pose a health risk on their own.

Primary Adaption Measures

For public agencies, the primary adaptation measure to deal with extreme heat is a heat emergency plan and accompanying outreach and assistance for vulnerable populations. Such plans are typically prepared by local government agencies, and they have been shown to be effective in reducing mortality due to extreme heat (Ebi et al., 2004). Heat emergency plans are also implemented at the local level, but involve coordination with state agencies and other non-profit groups.

Following the heat wave of 2006, the Governor's Office of Emergency Services (OES) issued a guidance report on the development of heat emergency plans (Governor's Office of Emergency Services, 2006). Heat emergency plans tend to be phased plans that start with monitoring of heat indicators. As conditions warrant, additional phases are implemented.[6] For example, in San Diego County, the heat emergency plan has four phases that culminates in the declaration of a heat emergency (Table 2).

[5] A socioeconomically depressed area is defined as one where more than 50 percent of the residents live under the federal poverty threshold.

[6] See Bernard and McGeehin, 2004, for a discussion of components that should be included in a heat emergency plan.

Table 2: Phases of San Diego County's Excessive Heat Response Plan

Phase	Description	Institutions
I. Seasonal readiness	• Begin monitoring of heat indicators on daily basis • Announce opening and location of cooling centers, distribute fans and bus passes, if needed • Develop and revise materials for agencies working with vulnerable populations • Convene Heat Plan Task Force	• Public Health Services Administration • Aging and Independence Services • Office of Media and Public Affairs • Emergency Medical Services
II. Increased readiness	• Triggered by: Credible prediction of prolonged heat or power outages during warmer than normal conditions • Release heat advisory press releases • Continue to monitor heat indicators • Notify all agency partners to outreach to vulnerable populations • Monitor 911 calls, ambulance response, and emergency room visits and fatalites that are indicative of heat-related symptoms	• Public Health Services Administration • Public Health Services Emergency Medical Services Branch • Aging and Independence Services • Office of Media and Public Affairs
III. Heat Alert	• Triggered by: Excessive hot weather, night temperatures of 75°F or more for three days or less; National Weather Service Advisories of excessive heat for 3 days or less; or high heat accompanied by blackouts • Continue public outreach • Enhance monitoring of 911 and other indicators and outreach to vulnerable populations • Institute daily call between all involved agencies • Twice daily check-ins with National Weather Service Heat Index	• Public Health Services Administration • Public Health Services Emergency Medical Services Branch • Aging and Independence Services • Office of Media and Public Affairs
IV. Heat Emergency	• Triggered by: 3 or more days with a heat index[(a)] greater than 105 degrees, National Weather Service heat advisories or warnings for more than three days, abnormal medical emergencies and mortality due to extreme heat • Issue regular media releases and brief public officials • Consider declaring a public health emergency • Activate Emergency Operation Center and Medical Operation Center • Send out Emergency Medical Alert Network notification to enrolled medical professionals and County staff • Twice daily check-ins with National Weather Service Heat Index • Enhance outreach to vulnerable populations and encourage cancellation of school-sponsored sporting events • Activate reverse 911 system[(b)] to notify vulnerable populations • Continue to monitor 911 calls and other indicators and daily calls	• Public Health Services Administration • Public Health Services Emergency Medical Services Branch • Aging and Independence Services • Office of Media and Public Affairs • Sherriff Department • Governor's Office of Emergency Services

Source: County of San Diego Health and Human Services Agency, 2006

Note: (a) Heat index is a measure that determines how hot it feels based on temperature and relative humidity.

(b) Reverse 911 is a system that can call targeted populations to provide emergency information (phone numbers must be pre-entered)

Current Readiness

Of the 34 jurisdictions that completed our survey of local public health officers, 30 had a heat emergency plan in place. Of these plans, all include cooling centers and a process for identifying vulnerable populations. Cooling centers are facilities that are made available to the public as heat relief stations. They can be operated by public or private organizations. OES has a list of recommended criteria for cooling center locations, such as air conditioning, back-up generators, available medical personnel, areas for pets, and services for children (Governor's Office of Emergency Services, 2006).[7] In many communities cooling centers include government buildings and community and senior centers.

Almost 90 percent of the responding public health officers in jurisdictions with a heat emergency plan indicated that their programs monitor heat indicators, conduct public education, and include outreach to vulnerable populations. Local health agencies work with other organizations to operate cooling centers and to provide other services (e.g., agricultural or domestic animal care). However, there are also some clear gaps. In particular, only a third of respondents (32%) indicated that their agency provided transportation to cooling centers; even fewer (12%) provided financial assistance to low-income residents to help with additional cooling costs. Such assistance could be made available by other institutions, such as utilities, but may be underutilized.

Air Pollution

Increases in temperature are likely to lead to increases in the frequency and intensity of high ozone episodes. Ozone is an air pollutant that is not emitted directly, but is formed in the atmosphere through a series of reactions driven by sunlight. Increases in temperature increase the rate of these reactions, increase emissions from natural sources (e.g, plants and trees), and affect other atmospheric conditions that can increase the formation of ozone (Steiner et al., 2006). In addition, higher temperatures often lead to increased electricity demand, which can increase ozone precursors (e.g., hydrocarbons and oxides of nitrogen) and greenhouse gas emissions.

One study estimates that for every approximately 2 degree farenheit rise in temperature that is attributable to increased atmospheric carbon dioxide, annual deaths in the United States attributable to air pollution could increase by 350 to 1800.[8] About 40 percent of these deaths would likely be attributable to increased ozone concentration and the remainder to increased particulate matter concentration (Jacobson, 2008). (For more details on the effects of climate change on air pollution, see (Bedsworth, 2008a)).

[7] Because cooling centers are not exempt from rolling blackouts, backup generators are important to insure that they can provide uninterrupted service.

[8] Results in the analysis are given for each 1 degree Kelvin increase in temperature, which is equivalent to 2.2 degrees Fahrenheit.

Primary Adaptation Measures

There are two primary adaptation measures to deal with the effects of climate change on air pollution. The first is to modify emission reduction plans (e.g., regional air quality attainment plans and the State Implementation Plan, the state's plan for overall compliance with federal air quality standards) to account for the increase in air pollution attributable to climate change, the so-called "climate penalty." This responsibility falls in the realm of air pollution control agencies and is discussed in more detail in (Bedsworth, 2008a). The second is to use public education and outreach programs to reduce emission-causing activities and limit exposure on high air pollution days. Examples of such programs that can result in behavior that reduce harmful emissions include the Bay Area Air Quality Management District's Spare the Air program and the state's Flex Your Power campaign. Other education programs can help to limit exposure in unhealthy conditions, such as the program in San Joaquin Valley schools that uses color-coded flags to indicate the state of air quality. Responsibilities for these programs can lie with local air quality and public health agencies as well as with state energy agencies and electricity utilities.

Current Readiness

Neither local health agencies nor the Department of Public Health are responsible for meeting air quality goals or designing emission reductions programs. Nonetheless, they can play an important role in publicizing air quality information and supporting programs to reduce emissions and the associated public health risks. The survey responses indicate that about 62 percent of the local health agencies work with the local air district to publicize air quality information. In addition, almost 60 percent of respondents indicated that their agencies support programs designed to reduce either smog-forming or greenhouse gas emissions.

Infectious Disease

Another indirect effect of climate change can be an increased incidence of infectious diseases. Changes in the climate can affect the range, incidence, and spread of infectious agents (Drechsler et al., 2006). These changes can affect vector-, water-, and food-borne illness. Climate change will likely affect the incidence, transmission, and range of several vector-borne diseases, including mosquito-borne diseases (e.g., malaria, dengue fever, and yellow fever) as well as those carried by ticks and other insects (McMichael et al., 2006). Weather also influences the transmission and development of the microbial pathogens that can contaminate food and water, leading to illness.

Given the success in eradicating many vector-borne diseases in the United States and the robust health infrastructure, it is likely that much of the risk from vector-borne diseases will be due to importation through international travel rather than outbreaks in the United States (Gubler et al., 2001). However, there are likely to be continuing concerns with mosquito-borne diseases. Of the 12 mosquito-borne viruses known to occur in California today, only three – West Nile virus, western equine encephalomyelitis virus and St. Louis encephalitis virus – are major causes of human illness (California Department of Health Services, 2006). Many of these diseases are under control in California at present, but the rapid spread of West Nile Virus across the country since the late 1990's is an example of the potential for new diseases to

emerge.[9] In 2005, there were 935 human cases of West Nile Virus in California, 19 of which resulted in death (California Department of Health Services, 2006).

Management of water-borne disease may also pose challenges. Drinking water contamination outbreaks in the U.S. are associated with extreme precipitation events (Rose et al., 2001). Runoff from rainfall is also associated with coastal contamination that can lead to contamination of shellfish and contribute to food-borne illness (Rose et al., 2001). While the effects of climate change on precipitation amounts are uncertain - with some projections showing a drier future – there is general agreement that more precipitation will fall as rain than snow (see Luers and Mastrandrea, 2008). Greater amounts of rain and runoff could enhance the potential for contamination.

Primary Adaptation Measures

The primary adaptation measures for managing the spread of infectious disease are prevention programs that reduce vulnerability to infectious disease (for instance, avoiding exposure to mosquitoes), public education, illness surveillance and tracking systems, and vector control.

Illness tracking and surveillance involves documenting patterns of disease among different groups of people. Such tracking can be used to detect the conditions that place populations at risk and identify emerging threats. Public health officials can then work to alter these conditions to reduce the health risk (California Policy Research Center, 2004).

Vector control includes educational programs for the public to reduce the breeding and spread of disease vectors. Vector control programs also include application of pesticides and use of biological agents (such as mosquito-eating fish) to reduce vector populations. Because increased use of pesticides could pose additional health risks, vector control needs to be considered with this risk in mind.

Current Readiness

Every jurisdiction that responded to our survey had a disease tracking program in place, though there was variation in the diseases that were tracked. The majority tracked mosquito-borne diseases including West Nile virus (100%), Western Equine encephalitis (91%), and St. Louis encephalitis (91%). A little less than half of the respondents indicated that they tracked heat-related morbidity and mortality. Other diseases tracked by the respondents included asthma, cancer, and cardiovascular disease. All of these responses refer to surveillance that is occurring at the local level. The state, through the CDPH, is also working to develop disease surveillance indicators that are relevant to climate change-related health effects, such as heat-related morbidity and mortality, air pollution, and vector-borne disease.

While only a few local health districts are responsible for vector control, almost all areas of the state are included in a vector control program. These programs are operated by a number of different agencies around the state, including environmental health departments, mosquito

[9] West Nile Virus was not detected in the Western Hemisphere until 1999, when it was found in New York State. By 2004, West Nile Virus has been found in 48 states (California Department of Health Services, 2006).

abatement districts, and some cities. Approximately half of the survey respondents indicated that their agency worked with the local vector control agency to identify areas for spraying as well as to publicize information about spraying activities. Almost all respondents (94%) indicated that their agency provided public education about vector control.

Wildfires

Climate change is expected to change the extent and characteristics of forests and other natural ecosystems and the risk of wildfires is expected to rise (Cayan et al., 2006; Westerling and Bryant, 2006). Modeling that incorporates changes in temperature, precipitation, and simulated hydrological variables estimates that the probability of large fires could increase by 12 to 53 percent by the end of the century (Westerling and Bryant, 2006).[10] In addition to increased risks to property and infrastructure, wildfires pose a risk to human health. Forest fires result in increased concentrations of particulate matter (PM), which have been linked to a number of adverse health outcomes, including cardiovascular disease, premature mortality, and asthma (Dockery, et al., 1993). Because many wildfires occur in less inhabited areas, there is little air quality monitoring data to show the effect of wildfires on ambient air quality.

Primary Adaptation Measures

The primary adaptation measures to decrease the occurrence and extent of wildfires include forest management, maintenance of defensible space around structures, and increased use of fire-resistant materials. The responsibility for these measures lie primarily with other agencies, including state and federal forestry agencies (who manage public lands), state and local authorities that oversee building codes and construction permitting, and state and local fire departments. Public health agencies nevertheless have an important role to play in providing information to the public about the risks present during wildfires and actions that can be taken to reduce this risk. In addition, tools for outreach to vulnerable populations in other circumstances (e.g., extreme heat) could be used to reach vulnerable populations in the event of wildfires.

Current Readiness

When asked how serious a threat to public health was posed by a suite of potential climate impacts, 62 percent of the survey respondents considered that wildfire poses "very serious" risk to human health. This was more than any other climate impact.[11] While it is clearly a concern for local health officers, we have no comprehensive information on programs in place to address this risk. A review of several of the websites of local health agencies in areas affected by the wildfires in 2008 indicate that they all provided information to the public on the health risks associated with wildfires and how to lessen exposure (e.g., Monterey County and Santa Cruz County). The Monterey County Department of Health announced a public health

[10] A large fire is defined as one that is greater than 200 hectares (494 acres).
[11] Extreme heat came in second, at 50 percent.

advisory in response to the wildfire in Big Sur.[12] CDPH offered similar advice on lessening risk from exposure to the wildfires on its website.

Other Public Health Impacts

In addition to the health impacts listed above, there are a number of other climate impacts that could affect public health and the provision of health services. This includes the risks posed by sea level rise and flooding, such as water contamination and population displacement. In addition, depending upon the effects of climate change seen in other parts of the country and the world, California could see an increase in population due to an influx of people from other regions that are displaced by climate change, or "climate refugees," to the state. Such an influx, coupled with the potential increase in heat-related illness and infectious disease within the state, could tax health care facilities in the state.

Other Adaptation Measures

A major role of public health agencies is to implement disease prevention programs. These programs can reduce the population's vulnerability to the threats of climate change by addressing pre-existing conditions, such as obesity, cardiovascular disease, and other chronic conditions. Therefore, prevention, a central tenant of public health, is also a key component of the adaptation toolkit.

[12] A public health advisory presents information on health risk, but does not always require immediate action. The Monterey advisory is available here: http://www.co.monterey.ca.us/health/HealthAlerts/pdf/080708Wildfire.pdf (accessed 7/22/2008)

2. Constraints on State and Local Public Health Agencies

Many of the programs that public health agencies around the state are currently implementing will help to limit the negative public health impacts of climate change, even if that is not their original intention. In some cases, slight modification or expansion might be needed to best address climate change issues, but significant institutional capacity already does exist. Nonetheless, public health agencies face constraints that could hinder them from fully addressing the public health risks associated with climate change. These are discussed below.

Resources and Funding

At both the state and local level, public health agencies face resource constraints. "Resources" in this case refers both to funding as well as personnel, technical resources, and institutional support. The CDPH and its predecessor, the California Department of Health Services, have faced chronic budget constraints. Even as the new agency was created to "elevate the visibility and importance of public health issues in the policy arena," it received no additional funding. In addition, the current CDPH budget is heavily dependent on federal funding, making national priorities important for guiding California's public health activities (see the Appendix for details).

Given the practical nature of the work that local public health organizations do, much of their funding is allocated to programs that provide direct services to the population. In general, adding a new priority, such as climate change, to the agenda of a public health agency will require moving resources from another area. The good news is that many of the tools that are likely to be needed to respond to climate change are in place, such as heat emergency plans and disease tracking systems. Rather than creating brand new programs, many of these tools could be augmented to include a climate change component. However, such changes could require additional resources and, in some cases, could be challenged by funding requirements and limitations.

For the most part, public health agencies need to be prepared to update these tools as additional information, both climate-related and otherwise, becomes available. This will not necessarily require the addition of a new program area, but rather the ability to adapt and respond to new information and reallocate resources should that become necessary. For example, early indications suggest that extreme heat will likely be a concern for the state under a changing climate. Public health agencies should be prepared to update and refine heat emergency plans as new information becomes available. The state clearly has an important role to play in making this information available. The CDPH has already begun this process with its assessment of vulnerability to heat-related illness and collection of data on heat-related morbidity and mortality.

Information and Practice Implications

In our survey of local public health officers, the majority (65%) felt that they had adequate information to respond to public health emergencies, generally. On the other hand, when asked about whether they had adequate information to respond to climate-related emergencies, an almost equal share (68%) answered that they did not (Figure 2). This contrast is interesting, given that the health impacts of climate change are likely to be amplifications of

issues that they are already facing, such as heat-related morbidity and mortality. It suggests that more information on the nature of climate risks could help increase local agencies' confidence in their ability to tackle these risks.

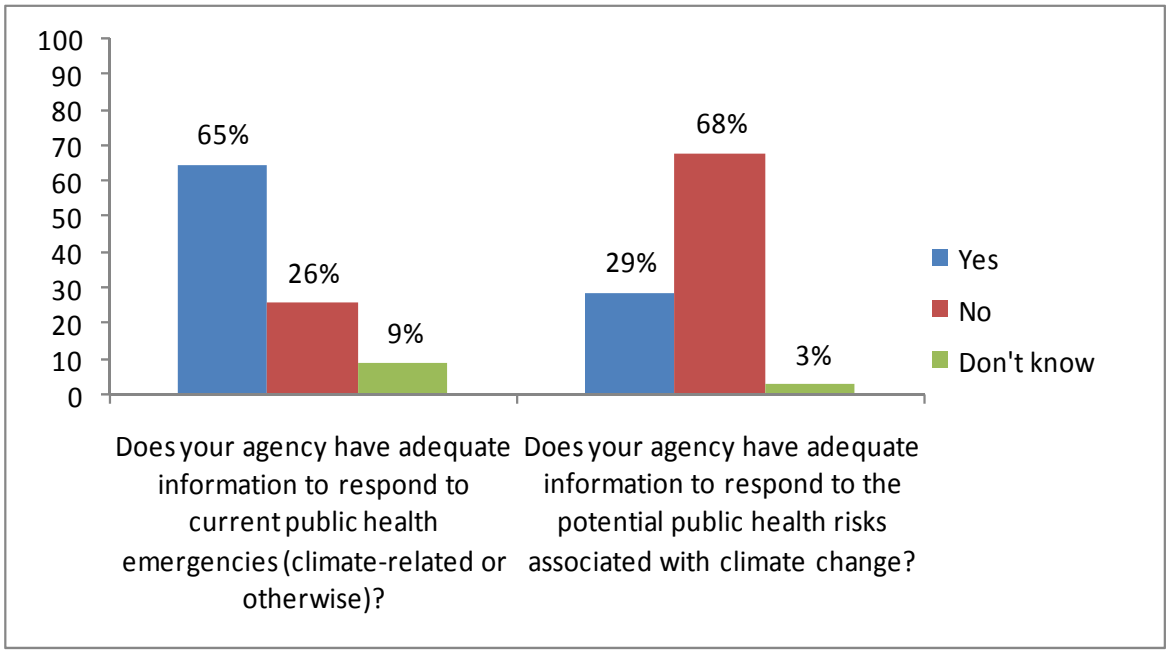

Figure 2 - Information Availability for Public Health Emergencies

Source: Bedsworth, 2008b

Note: Based on 34 responses from local public health officers

When asked what kinds of information would be useful, all options received overwhelming support (with more than 80% of respondents indicating they would be either helpful or very helpful). The options ranged from detailed risk assessments of climate impacts to education for agency staff to guidance from the OES and the CDPH.

One reason for this strong desire for additional climate-related information is the fact that public health agencies want practically-oriented information that they can act upon. Currently, much of the climate-related information is focused on climate science and climate impacts, but not on how to respond to these impacts. Response-oriented information is the missing link that could help local public health agencies address the public health risks that climate change poses.

Interagency Coordination

Many of the adaptations needed to lessen or avoid negative public health impacts of climate change cannot be accomplished by public health agencies alone. The most striking example is wildfire prevention, where other agencies have the lead, with public health agencies' role limited to assisting in emergency preparedness. But coordination is also required in other

areas, including those where public health agencies have the lead, such as heat emergency plans.

Where local public health agencies do not have regulatory authority – as in the wildfire example - they can represent public health concerns in other agency's rulemaking procedures. Therefore, public health agencies have to be on the lookout for (or be approached to support) regulations or programs that could have large public health co-benefits. As noted above, most public health agencies are already involved in interagency processes in areas such as air quality-related outreach and vector control.

At the state level, the CDPH, like its predecessor the Department of Health Services, is largely absent from the climate change regulatory discussion. The CDPH is not represented on the state's Climate Action Team, which is the interagency group led by the Secretary of the California Environmental Protection Agency and tasked with overseeing the implementation of the state's greenhouse gas emission reduction programs. [13] Nor has the CDPH been represented in the preparation of the Statewide Assessment, the biennial analysis of the likely impacts of climate change and adaptation needs in the state. In both of these instances, the CDPH could be providing valuable input and helping to inform the analysis that is needed to help minimize the public health effects of climate change.

[13] The Climate Action Team was formed following Governor Schwarzenegger's Executive Order in 2005 to help to meet the state's emission reduction targets. It is headed by the Secretary of the California Environmental Protection Agency and includes members from the Department of Transportation, the Governor's Office of Planning and Research, the California Energy Commission, the Integrated Waste Management Board, the California Air Resources Board, the Department of Parks and Recreation, the Department of Water Resources, the California Public Utilities Commission, the State and Consumer Services Agency, the Department of Food and Agriculture, the Department of Forestry and Fire Protection, the Business, Transportation, and Housing Agency, Health and Human Services, the Resources Agency, the Department of General Services, and the State Water Resources Control Board.

3. Finding A "Voice" for State and Local Public Health Agencies

Currently, state and local public health agencies are not as involved in state climate policy as agencies in other sectors. Yet there are significant opportunities for public health agencies to contribute to climate policies, including steps to reduce greenhouse gas emissions (often called climate change "mitigation" activities) as well as steps to prepare California for the inevitable changes ("adaptation" policies).

Leadership – Defining a Role for the Department of Public Health

As noted at the outset of this report, almost all public health officers stated that they felt climate change was either a somewhat (38%) or very (56%) serious threat to public health. Yet, most felt that they did not have the resources or information to address this threat adequately. When asked where they would like to get more information from, 77 percent identified the Department of Public Health, which was second only to the scientific community (86%).

A good near-term first step would be for CDPH to join the interagency, state-level Climate Action Team. As a member of this team, CDPH could more easily keep track of climate change mitigation efforts as well as statewide climate assessment activities. CDPH could play an important liaison role by translating information from the state level down to the local public health agencies, helping them to receive the practical, actionable information that they desire. In addition, CDPH could help to identify new information needed to support public health agency climate-related activities.

In addition, CDPH views itself as having an important role to play in the areas of preparedness and prevention activities, preparing work on community vulnerability, and public education. Through the State Environmental Health Collaborative of the Council of State and Territorial Epidemiologists, CDPH is currently preparing state-specific indicators of the health effects of climate change. The list includes indicators of population vulnerability, air pollution, and vector-borne disease, all of which will help to track the health effects of climate change both locally and at the state level. These analyses could contribute significantly to the statewide assessment and other state efforts to understand the potential impacts of climate change in California.

Evaluating and Refining Existing Tools

As we have seen, CDPH and local public health agencies already have a suite of existing tools that could help minimize the public health impacts of climate change. In particular, almost every local public health agency has a heat emergency plan in place. Evaluation and refinement of these plans over time will help to prepare regions for the anticipated increase of heatwaves. For example, both Stanislaus and San Diego Counties activated their heat emergency plans in 2006 and 2007. For each county, valuable lessons were learned in 2006 that were then incorporated into the plan for 2007. These lessons should be shared across agencies to facilitate the refinement of these plans.

Analysis from outside of California shows that access to transportation can be a protective factor against extreme heat (Basu and Samet, 2002), but few local heat emergency plans in the state currently provide transportation to cooling centers. Public health agencies should explore their potential to add transportation services, to improve the effectiveness of their heat emergency plans.

Continued development of disease tracking and surveillance information at the local level could contribute to statewide efforts to identify risks related to climate change. CDPH could play a valuable role by synthesizing the information gathered from local impacts and events.

Integration in Local and Regional Planning

Whereas CDPH has an important role to play in state-level climate activities, local public health agencies can do the same for local and regional planning. In a document examining the link between public health and land use planning prepared by Contra Costa Health Services, the authors outline a new role for public health. In particular, they indicate that the public health community can provide data on the nature and extent of local health problems, identify health impacts of proposed developments, and educate the public, developers, elected officials, and others on the links between public health and land use (Baer and Rattray, no date).

This role for public health agencies should be extended further into the climate change arena. Over the coming years, as California works to meet its climate change goals, numerous policy decisions will be made at the local level that will affect public health. Local land use practices will certainly be one important focus, but so will decisions on other issues including goods movement, transportation planning, and energy and waste management. Local public health agencies can provide valuable information on potential public health impacts and help to inform decisions that will maximize the public health co-benefits of climate change policies. For example, well-planned communities that improve walkability can lessen public health risks associated with obesity and cardiovascular disease and can also reduce the climate change emissions associated traditional modes of transportation.

Conclusion

Climate change will likely exacerbate numerous health challenges currently being addressed by the state's public health institutions. CDPH and local health agencies need to be prepared to cope with this change. Although the majority of public health officers surveyed feel that they lack the information and resources needed to respond to these new challenges, some existing tools – such as heat emergency plans and vector control – provide good building blocks.

Moving forward, it will be key for the newly-formed CDPH to take a leadership role on climate change. In this capacity, CDPH can provide guidance to local health agencies and can help ensure that the state's climate policy process reflects the needs and concerns of the public health community. This involvement will help generate climate-related information needed by the public health community, provide a means to refine and evaluate existing tools, and maximize the public health co-benefits associated with policy decisions. All of these actions are important to prepare California's public health institutions to address the public health impacts associated with a changing climate.

Appendix: Public Health Institutions in California

Numerous state and local agencies are involved in public health policy in California. The CDPH and local public health agencies – the focus of this report – oversee direct public health concerns and are tasked with improving public health outcomes and providing access to public health services. Their activities are interdependent, of course, on a network of other agencies, including the California Environmental Protection Agency, the State Office of Emergency Services, state and local water quality control agencies, and state and local air quality management agencies.

California Department of Public Health

The CDPH is the state agency responsible for improving access to public health services, improving public health outcomes, developing prevention programs to reduce adverse health effects and associated costs, and improving public health emergency preparedness and response. The CDPH was formed in July 2007 as a separate organization to provide more focused leadership on improving public health in California. Prior to that time, the California Department of Health Services covered public health functions at the state level and oversaw the provision and access to health care services for low-income residents and those with disabilities (e.g., MediCal). These latter functions are now the responsibility of the Department of Healthcare Services.

The CDPH's organization includes centers for chronic disease prevention and health promotion, infectious disease, family health, environmental health, and healthcare quality, as well as an office of emergency preparedness. An ad hoc working group is tasked with building connections across divisions on issues related to climate change. This group has prepared analyses of vulnerability to climate change and analyzed data on heat-related deaths (Climate Change Public Health Impacts and Response Collaborative, 2008). The group is also working to build institutional capacity to address issues related to climate change.

Limits on discretionary funding could pose a constraint to CDPH's efforts on the climate front. The CDPH's budget in 2007-2008 was $3.1 billion. Of this, only $390.7 million comes from the state's general fund. An additional $800 million is derived from special funds and selected bond funds. The remainder comes from non-state sources, including funds from the federal government through the Centers for Disease Control and Prevention.[14] Therefore, federal funds and mandates are an important determinant of what state and local public health agencies work on.

Local Health Agencies

Local public health agencies provide direct public health services and are responsible for protecting public health at the local level. Each of California's 58 counties has its own public health agency, as do three cities (Berkeley, Long Beach, and Pasadena). These agencies are overseen by public health officers, and they provide a host of practically-oriented public health assistance, outreach, education, and prevention programs. They also track disease in their region, provide disease prevention services, and work with other local agencies to manage

[14] Budget data from www.ebudget.ca.gov, accessed January 5, 2008.

public health emergencies. In some counties, the local public health agencies are also responsible for environmental health, providing services such as hazardous waste management, food safety, and vector control. In other counties, environmental health is a separate organization.

Other Public Health Institutions

Office of Environmental Health Hazard Assessment

The Office of Environmental Health Hazard Assessment (OEHHA) is a unit within the California Environmental Protection Agency, the lead agency for the Climate Action Team. OEHHA's primary responsibility is the risk assessment of hazardous substances. More recently, OEHHA completed an epidemiological analysis of temperature and mortality in California (Basu and Ostro, 2008). OEHHA is also participating in the Statewide Assessment of the impacts of climate change.

Other Local Agencies

Local public health agencies work with other organizations at the local and regional level on activities including vector control, air quality management, and emergency response.

Vector control. The agency responsible for vector control at the local level varies around the state. Roughly two-thirds of our survey respondents indicated that an agency other than their own was responsible for vector control, including environmental health departments, mosquito abatement districts, and vector control agencies. Some form of a vector control program covers almost all areas of the state.

Air quality. Some local health agencies help local air districts to publicize air quality information and some take an active role in promoting policies and regulations to improve air quality.

Emergency response. In the event of a public health emergency, local public health agencies work with other agencies to conduct outreach and provide services. Partners include sheriff's offices and other law enforcement agencies and the regional offices of the state Office of Emergency Services.

Non-governmental Organizations

Local public health agencies also work with non-governmental organizations. Partners include organizations, like the Red Cross, which operate emergency shelters and other facilities during public health emergencies. In addition, various non-governmental organizations (including foundations) provide funding and other support for local public health programs.

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