

Preparing the U.S. Health Community for Climate Change*

Richard Jackson and Kyra Naumoff Shields

Division of Environmental Health Sciences, School of Public Health,
University of California Berkeley, California 94720; email: dickjackson@berkeley.edu,
knaumoff@nature.berkeley.edu

Annu. Rev. Public Health 2008.29:57-73

First published online as a Review in Advance on
January 3, 2008

The *Annual Review of Public Health* is online at
<http://publhealth.annualreviews.org>

This article's doi:
10.1146/annurev.publhealth.29.020907.090755

Copyright © 2008 by Annual Reviews.
All rights reserved

0163-7525/08/0421-0057\$20.00

*The U.S. Government has the right to retain a
nonexclusive, royalty-free license in and to any
copyright covering this paper.

Key Words

physicians, hospitals, cities

Abstract

In society's effort to address and prepare for climate change, the health community itself must ensure that it is prepared. Health personnel will require flexible and iterative action plans to address climate change at the individual, hospital, local health department, state, and national levels. This requires that health workers analyze the impact of climate change with a view to human health, and then formulate robust policy and demonstrate authentic leadership. In this review, we summarize the status of the health community's preparation for climate change and provide specific recommendations for action at each level. Although preparation status and recommendations vary, our observation is that it is not enough for public health and medical care agencies and departments to develop policies and advocate change. They have a direct responsibility to demonstrate substantive leadership.

Health community:
public health and
medical care
professionals

INTRODUCTION

Identifying how the health community in the United States can work to more effectively address climate change requires a clear understanding of the composition of this community. Our view of this community is embodied below in an excellent working group report authored by leaders at the Centers for Disease Control and Prevention (47):

From one perspective, the U.S. health community comprises the array of institutions and professionals that provide, purchase, or oversee health care services, such as hospitals, physicians and other clinicians, health insurers, employers, governmental policy makers and regulators (15). An alternative, broader definition also includes the array of organizations and professionals that engage in population-based activities to promote health and prevent disease and injury (95). This definition recognizes the roles played by governmental public health agencies at federal, state, and local levels, as well as the array of nongovernmental institutions that contributes to population-based health activities (36).

An even broader definition is possible—one that includes the full complement of individuals and institutions whose actions influence the public's health. This definition, used by the Institute of Medicine in its recent study of public health (44), includes not only health care and public health institutions, but also actors working in many other areas that impact health, such as education, housing, business and industry, transportation, economic and community development, agriculture and food production, urban and rural planning, and environmental protection. Moreover, this definition acknowledges the critical roles played by communities and the general public in the health system—not just as consumers of health services, but also as key decision makers and leaders within the system.

This broad and encompassing view of the health system leads to a clearer understanding of the nature of health problems and the opportunities for health improvement. Because no single organization or sector within society has full control over the health problems and threats that face the public, effective solutions often require multisectoral efforts (42, 62, 82). The nation's successful quest to prevent death and disability from polio, for example, occurred through the concerted efforts of researchers, clinicians, public health professionals, and community organizations, working in tandem to protect an entire population with an effective vaccine. Addressing the health implications of climate change will require similar, multisectoral efforts. Leading such efforts requires the ability to navigate and influence a dynamic web of relationships among health community actors.

Climate change, in addition to other global environmental changes, is an increasingly important health issue. Research has focused on health outcomes associated with thermal stress (8, 55, 56, 63, 76), extreme weather events (32, 77, 91, 94), and vector-borne disease (33, 34, 54, 69, 70, 92), with some attention to estimates of future regional food yields and hunger prevalence (84). Complex climate change consequences, including those that will perturb social systems, will have impacts on health that cannot be captured by itemized tallying (64). For example, unabated climate change will likely impair regional food and water supplies, thus disrupting social and economic conditions, particularly among already poor and vulnerable populations. As a result, conflict will arise; migrant flows will increase; and a mix of violence, injury, infectious disease, malnutrition, mental disorders, and other health challenges will result.

Wealthier human societies have been assumed, at least initially, that they would be better able to buffer themselves from the more severe health-related impacts of climate change. However, events such as Hurricane

Katrina and the European heat waves demonstrated that societies everywhere are vulnerable to extreme and unpredictable weather, and that wealth alone does not provide adequate protection (103). A recent British report provides an indication of the financial impact of climate change; it concludes that the eventual cost of each ton of carbon dioxide added to the environment is approximately \$95 (89). Considering that the United States alone emitted 6623 million tons of carbon dioxide in 2004 (19), the financial implications are sobering. The British report also estimated that the current cost of taking action to address climate change is likely to be 1% of the global gross domestic product, but the cost of doing nothing may be up to 20% of the global gross domestic product.

Given both the magnitude of the climate change's potential health impacts and the mission of the health community, it is incumbent on the health community to (a) ensure that "its own house is in order," (b) develop flexible and iterative action plans to address climate change at the individual, hospital, city, county, state, and national levels, and (c) advocate for and implement leadership and policies that address climate change. In this review, we summarize the status of the health community's preparation for climate change at the individual, local health department, state, and national levels, and provide specific recommendations for action at each level. Recommendations provided throughout represent both a synthesis of the literature as well as original recommendations based on the first author's public health leadership experience. We divided each set of recommendations into those specific to adaptation and mitigation strategies, according to the terminology of the Intergovernmental Panel on Climate Change. Although preparation status and recommendations vary, our cross-cutting observation is that it is not enough for public health and medical care agencies and departments to develop policies and advocate change. The health community has a direct

responsibility to demonstrate substantive leadership.

HEALTH PROFESSIONALS' PREPARATION

Precedent for Action

Health professionals have successfully engaged larger health issues outside strict clinical practice, for example, by their efforts in the nuclear weapons disarmament movement (52, 61, 84). Over 135,000 health professionals participated in the Nobel Peace Prize-winning organization International Physicians for Prevention of Nuclear War and helped turn political attention to the prevention of accidental or international use of nuclear weapons, in part through the publication of numerous articles depicting the immense human and environmental costs of nuclear war. A similar approach continues to be used by health professionals in the Health Care Without Harm effort, which led to the removal of many toxic agents from hospitals (38).

Current Status of Preparation

Various health organizations have begun to demonstrate leadership in the area of climate change and health (Table 1). The American Medical Association does not currently have a position statement on climate change and human health; for comparison, the Australian Medical Association issued a position statement on this topic in 2004. The American Public Health Association recently posted a draft policy statement addressing the urgent threat of global climate change to public health and the environment. Both the U.S. Environmental Protection Agency (EPA) and the World Health Organization have published extensive materials related to climate change and human health (66, 68). Beyond issuing statements, the British Medical Journal recently created a "carbon council" to (a) recruit health professionals to address the links

Table 1 Examples of key publications and activities addressing both climate change and health by selected health leadership organizations^a

Organization	Formal climate change and health policy or information statement?	Key publication(s) and activities related to the impact of climate change on health	References
Association of State and Territorial Health Organizations	No	None	
American Medical Association	No	Stewardship of the Environment and Global Climate Change (1989): The “Greenhouse Effect (1989)”	1, 2
Australian Medical Association	Yes	Action Needed on Climate Change and Energy Policy (2006) and Climate Change and Human Health (2004)	5, 6
American Public Health Association	Yes (draft)	Addressing the Urgent Threat of Global Climate Change to Public Health and the Environment (2007)	3
Centers for Disease Control	No	Public Health Response to Global Climate Change workshop (2007)	
Institute of Medicine	Yes	Under the Weather: Climate, Ecosystems and Infectious Disease (2001) Conference on Human Health and Global Climate Change: Summary of the Proceedings (1996)	41, 43
National Association of City and County Health Officials	No	Organizing session(s) at 2007 annual meeting around climate change and health	
National Conference of State Legislators	No	None	
National Governors Association	No	Policy Position on Global Climate Change (2006)	72
Physicians for Social Responsibility (U.S. affiliate of International Physicians for Prevention of Nuclear War)	Yes	The Medical and Public Health Impacts of Global Warming (2006); state reports of the public health implications of climate change for Arizona, California, Florida, Georgia, Massachusetts, Maine, Michigan, New Hampshire, New Mexico, New York, North Carolina, Ohio, Oregon, Texas, and Washington	80
U.S. Environmental Protection Agency	Yes	Climate Change: Health and Environmental Effects (2007)	99
World Health Organization	Yes	Climate Change and Health (2005)	105

^aNot an exhaustive list.

between climate and health, (*b*) identify the most effective policies to reduce greenhouse gas emissions, (*c*) establish a coalition of health professionals to act as national and international policy advocates, and (*d*) encourage individual lifestyle changes among health professionals (90).

RECOMMENDATIONS FOR HEALTH PROFESSIONALS

The following are adaptation strategies:

- Include clinically relevant recommendations to patients that both promote health and reduce greenhouse gases, for

example, to lose weight by leaving the car at home and walking to work or to the bus stop.

- Contact health and medical-training institutions to request that training be provided in both the health implications of global environmental change as well as in the diagnosis of conditions such as heat stress and other conditions expected to be more prevalent in the future.

The following are mitigation strategies:

- Provide informational material on steps an individual can take to reduce his or her greenhouse gas emissions, in addition to other preventive health literature in waiting rooms or on the Web.
- Model carbon-literate (81) behavior by implementing green practices in medical and other health-related facilities (e.g., energy-efficient appliances, recycling, more insulation, and smart design) (12, 81, 84).

RECOMMENDATIONS FOR HEALTH ORGANIZATIONS

The following are adaptation strategies:

- Develop a formal climate change and health policy or information statement that describes likely future health risks and how the organization plans to respond to the risks. In a small sample of prominent health organizations, 50% of the organizations surveyed have posted a public version of a climate and health statement (**Table 1**).
- Compile credible informational material on steps an individual can take to reduce his or her greenhouse gas emissions that health professionals can easily access and provide to their patients and/or constituents.
- Learn from the success of organizational and governmental policies that limited contracts to only nonsmoking and disability-accessible facilities. We

suggest that all health and professional organizations limit their meetings and lodging decisions to energy-efficient green facilities.

- Advocate more effectively for climate- and health-friendly policies, in part by providing testimony to local, state, and congressional hearings related to these issues.

The following is a mitigation strategy:

- Develop continuing education programs about these issues, similar to those being run by the American Institute of Architects and others. The American Institute of Architects, for example, has committed itself to the greening of all its facilities, conventions, education programs, and advocacy policies.

LOCAL HEALTH DEPARTMENT PREPARATION

Some cities¹ have taken steps to prepare for climate change, for example, by establishing real-time operational heat-watch warning systems (49). The first system was installed in Philadelphia in 1995 to alert the city's population when weather conditions posed a risk to health (50). A recent review concluded that this program saved 117 lives from 1995 to 1998 (26). Other cities have developed heat emergency plans. Bernard & McGeehin reviewed such plans from 18 cities (10). They found that one-third of the cities² contacted lacked any written plan, and of the 10 cities that did have stand-alone heat response plans, almost one-third of these plans were perfunctory. These findings point to the urgency of developing heat emergency plans for cities before the need arises and to include objective

Carbon literate: a person's knowledge and understanding of her or his carbon consumption and its importance

Greening: employment of environmentally sound or beneficial practices

¹Philadelphia, PA; Washington, DC; Cincinnati and Dayton, OH; New Orleans and Baton Rouge, LA; Phoenix, AZ; Lake Charles and Alexandria, LA; Shreveport and Monroe, LA; Jackson and Meridian, MS; Little Rock, AR; and Memphis, TN.

²The cities remained anonymous.

criteria in these plans for assessing their effectiveness (20). A useful review of heat adaptation measures is provided in Reference 63; air conditioners, which are a strong protective factor against heat-related mortality,³ are discussed in detail in References 10, 73, and 85. Television, radio, and print public service announcements that include advice and information about available heat-coping strategies have also been effective mitigating actions in cities in the eastern United States (20).

RECOMMENDATIONS FOR LOCAL HEALTH DEPARTMENTS

The following are adaptation strategies:

- Develop plans, monitoring systems, and communication methods to collect and disseminate information in a timely, well-organized fashion (4).
- Continue developing and improving heat-related warning systems (24, 25, 48, 49, 75, 93).
- Work with social service and housing agencies to ensure that isolated populations have access to air conditioning during heat waves.
- Incentivize carbon-literate behaviors, such as carbon and other environmental labeling of products (84) and/or requiring that all health care and public health facilities purchase only energy-efficient vehicles and incentivize their purchase by staff.
- Increase public education and communication related to climate change (13, 18, 57, 88).

The following is a mitigation strategy:

- Continue adopting and enforcing building and energy codes that maximize energy efficiency as well as the healthfulness of indoor environments (32, 45, 53).

³In contrast, electric fans provide no protective benefit.

HOSPITAL PREPARATION

With increasing numbers of hospitals experiencing bed shortages and capacity bottlenecks in their emergency rooms, surgical suites, and critical-care units; the aging population; and capital investment in new and replacement hospitals in the 1990s, the health care industry in the United States is in the midst of an impressive construction and hiring boom: 40% of all new jobs in the United States since 2000 have been in the health care sector (58, 71). In 2004 alone, the health care sector consumed \$23 billion worth of durable medical equipment and \$32 billion worth of nondurable medical equipment (96). Moreover, the industry employs 1 out of 8 Americans, directly or indirectly, and drives upwards of 15% of the gross domestic product (58). Owing to the sheer size of health care institutions, the decisions that health care purchasers make have a dramatic impact on the marketplace (17).

Given such hospital characteristics as around-the-clock operations, energy- and water-use intensity, chemical use, infection control requirements, and formidable regulatory requirements, hospitals are traditionally energy-intensive institutions. Among all United States commercial buildings, the health care industry ranks second in energy-usage intensity (**Figure 1**). In 2005, each square foot of health care space cost an average of \$2.15 in electrical and natural gas expenses. Medical facilities spend more than \$6.5 billion on energy annually according to the U.S. Department of Energy and the EPA's Star program (101). Similarly, an analysis of the National Health Service in England and Wales revealed that it accounted for approximately 0.8% of all energy consumed in England and Wales in 2001 (7). Until recently, hospitals paid little attention to the energy performance and efficiency of their building infrastructure despite the fact that some costs could be reduced by energy-efficiency upgrades and better design (16).

The health care industry has demonstrated that it can be responsive to environmental

concerns. The industry dramatically reduced reliance on medical waste incineration, which in 1994 was identified by the EPA as one of the largest identified dioxin sources in the United States (98). Post 1994, the number of medical waste incinerators in North America decreased from almost 5000 to fewer than 100. In addition, in 1998, the American Hospital Association signed a memorandum of understanding (40) with the EPA, with a commitment to phase out the use of mercury altogether (58). Since hospitals began working to remove mercury from their operations in 1998, more than 29 states passed laws restricting mercury-based products in their states (27).

Health care, like other major sectors, will need to move to cleaner energy sources and reduce overall energy use as the environmental and health effects of global warming become more imminent (16). Hospitals are well suited to become environmentally friendly, high-performance buildings for several reasons. First, the mission of health care implies that health care institutions should be leaders in healthy construction and operational transformations (51). Second, because hospital operators usually own their buildings, they bear the life cycle implications of their construction choices (16). Typical hospital operation consumes large amounts of energy and resources, and thus presents a great opportunity for savings from efficiency measures. For example, each dollar a nonprofit health care organization saves on energy is equivalent to generating new revenues of \$20 for hospitals or \$10 for medical offices (101). In 2001, leading architects and designers developed a tool for sustainable health care design known as the Green Guide for Health Care (31). It is based on the U.S. Green Building Council Leadership in Energy and Environmental Design family of products and provides the health care sector with a voluntary tool kit of best practices. Kaiser Permanente, the nation's largest nonprofit health-maintenance organization, has committed to using the Green Guide for Health

Care as a framework for its entire system's building plans.

RECOMMENDATIONS FOR HEALTH CARE FACILITIES

The following are adaptation strategies:

- Complete an energy audit of the health care facility and publicly disclose the results. For example, use the EPA's online national rating system (101).
- Assign specific responsibility and accountability for energy issues to a senior hospital official.
- Limit the hospital's environmental impact by implementing a program(s) to save water, energy, and construction and operational waste.
- Incorporate preparation for heat-related events as part of the normal hospital preparation for large emergencies and pandemics.
- Join an organization such as Hospitals for a Healthy Environment.⁴ Hospitals for a Healthy Environment was launched in 1998 by an agreement with the EPA, American Hospital Association, American Nurses Association, and Healthcare Without Harm, and is based on a vision of a healthy health care system.

The following is a mitigation strategy:

- Move to twenty-first century design and construction, such as that being done by Kaiser Permanente and other institutions (39).

STATE PREPARATION

As the impact of climate on health is expected to vary by location and given the level of leadership shown on this issue by the U.S. government, it is important to address issues at the state level rather than wait for federal

Sustainable: able to meet present needs without compromising those of future generations

⁴<http://cms.h2e-online.org/about>

agencies to respond. At the time of this review, the state of California had the most wide-ranging and accessible reporting mechanism designed to address the public health–related impacts of climate change (20). The secretary of the California EPA is required to report to the governor and the state legislature biannually on the impacts on the state of global warming, including impacts on public health, and to report on mitigation and adaptation plans to combat these impacts. The 2006 report includes information on the changing prevalence of heat-related morbidity and mortality, air pollution, infectious diseases, and wildfires associated with climate change, as well as a discussion of adaptation costs, environmental justice issues, and research needs. Many other states have developed climate action plans designed to identify and evaluate feasible and effective policies to reduce greenhouse gas emission, but few include a discussion of the relationship between climate and health. As of July 2006, 29 states and Puerto Rico have completed, or are working on, action plans (100), although only three states—Colorado (102), Massachusetts (37), and Washington (30)—have explicitly mentioned the impact of climate change on human health. Additionally, the nongovernmental organization Physicians for Social Responsibility prepared 15 state reports⁵ on the public health implications of climate change. In general, the Physicians for Social Responsibility reports describe how climate change could affect various environmental parameters (e.g., air quality, water, extreme weather, and so forth), how each environmental parameter can affect health, the steps the state has taken to confront climate change, and steps for individual action, as well as useful references.

⁵Arizona, California, Florida, Georgia, Massachusetts, Maine, Michigan, New Hampshire, New Mexico, New York, North Carolina, Ohio, Oregon, Texas, and Washington. See http://www.psr.org/site/PageServer?pagename=enviro_resources.

RECOMMENDATIONS FOR STATES

The following are adaptation strategies:

- Create a multidisciplinary leadership team to lead state adaptation and mitigation scenario planning.
- Develop partnerships with other government agencies, the private sector, nongovernmental organizations, and universities to more effectively address health aspects of climate change.
- Support training programs in universities and other settings to develop the interdisciplinary experts needed to confront the broad spectrum of interwoven issues, for example, joint training in public health, city planning, health care, and architecture. Ideally such programs should support intern programs for young interdisciplinary scientists and public health practitioners.
- Because heat speeds the formation of ozone and other air pollutants, asthma and other lung diseases will likely increase in the population, especially in children and other vulnerable populations. As a first step, all health departments should implement asthma tracking and control programs with a view toward instating similar programs at the local health department levels.
- Explore opportunities for the detection of real-time heat stress–related conditions by tracking electronic medical records.
- Advocate for a “climate change preparedness report card,” including preparations for climate change and energy efficiency of all health care and public health facilities, and require that this information be available to the public.
- Incorporate energy and waste reduction targets into licensing agreements for health care facilities.

The following are mitigation strategies:

- Support greenhouse gas emission legislation expansion to other states similar to that of California (74).
- Provide state-level incentives for green building construction to promote carbon neutrality.

NATIONAL PREPARATION

The first U.S. national assessment of the potential consequences of climate variability and change was completed in 2000 (79). During the first assessment process, the health sector group consulted with other experts and reviewed hundreds of peer-reviewed studies, government reports, and limited ongoing research on the potential links between climate events, human exposure, and health impacts to synthesize the state of the science and to identify adaptation measures (9). Five categories of health outcomes associated with climate change were identified in the first health sector assessment: (*a*) temperature-related morbidity and mortality (63), (*b*) health effects of extreme weather events (32), (*c*) air-pollution-related health effects (11), (*d*) water- and food-borne diseases (83), and (*e*) insect-, tick-, and rodent-borne diseases (33). In the final report, the authors concluded that vigilance in the maintenance and improvement of public health systems and their responsiveness to changing climate should help protect the U.S. population from adverse health outcomes driven by climate change (79).

The original health sector assessment was updated in 2006 (23). The authors concluded that the literature published since the original health sector assessment supported previous conclusions and synthesized new data refining quantitative exposure-response relationships for several health outcomes, in particular, extreme heat events and air pollution. They also observed that the United States continues to have a high capacity to plan for and respond to climate change, although relatively little progress has been noted in the literature on implementing adaptive strate-

gies and measures. To this end, most informative is the White House report on the response to Hurricane Katrina (28). The surprisingly forthright report details 17 critical challenges as well as the subsequent lessons learned, and provides 125 recommendations designed to institutionalize a comprehensive National Preparedness System and foster a new, robust culture of preparedness.

A major continuing challenge for health researchers is to undertake research that will assist society in understanding and averting systematic dangers to health. McMichael identifies three categories of research designed to better understand health risks posed by global environmental change (65). First, empirical studies are needed to elucidate how variations in environmental and ecological systems affect health. Second, the health community must address the question, Are global environmental changes already affecting health? Gleaning such evidence is challenging in the early stages of such research owing to high signal-to-noise ratios, and there is a pressing need to develop pattern-recognition methods applicable to such scenarios. The third research needed is to make credible estimates of future changes in the health risks due to plausible scenarios of ongoing changes in large environmental systems (4, 104). Other specific research goals, including the need to (*a*) develop innovative approaches to analyze weather and climate in relation to health, (*b*) set up long-term data sets to answer key questions, and (*c*) improve our understanding of how to incorporate outputs from global climate models into human health studies, are discussed in detail in References 11, 32, 33, 60, 63, 66, 67, and 83.

Research must be coupled with leadership in order to achieve measurable success. One illustrative example is the successful focus on children's environmental health in the 1990s (46). Recognizing the improvements that a children's health initiative could bring about, President Clinton ordered that all agencies develop strategies to improve the

HEALTH PROFESSIONALS MUST PROVIDE CLIMATE CHANGE LEADERSHIP

Public health saves lives and informs big decisions. Immense industrial projects—new technology, changed tax policy, international agreements—will all be required to reduce greenhouse gas loading of the atmosphere and to mitigate climate change effects. However, throughout history each new technology has generated profound effects on human health, both positive and negative. The rapid ascendancy of the automobile in twentieth-century America changed air and water quality, but also walking and social behavior, exercise, and population density. The massive shift to mechanized commodity food production has also come with health benefits and risks. The greenhouse gas reduction effort will offer benefits (better air quality, perhaps more locally grown food, more social urban environments), but inevitably there will be new worker hazards, particularly within indoor environments, and other impacts. Public health must quantify and assess these threats and be positioned to offer balanced and effective public guidance. These issues are too important for only specialists. Climate change leadership must include strong public health voices.

health of children and mandated twice-yearly cabinet-level meetings to make it happen. Several important efforts, including the proposal for the National Children's Study, grew out of this initiative.

RECOMMENDATIONS APPLICABLE AT THE NATIONAL LEVEL

The following are adaptation strategies:

- Create a national multidisciplinary leadership team to lead adaptation and mitigation scenario planning (46).
- Form an executive-level policy task force with specific requirements for policy development, negotiating of agency deliverables, and timelines, including the achievement of greenhouse gas emission targets. Such data must be publicly reported on a timely basis. For example, the U.S. Department of Housing and Urban Development could be

directed to join with the Department of Energy to examine potential energy, health, and greenhouse gas benefits of expanding the Low Income Home Energy Assistance Program.

- The Centers for Disease Control and Prevention, EPA, and National Institutes of Health should develop and fund an interagency work group to develop a research, training/fellowship, and policy agenda on the impact of climate change on human health. Presently, most work in the health and climate change arena is focused primarily on infectious diseases and is remarkably exiguous in the areas of individual, family, social, and nutritional risks to the population.
- National nongovernmental organizations should advocate for health-protective environmental, transportation, and energy policies.

The following are mitigation strategies:

- Provide incentives for the construction of all new buildings with a view toward better protecting occupants from climate stress, particularly protracted heat waves and severe weather.
- Consider the many additional strategies recommended by the Intergovernmental Panel on Climate Change that were recently published by Working Group III (45).

CONCLUSION

We provide recommendations for action on climate change at the individual, hospital, local health department, state, and national level. Additional recommendations can be found in References 4, 14, 20, 22, 29, 35, 59, 78, and 86. Public health agencies and medical institutions, however, must do more than just advocate environmental responsibility and policy change; the health community also has a direct responsibility to demonstrate substantive leadership.

The health community has achieved much using intervention strategies. Sanitation and immunization programs have had remarkable success for infectious diseases, as have counter-advertising taxation and environmental regulation for tobacco disease reduction. Similar but more aggressive strategies will be required for a threat of the scale of climate change given its generational consequences. The health community is slowly becoming more carbon literate, for example, with the formation of the *British Medical Journal's* carbon council; the establishment of real-time operational heat-related warning systems in several major U.S. cities; the publication of the Green Guide to Health Care; the founding of the organization Hospitals for a Healthy Environment; California Governor Schwarzenegger's directive that the California EPA provide a biannual report on the impacts of global warming there, including the impact of climate on health; and the publication of the U.S. national assessment of the potential consequences of climate variability and change in 2000 and its update in 2006. However, on the basis of the Hippocratic principle, "first, do no harm," these activities alone are not sufficient steps for a community.

The extent of climate change's impacts on health will be partially determined by policies designed to increase the ability of individuals and societies to cope with future challenges (21). Policy makers have a variety of tools for addressing climate change; not all will be equally effective, and some may themselves create adverse health impacts. In environmental health, aggressive removal of sources—for example, lead—or outright bans—for example, of certain pesticides—

have the clearest record of success. Similarly, for climate policies to be health protective, the health community must become much more engaged in these debates. Successful environmental health protection programs of the past required effective priority setting, extensive public and policy education, the accounting for and public reporting of hazards, substantial increased regulation, and evaluation of overall successes and failures. It will also be important to guide mitigation and adaptation measures in nonhealth sectors such that they avoid public health impacts or, even better, help achieve other public health goals. This important topic is addressed in an accompanying chapter in this volume (87).

The threats to health from climate change have fearsome precedent in the pandemics of the past. With the plague, for example, nearly one-third of Europe's population succumbed; the nostrums of the day, such as breathing through perfumed handkerchiefs, were worthless. Looking back, we see how simple sanitation and vermin removal could have blunted or even ended the pestilence. Then, more knowledgeable and effective health leadership could have saved millions of lives. Today, we are on the threshold of the next great pandemic. We cannot dismiss the threat because remedies are costly or inconvenient. Future generations who bear the brunt of our failure may look back at a "criminal generation"—one that failed to prevent catastrophe even when it had the tools. Even if failed leaders face condemnation, at a minimum, let it be said that the "health people" did all we could to minimize our own environmental impacts and to alert our leaders and society of the gravity of the endangerment.

SUMMARY POINTS

1. Require both organizationally and legislatively that all new and pending health care and public health facilities be built to the highest level of energy efficiency, including advocating for transit to these facilities to reduce car dependency.

2. Work toward higher energy efficiency and minimized environmental footprint for all existing public health and health care facilities. This could be the best “no-regrets” strategy for our health.
3. Advocate for a climate change preparedness report card, including energy efficiency of all health care and public health facilities and require that this information be available to the public. Such a report should be scrutinized in health care facility licensing and certification programs.
4. Advocate for and implement policies that incentivize climate-friendly and carbon-literate behaviors.
5. Advocate that all environmental impact reports include an assessment of energy efficiency and resource use, as well as impact on human health.
6. Advocate for the divestiture of nonsustainable investments by major pension plans servicing health care and public health personnel.
7. Train all public health and health care professionals about the impact of global climate change on health.

DISCLOSURE STATEMENT

The authors are not aware of any biases that might be perceived as affecting the objectivity of this review.

LITERATURE CITED

1. Am. Med. Assoc. 1989. *Global climate change: the “Greenhouse Effect.”* Policy number H-135.977. http://www.ama-assn.org/apps/pf_new/pf_online
2. Am. Med. Assoc. 1989. *Stewardship of the environment.* Policy Number H-135.973. http://www.ama-assn.org/apps/pf_new/pf_online
3. Am. Public Health Assoc. 2007. *Addressing the urgent threat of global climate change to public health and the environment.* <http://www.apha.org/advocacy/policy/newpolicy/2007policies.htm>
4. Anderson P, Brownstein J, Confalonieri U, Causey D, Chan N, et al. 2005. *Climate Change Futures: Health, Ecologic and Economic Dimensions.* Boston: Cent. Health Glob. Environ. Harvard Med. Sch.
5. Aust. Med. Assoc. 2004. *Climate change and human health.* <http://www.ama.com.au/web.nsf/doc/WOOD-5ZD6BT>
6. Aust. Med. Assoc. 2006. *Action needed on climate change and energy policy.* <http://www.ama.com.au/web.nsf/doc/WEEN-6VA8S9>
7. Barrett J, Chambers N, Cherrett N, Jenkin N, Lewis K, Vergoulas G. 2004. *Material Health: A Mass Balance and Ecological Footprint Analysis of the NHS in England and Wales.* Oxford: R. Soc. Nat. Conserv.
8. Basu R, Samet JM. 2002. Relation between elevated ambient temperature and mortality: a review of the epidemiologic evidence. *Epidemiol. Rev.* 24:190–202
9. Bernard SM, Ebi KL. 2001. Comments on the process and product of the health impacts assessment component of the national assessment of the potential consequences of climate

variability and change for the United States. *Environ. Health Perspect.* 109(Suppl. 2):177–84

10. Bernard SM, McGeehin MA. 2004. Municipal heat wave response plans. *Am. J. Public Health* 94:1520–22
11. Bernard SM, Samet JM, Grambsch A, Ebi KL, Romieu I. 2001. The potential impacts of climate variability and change on air pollution-related health effects in the United States. *Environ. Health Perspect.* 109(Suppl. 2):199–209
12. Blashki G, Butler CD, Brown S. 2006. Climate change and human health: What can GPs do? *Aust. Fam. Phys.* 35:909–11
13. Bostrom A, Morgan MG, Fischhoff B, Read D. 1994. What do people know about global climate change? 1. Mental models. *Risk Anal.* 14:959–70
14. Burton I, Smith JB, Ebi KL, Scheraga J. 2005. Lessons learned and insights for adaptation policy. See Ref. 25, pp. 258–69
15. Christianson JB. 1998. The role of employers in community health care systems. *Health Aff. (Millwood)* 17:158–64
16. Cohen G. 2006. *First, do no harm*. Presented at Des. 21st Century Hosp. Environ. Lead. Health. Patients Facil., Hasbrouck Heights, N.J.
17. Coote A. 2006. What health services could do about climate change. *Br. Med. J.* 332:1343–44
18. Dempsey R, Fisher A. 2005. Consortium for Atlantic regional assessment: information tools for community adaptation to changes in climate or land use. *Risk Anal.* 25:1495–509
19. Dep. Energy/Energy Info. Admin. 2005. Emissions of greenhouse gases in the United States 2005, ed. DOE/EIA-0573 Adm. Washington, DC: U.S. Dep. Energy
20. Drechsler DM, Motallebi N, Kleeman M, Cayan D, Hayboe K, et al. 2006. *Public health: related impacts of climate change in California*. Sacramento: Calif. Clim. Chang. Cent.
21. Ebi KL, Burton I, Menne B. 2006. *Policy implications of climate change: related health risks in Europe*. Geneva: World Health Org.
22. Ebi KL, Kovats RS, Menne B. 2006. An approach for assessing human health vulnerability and public health interventions to adapt to climate change. *Environ. Health Perspect.* 114:1930–34
23. Ebi KL, Mills DM, Smith JB, Grambsch A. 2006. Climate change and human health impacts in the United States: an update on the results of the U.S. national assessment. *Environ. Health Perspect.* 114:1318–24
24. Ebi KL, Schmier JK. 2005. A stitch in time: improving public health early warning systems for extreme weather events. *Epidemiol Rev.* 27:115–21
25. Ebi KL, Smith JB, Burton I, eds. 2005. *Integration of Public Health with Adaptation to Climate Change: Lessons Learned and New Directions*, ed. KL Ebi, JB Smith, I Burton, pp. 258–69. New York: Taylor & Francis
26. Ebi KL, Teisberg TJ, Kalkstein LS, Robinson L, Weiher RF. 2004. Heat watch/warning systems save lives: estimated costs and benefits for Philadelphia 1995 to 1998. *Bull. Am. Meteorol. Soc.* 85:1067–73
27. Electron. Ind. Alliance. 2005. *Matrix of enacted mercury-containing product state laws in the USA. Electronic Industries Alliance Regulatory Tracking Tool.* <http://www.eiatrack.org/p/219>
28. Fragos Townsend F, Rapuano P, Bagnal JB, Malvesti ML, Nielsen KM, et al. 2006. *The Federal Response to Hurricane Katrina: Lessons Learned*. Washington, DC: U.S. White House

29. Fussel H, Klein RJT, Ebi KL. 2006. Adaptation assessment for public health. In *Climate Change and Adaptation Strategies for Human Health*, ed. B Menne, KL Ebi, pp. 41–62. Darmstadt, Germ.: Steinkopff Verlag
30. Garcia N. 1996. *Greenhouse Gas Mitigation Options for Washington State*. Olympia, WA: Wash. State Energy Off.
31. Green Guide Health Care. 2007. *Green guide for health care*. <http://gghc.org/>
32. Greenough G, McGeehin M, Bernard SM, Trtanj J, Riad J, Engelberg D. 2001. The potential impacts of climate variability and change on health impacts of extreme weather events in the United States. *Environ. Health Perspect.* 109(Suppl. 2):191–98
33. Gubler DJ, Reiter P, Ebi KL, Yap W, Nasci R, Patz JA. 2001. Climate variability and change in the United States: potential impacts on vector- and rodent-borne diseases. *Environ. Health Perspect.* 109(Suppl. 2):223–33
34. Gubler DJ, Wilson ML. 2005. The global resurgence of vector-borne diseases: lessons learned from successful and failed adaptation. See Ref. 25, pp. 44–59
35. Haines A, Kovats RS, Campbell-Lendrum D, Corvalan C. 2006. Climate change and human health: impacts, vulnerability, and mitigation. *Lancet* 367:2101–9
36. Halverson PK, Miller CA, Kaluzny AD, Fried BJ, Schenck SE, Richards TB. 1996. Performing public health functions: the perceived contribution of public health and other community agencies. *J. Health Hum. Serv. Adm.* 18:288–303
37. Hamel S, McCarthy G, Tennis A, Friedman E, Wickersham J, Nappi S. 2004. *Massachusetts Climate Protection Plan*. Boston, MA: Off. Commonw. Dev.
38. Health Care Without Harm. 2007. *Healthcare without harm history*. <http://www.noharm.org/europe/aboutUs/missionGoals>
39. Houghton A. 2007. *Green Guide for Health Care: Version 2.2*. Austin: Cent. Max. Potential Build. Syst.
40. Hosp. Healthy Environ. 2007. *Memorandum of understanding*. <http://cms.h2e-online.org/about/mou>
41. Inst. Med. 1996. *Conference on Human Health and Global Climate Change: Summary of the Proceedings*. Washington, DC: Natl. Acad. Press. 64 pp.
42. Inst. Med. 1996. *Health Communities: New Partnerships for the Future of Public Health*. Washington, DC: Natl. Acad.
43. Inst. Med. 2001. *Under the Weather: Climate, Ecosystems, and Infectious Disease*. Washington, DC: Natl. Acad. Press. 160 pp.
44. Inst. Med. 2002. *The Future of the Public's Health in the 21st Century*. Washington, DC: Natl. Acad.
45. Intergov. Panel Clim. Chang. 2007. *Climate change 2007: Mitigation of Climate Change. Summary for Policymakers*. Bangkok: Intergov. Panel Clim. Chang.
46. Jackson RJ. 2007. Environment meets health, again. *Science* 315:1337
47. Jackson RJ, Valdiserri R. 2004. *Futures Initiative: Health Systems Workgroup Report*. Atlanta: Cent. Dis. Control Prev.
48. Kalkstein AJ, Sheridan SC. 2007. The social impacts of the heat-health watch/warning system in Phoenix, Arizona: assessing the perceived risk and response of the public. *Int. J. Biometeorol.* 52(1):43–55
49. Kalkstein LS. 2003. *Description of Our Heat/Health Watch-Warning Systems: Their Nature and Extent and Required Resources*. Newark, Del.: Minn. Dep. Health
50. Kalkstein LS, Jamason PF, Green JS, Libby J, Robinson L. 1996. The Philadelphia hot weather-health watch/warning system: development and application, summer 1995. *Bull. Am. Meteorol. Soc.* 77:1519–28

51. Karolides A, Archambault T, Ravanese B, Guenther R, Vittori G, Batshalom B. 2005. *Design for Health: Summit for Massachusetts Health Care Decision Makers*. Snowmass, CO: Rocky Mt. Inst.
52. Kefford RF. 2006. Medical heat for climate change. *Med. J. Aust.* 184:582
53. Kilbourne EM. 2002. Heat-related illness: current status of prevention efforts. 22:328
54. Kovats RS, Campbell-Lendrum DH, McMichael AJ, Woodward A, Cox JS. 2001. Early effects of climate change: Do they include changes in vector-borne disease? *Philos. Trans. R. Soc. London B Biol. Sci.* 356:1057–68
55. Kovats RS, Jendritzky G, Hajat S, Havenith G, Koppe C, et al. 2006. Heat-waves and human health. See Ref. 70, pp. 449
56. Kovats RS, Koppe C. 2005. Heat waves: past and future impacts on health. See Ref. 25, pp. 136–60
57. Leiserowitz AA. 2005. American risk perceptions: Is climate change dangerous? *Risk Anal.* 25:1433–42
58. Levin D. 2006. *Foreward*. Presented at Des. 21st Century Hosp. Environ. Lead. Health. Patients Facil. Hasbrouck Heights, NJ.
59. Linder SH. 2005. The adoption of adaptation measures. See Ref. 25, pp. 242–57
60. Lorenzoni I, Pidgeon NF, O'Connor RE. 2005. Dangerous climate change: the role for risk research. *Risk Anal.* 25:1387–98
61. Lown B, Muller J, Chivian E, Abrams H. 1981. The nuclear-arms race and the physician. *N. Engl. J. Med.* 304:726–29
62. Mays GP, Halverson PK, Kaluzny AD. 1998. Collaboration to improve community health: trends and alternative models. *Jt. Comm. J. Qual. Improv.* 24:518–40
63. McGeehin MA, Mirabelli M. 2001. The potential impacts of climate variability and change on temperature-related morbidity and mortality in the United States. *Environ. Health Perspect.* 109(Suppl. 2):185–89
64. McMichael A, Woodruff R. 2004. Climate change and risk to health. *Br. Med. J.* 329:1416–17
65. McMichael AJ. 2006. Population health as the ‘bottom line’ of sustainability: a contemporary challenge for public health researchers. *Eur. J. Public Health* 16:579–81
66. McMichael AJ, Campbell-Lendrum D, Corvalan C, Ebi KL, Giteko AK, et al. 2003. *Climate Change and Human Health: Risks and Responses*. Geneva: World Health Org.
67. Menne B, Ebi KL. 2006. Conclusions. See Ref. 70, pp. 409–26
68. Menne B, Ebi KL. 2006. Introduction. See Ref. 70, pp. 1–8
69. Menne B, Ebi KL. 2006. Vector- and rodent-borne diseases. See Ref. 70, pp. 129–267
70. Menne B, Ebi KL, eds. 2006. *Climate Change and Adaptation Strategies for Human Health*. Hessen/Darmstadt, Germ.: Steinkopff Verlag
71. Natl. Cent. Health Stat. 2006. *Health, United States, 2006, with Chartbook on Trends in the Health of Americans*. Hyattsville, MD: Natl. Cent. Health Stat. 559 pp.
72. Natl. Gov. Assoc. 2006. *Policy position on global climate change*. Policy number NR-11. <http://www.nga.org/portal/site/nga/menuitem.8358ec82f5b198d18a278110501010a0/?vgnnextoid=220b9e2f1b091010VgnVCM1000001a01010aRCRD&vgnnextchannel=4b18f074f0d9ff00VgnVCM1000001a01010aRCRD>
73. Naughton MP, Henderson A, Mirabelli MC, Kaiser R, Wilhelm JL, et al. 2002. Heat-related mortality during a 1999 heat wave in Chicago. *Am. J. Prev. Med.* 22:221–27
74. Off. Gov. 2005. *Executive order S-3-05 by Arnold Schwarzenegger*. <http://gov.ca.gov/index.php?/executive-order/1861>
75. Pascal M, Laaidi K, Ledrans M, Baffert E, Caserio-Schonemann C, et al. 2006. France's heat health watch warning system. *Int. J. Biometeorol.* 50:144–53

76. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. 2005. Impact of regional climate change on human health. *Nature* 438:310
77. Patz JA, Engelberg D, Last J. 2000. The effects of changing weather on public health. *Annu. Rev. Public Health* 21:271–307
78. Patz JA, McGeehin MA, Bernard SM, Ebi KL, Epstein PR, et al. 2001. The potential health impacts of climate variability and change for the United States. Executive summary of the report of the health sector of the U.S. National Assessment. *Environ. Health Perspect.* 64:20–28
79. Patz JA, McGeehin MA, Bernard SM, Ebi KL, Epstein PR, et al. 2001. Chapter 15: Potential consequences of climate variability and change for human health in the United States. In *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*, pp. 437–58. Cambridge, UK: Cambridge Univ. Press
80. Phys. Soc. Responsib. 2006. *The medical and public health impacts of global warming*. http://www.psr.org/site/PageServer?pagename=enviro_resources#GlobalWarming
81. Roberts I. 2006. When doctors learned to speak carbon. *Br. Med. J.* 332:497
82. Roper WL, Baker EL Jr, Dyal WW, Nicola RM. 1992. Strengthening the public health system. *Public Health Rep.* 107:609–15
83. Rose JB, Epstein PR, Lipp EK, Sherman BH, Bernard SM, Patz JA. 2001. Climate variability and change in the United States: potential impacts on water- and foodborne diseases caused by microbiologic agents. *Environ. Health Perspect.* 109(Suppl. 2):211–21
84. Schwartz BS, Parker C, Glass TA, Hu H. 2006. Global environmental change: What can health care providers and the environmental health community do about it now? *Environ. Health Perspect.* 114:1807–12
85. Semenza JC, Rubin CH, Falter KH, Selanikio JD, Flanders WD, et al. 1996. Heat-related deaths during the July 1995 heat wave in Chicago. *N. Engl. J. Med.* 335:84–90
86. Sharpe M. 2005. International public health policy case study. See Ref. 25, pp. 258–69
87. Smith K, Haigler E. 2007. Considerations in co-benefits analysis for energy interventions with examples from the household sector. *Annu. Rev. Public Health* 29:11–25
88. Smith PF. 2006. Climate change: contraction and convergence: myth and reality. *Br. Med. J.* 332:1509
89. Stern N. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge, UK: Cambridge Univ. Press. 712 pp.
90. Stott R, Godlee F. 2006. What should we do about climate change? Health professionals need to act now, collectively and individually. *Br. Med. J.* 333:983–84
91. Street R, Maarouf A, Jones-Otazo H. 2005. Extreme weather and climate events: implications for public health. See Ref. 25, pp. 161–90
92. Sutherst RW. 2004. Global change and human vulnerability to vector-borne diseases. *Clin. Microbiol. Rev.* 17:136–73
93. Tan J, Kalkstein LS, Huang J, Lin S, Yin H, Shao D. 2004. An operational heat/health warning system in Shanghai. *Int. J. Biometeorol.* 48:157–62
94. Tibbetts J. 2007. Driven to extremes health effects of climate change. *Environ. Health Perspect.* 115:A196–203
95. Turnock BJ. 2000. *Public Health: What it Is and How it Works*. Gaithersburg, MD: Aspen Publ.
96. U.S. Dep. Health Hum. Serv. 2005. *National health expenditure data, Table 2—National health expenditures aggregate amounts and average annual percent change by type of expenditure: selected calendar years 1960–2004*. <http://www.cms.hhs.gov/NationalHealthExpendData/downloads/tables.pdf>

97. U.S. Energy Info. Admin. 2007. *Table 5b. U.S. commercial buildings energy intensity using site energy by census region and principle building activity, 1992–2003. Energy Information Administration: official energy statistics from the US Government.* http://www.eia.doe.gov/emeu/efficiency/cbecstrends/cbi.html/cbecs_trends_5b.html
98. U.S. Environ. Protect. Agency. 1994. Estimating exposures to dioxin-like compounds: Executive summary Vols. I–III (review draft). Rep. EPA/600/6-88-005, EPA Off. Res. Dev., Washington, DC
99. U.S. Environ. Protect. Agency. 2007. *Climate change: health and environmental effects.* <http://www.epa.gov/climatechange/effects/index.html>
100. U.S. Environ. Protect. Agency. 2007. *Climate change: state and local governments.* http://www.epa.gov/climatechange/wycd/stateandlocalgov/state_action.html
101. U.S. Environ. Protect. Agency. 2007. *Energy STAR for healthcare.* http://www.energystar.gov/index.cfm?c=healthcare.bus_healthcare
102. Woodford P, Quartarone F, Berg WW. 1998. *Climate Change and Colorado: A Technical Assessment.* Denver: Colo. Dep. Public Health Environ.
103. Woodruff RE, McMichael AJ, Hales S. 2006. Action on climate change: no time to delay. Global warming is real, so what are we going to do about it, who will do it, and when? *Med. J. Aust.* 184:539–40
104. Woodruff RE, McMichael T, Butler C, Hales S. 2006. Action on climate change: the health risks of procrastinating. *Aust. N. Z. J. Public Health* 30:567–71
105. World Health Organ. 2005. *Climate change and health.* <http://www.who.int/globalchange/news/fsclimandhealth/en/index.html>

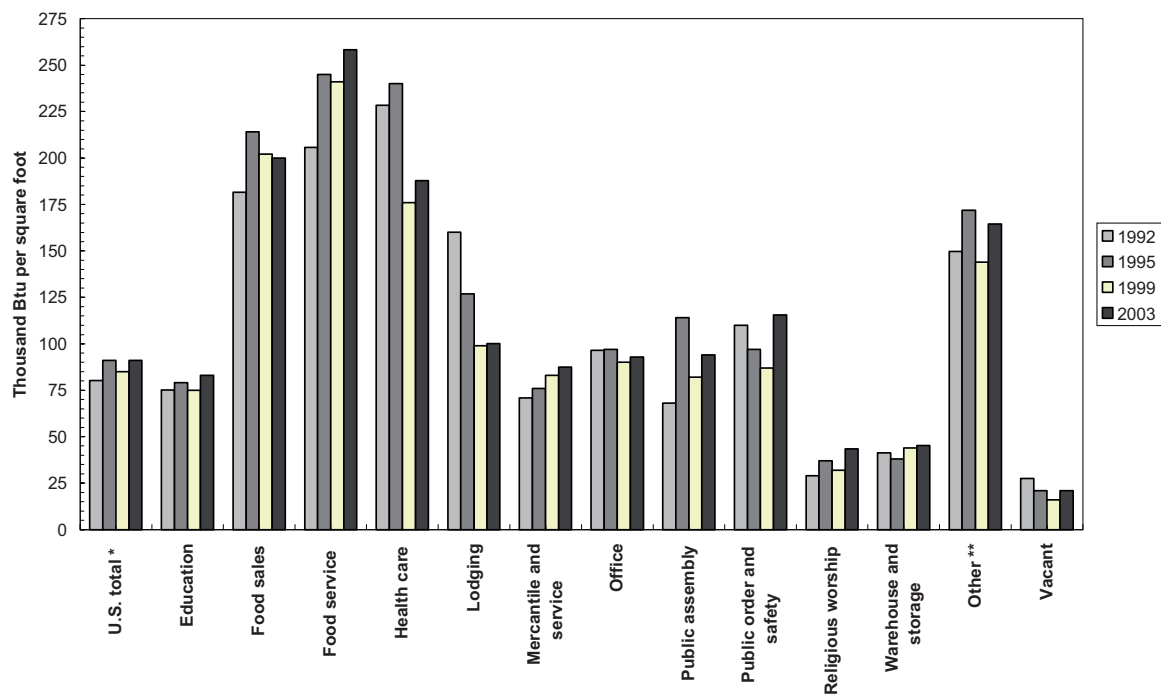


Figure 1

U.S. commercial building's energy intensity. The health care industry ranks second in energy-use intensity, behind the food industry (97). *, the United States' total estimate was adjusted to match the 1995, 1999, and 2003 Commercial Buildings Energy Consumption Survey definition of a target population. **, laboratory buildings are included in this category.



Contents

Commentary

Public Health Accreditation: Progress on National Accountability <i>Hugh H. Tilson</i>	xv
---	----

Symposium: Climate Change and Health

Mitigating, Adapting, and Suffering: How Much of Each? <i>Kirk R. Smith</i>	xxiii
--	-------

Ancillary Benefits for Climate Change Mitigation and Air Pollution Control in the World's Motor Vehicle Fleets <i>Michael P. Walsh</i>	1
--	---

Co-Benefits of Climate Mitigation and Health Protection in Energy Systems: Scoping Methods <i>Kirk R. Smith and Evan Haigler</i>	11
--	----

Health Impact Assessment of Global Climate Change: Expanding on Comparative Risk Assessment Approaches for Policy Making <i>Jonathan Patz, Diarmid Campbell-Lendrum, Holly Gibbs, and Rosalie Woodruff</i>	27
--	----

Heat Stress and Public Health: A Critical Review <i>R. Sari Kovats and Shakoor Hajat</i>	41
---	----

Preparing the U.S. Health Community for Climate Change <i>Richard Jackson and Kyra Naumoff Shields</i>	57
---	----

Epidemiology and Biostatistics

Ecologic Studies Revisited <i>Jonathan Wakefield</i>	75
---	----

Recent Declines in Chronic Disability in the Elderly U.S. Population: Risk Factors and Future Dynamics <i>Kenneth G. Manton</i>	91
---	----

The Descriptive Epidemiology of Commonly Occurring Mental Disorders in the United States <i>Ronald C. Kessler and Philip S. Wang</i>	115
The Women's Health Initiative: Lessons Learned <i>Ross L. Prentice and Garnet L. Anderson</i>	131
U.S. Disparities in Health: Descriptions, Causes, and Mechanisms <i>Nancy E. Adler and David H. Rebkopf</i>	235
Environmental and Occupational Health	
Industrial Food Animal Production, Antimicrobial Resistance, and Human Health <i>Ellen K. Silbergeld, Jay Graham, and Lance B. Price</i>	151
The Diffusion and Impact of Clean Indoor Air Laws <i>Michael P. Eriksen and Rebecca L. Cerak</i>	171
Ancillary Benefits for Climate Change Mitigation and Air Pollution Control in the World's Motor Vehicle Fleets <i>Michael P. Walsh</i>	1
Co-Benefits of Climate Mitigation and Health Protection in Energy Systems: Scoping Methods <i>Kirk R. Smith and Evan Haigler</i>	11
Health Impact Assessment of Global Climate Change: Expanding on Comparative Risk Assessment Approaches for Policy Making <i>Jonathan Patz, Diarmid Campbell-Lendrum, Holly Gibbs, and Rosalie Woodruff</i>	27
Heat Stress and Public Health: A Critical Review <i>R. Sari Kovats and Shakoor Hajat</i>	41
Preparing the U.S. Health Community for Climate Change <i>Richard Jackson and Kyra Naumoff Shields</i>	57
Protective Interventions to Prevent Aflatoxin-Induced Carcinogenesis in Developing Countries <i>John D. Groopman, Thomas W. Kensler, and Christopher P. Wild</i>	187
Public Health Practice	
Protective Interventions to Prevent Aflatoxin-Induced Carcinogenesis in Developing Countries <i>John D. Groopman, Thomas W. Kensler, and Christopher P. Wild</i>	187
Regionalization of Local Public Health Systems in the Era of Preparedness <i>Howard K. Koh, Loris J. Elqura, Christine M. Judge, and Michael A. Stoto</i>	205

The Effectiveness of Mass Communication to Change Public Behavior <i>Lorien C. Abrams and Edward W. Maibach</i>	219
U.S. Disparities in Health: Descriptions, Causes, and Mechanisms <i>Nancy E. Adler and David H. Rebkopf</i>	235
The Diffusion and Impact of Clean Indoor Air Laws <i>Michael P. Eriksen and Rebecca L. Cerak</i>	171
Public Health Services and Cost-Effectiveness Analysis <i>H. David Banta and G. Ardine de Wit</i>	383
Social Environment and Behavior	
Creating Healthy Food and Eating Environments: Policy and Environmental Approaches <i>Mary Story, Karen M. Kaphingst, Ramona Robinson-O'Brien, and Karen Glanz</i>	253
Why Is the Developed World Obese? <i>Sara Bleich, David Cutler, Christopher Murray, and Alyce Adams</i>	273
Global Calorie Counting: A Fitting Exercise for Obese Societies <i>Shiriki K. Kumanyika</i>	297
The Health and Cost Benefits of Work Site Health-Promotion Programs <i>Ron Z. Goetzel and Ronald J. Ozminkowski</i>	303
The Value and Challenges of Participatory Research: Strengthening Its Practice <i>Margaret Cargo and Shawna L. Mercer</i>	325
A Critical Review of Theory in Breast Cancer Screening Promotion across Cultures <i>Rena J. Pasick and Nancy J. Burke</i>	351
The Effectiveness of Mass Communication to Change Public Behavior <i>Lorien C. Abrams and Edward W. Maibach</i>	219
U.S. Disparities in Health: Descriptions, Causes, and Mechanisms <i>Nancy E. Adler and David H. Rebkopf</i>	235
Health Services	
A Critical Review of Theory in Breast Cancer Screening Promotion across Cultures <i>Rena J. Pasick and Nancy J. Burke</i>	351
Nursing Home Safety: Current Issues and Barriers to Improvement <i>Andrea Gruneir and Vincent Mor</i>	369

Public Health Services and Cost-Effectiveness Analysis <i>H. David Banta and G. Ardine de Wit</i>	383
The Impact of Health Insurance on Health <i>Helen Levy and David Meltzer</i>	399
The Role of Health Care Systems in Increased Tobacco Cessation <i>Susan J. Curry, Paula A. Keller, C. Tracy Orleans, and Michael C. Fiore</i>	411

Indexes

Cumulative Index of Contributing Authors, Volumes 20–29	429
Cumulative Index of Chapter Titles, Volumes 20–29	434

Errata

An online log of corrections to *Annual Review of Public Health* articles may be found at <http://publhealth.annualreviews.org/>