

The Physician's Response to Climate Change

Mona Sarfaty, MD; Safiya Abouzaid, PharmD

Climate change will have an effect on the health and well-being of the populations cared for by practicing physicians. The anticipated medical effects include heat- and cold-related deaths, cardiovascular illnesses, injuries and mental harms from extreme weather events, respiratory illnesses caused by poor air quality, infectious diseases that emanate from contaminated food, water, or spread of disease vectors, the injuries caused by natural disasters, and the mental harm associated with social disruption. Within several years, such medical problems are likely to reach the doorsteps of many physicians. In the face of this reality, physicians should assume their traditional roles as medical professionals, health educators, and community leaders. Clinicians provide individual health services to patients, some of whom will be especially vulnerable to the emerging health consequences of global warming. Physicians also work in academic medical institutions and hospitals that educate and provide continuing medical education to students, residents, and practitioners. The institutions also produce a measurable carbon footprint. Societies of physicians at national, state, and local levels can choose to use their well-developed avenues of communication to raise awareness of the key issues that are raised by climate change as well as other environmental concerns that have profound implications for human health and well-being.

(Fam Med 2009;41(5):358-63.)

The long-term implications of climate change for the health of the American public are substantial enough to cause physicians to be concerned both as health professionals and as private citizens. Yet, active participation by medical practitioners in preparing for the challenge of climate change, which has implications for health and mental health, has been limited. While the public health community, represented by the American Public Health Association, focused its attention on climate and health during National Public Health Week

(NPHW) in April 2008, there has been no analogous activity in organized medicine. During NPHW, activities focused the attention of public health professionals on the public health consequences of and appropriate response to global warming.¹ It is time for physicians to consider their response as well.

With the release of the Fourth Assessment of the Intergovernmental Panel on Climate Change (IPCC) and the increasing certainty about the contribution of humans to the accumulation of carbon dioxide in the atmosphere, the medical literature devoted to the effects of climate change on health is beginning to increase.²⁻⁶ A few medical professional societies have expressed concern through the adoption of policy statements.^{7,8} But, an education process has barely surfaced at medical meetings.⁹⁻¹¹ Formal sessions on climate and health are

hard to find at continuing medical education events, yet education is needed so that physicians will be prepared to address the medical consequences of climate change as well as to support or even facilitate efforts to address the root causes of climate change.

The Physician's Role

There is more than one framework or context from which physicians may reflect about their role in addressing climate change. The health effects of climate change are one such context as reflected in clinical medicine. Climate change and related environmental phenomena are already causing patients in certain regions, certain ages, or with certain medical conditions to seek clinical care. Other contexts include the workplace to reduce carbon emissions, the realm of communications to educate pa-

From the Department of Health Policy (Drs Sarfaty and Abouzaid) and Department of Family and Community Medicine (Dr Sarfaty), Thomas Jefferson University.

tients and the public, and the sphere of surveillance to identify conditions associated with or caused by climate change. The public policy arena is also a context in which physicians can become involved.

The Health Effects of Climate Change

Heat Waves and Increased Death Rates

The existing and anticipated health effects of climate change on the health of Americans have been described.¹²⁻¹⁵ Heat waves, defined as stagnant warm air masses and consecutive nights with high minimum temperatures, are projected to increase both in magnitude and duration in areas of the United States and Canada where they already occur.² Extensive literature reviews conclude that these increases in temperature will result in higher weather-related morbidity and mortality, largely through deaths from cardiac and respiratory events. Though the vulnerability of populations will vary depending on geographic location and socioeconomic status,^{5,16-18} For example, it is estimated that during the extreme heat of summer 2003, 70,000 excess deaths occurred in Europe.¹⁷ Predictive modeling studies have estimated that future summer heat-related mortality will increase several-fold in the United States by 2050. Assuming physiological and infrastructural adaptation, the excess deaths are estimated to be 500–1,000 for New York City and 100–250 for Detroit. These numbers could be much higher without infrastructure adaptation.¹⁸

Higher Temperatures and Respiratory Disease

High temperatures raise the levels of ground-level ozone and other air pollutants, especially in areas where the air quality is already poor.¹⁷ Ozone is generated by the action of light on chemicals, mainly nitrogen oxides and volatile organic compounds. While ozone

levels do not always increase with rising temperature, an increase in temperature generally accelerates the rate of photochemical reactions, and scientists have found a strong correlation between warmer days and ozone levels.^{19, 20}

Ground-level air that contains high levels of ozone contributes to morbidity and mortality in individuals who suffer from asthma and chronic pulmonary disease.^{21,22} Indeed, a number of studies have evaluated the effects of air quality on the number of asthma-related emergency visits in the United States, concluding that there is a strong correlation between acute care visits and ozone levels.²³⁻²⁵ This association was found to be strongest in 5–12 year olds.^{23,24} Increases in average temperatures can also result in prolonged blooming and growing seasons that begin earlier in the year and remain longer, increasing exposure to plant allergens and intensifying allergy problems in some areas.^{2, 26}

Extreme Weather Events

While one cannot say that a specific drought, flood, or hurricane is “caused” by climate change, the number of extreme weather events is expected to rise.¹⁸ Compared to the 1960s, reports of natural catastrophes have more than tripled in the last 10 years.¹⁷ While better reporting systems contribute to this increase, it is thought that climate change is also a factor.

According to a World Health Organization (WHO) report, the number of extreme events in developed nations was 563 versus 577 and affected 2.8 million versus 40.8 million individuals in the 1980s and 1990s, respectively.¹⁸ Extreme weather events can result in physical injuries.²⁷ Recent studies have also confirmed an increase in mental harm as manifested by a rise in post-traumatic stress disorder (PTSD) diagnoses following severe floods or hurricanes.^{16,27}

Water- and Food-borne Illness

Both temperature and water levels have an effect on water- and food-borne illnesses. Water levels that are too high or too low can influence the transport of infectious agents, while temperature can affect their growth.¹⁷ A rise in extreme precipitation events in the United States is expected to result in more run-off and increased loading of contaminants in waterways, resulting in a higher risk of waterborne illnesses.²⁷⁻²⁹ One study found that extreme precipitation events preceded 51% of waterborne disease outbreaks in the United States.²⁷

Climate change is also expected to increase rates of salmonella and other food-borne infections in developed nations.¹⁷ One epidemiologic study found a correlation between increased daily temperatures and reports of salmonellosis infections in five Australian cities.³⁰

Infectious Diseases

Infectious diseases transmitted by mosquitoes are strongly affected by rainfalls, temperatures, and humidity. For example, epidemics of Saint Louis encephalitis virus (SLEV), the most common cause of viral encephalitis in the United States, have been associated with warmer climates. While SLEV epidemics generally only occur in warmer southern regions, northern shifts of epidemics have been documented in warmer years.³¹

Similarly, proliferation of the West Nile Virus (WNV) is thought to occur best during warm winters followed by hot dry summers.¹⁸ WNV first appeared in New York in 1999 and has since spread via a mosquito vector (with birds as an intermediate host) to almost every state in the Union. Some believe that weather conditions associated with climate change are contributing to the spread of WNV in the United States,³² though there is scientific disagreement on the fac-

tors influencing the spread of this disease.

Dengue fever is appearing in the United States in new more northern locations and larger numbers. Warmer climate, along with increased transport and mixing of virus serotype, may be increasing the risk.^{6,31} Finally, although it is unlikely that climate change will cause the malaria mosquito to be re-established in the United States and Europe,³³ there is ample evidence that global risks of malaria epidemics are associated with rainfalls and higher temperatures.³¹

Evidence also exists for associations between climate change and infectious diseases transmitted by vectors other than mosquitoes. For example, ticks are highly sensitive to climate change, and the northern migration of ticks carrying Lyme disease has resulted in outbreaks of Lyme disease encephalitis in Sweden following warm winters.³¹ Studies in the United States concluded that climate change could also result in conditions that increase tick populations and the incidence of Lyme disease.^{16,34}

Hantavirus may be another example. Hantavirus, a disease spread by rodent vectors, appeared for the first time in the Southwest United States in conjunction with unusual climactic conditions. However, further understanding of the vector population dynamics needs to be reached before making final conclusions regarding the effect of climate change on the incidence of this illness.¹⁶

Regional Variation

Because local climate conditions vary, vulnerability to the effects of climate change will be different in different locales.³⁵⁻³⁷ Drought conditions in the Southwest and Southeast create different challenges than in areas where annual rainfall is increasing. The effects of the "urban heat island" create different challenges than those faced in rural areas, where dependence

on well water may cause residents to be vulnerable to ground water contamination in conditions of flood or ubiquitous rain.¹⁰

Climate Change and Clinical Medicine

The elderly people who work outdoors, and those without air conditioning require advice about protection from heat exposure and may need referrals to community resources.^{38,39} Children and adults with asthma or chronic lung disease will need advice about how to protect their health when air quality deteriorates and ozone levels increase because of heat and traffic congestion.^{40,41}

Many clinicians already counsel their patients on use of protective clothing in areas where Lyme Disease and Rocky Mountain Spotted Fever are threats stemming from tick infestation or counsel their patients regarding use of DEET repellants in areas where mosquitoes carry West Nile Virus, Dengue Fever, and other diseases. A certain amount of travel medicine is already practiced by many physicians who turn to the Centers for Disease Control and Prevention (CDC) resources to inform their patients prior to departure. Information about local climate-related medical problems is available on the Web site of the Environmental Protection Agency and can be used to help patients prevent illness in themselves and their families.

Climate Change and the Workplace

The "carbon footprint" of all workplaces in America can be reduced. Three quarters of all energy use, which produces that carbon footprint, is accounted for by buildings. As business owners and inhabitants of office complexes and hospitals, physicians could take interest in their energy use that represents a part of that carbon footprint.⁴² Indeed, a 25%–40% reduction in energy use nationwide

could be achieved merely by using readily available means of energy efficiency.⁴³ Decreased energy use means decreased carbon emissions.

Energy-efficient Offices

Each physician and medical practice can achieve a 5%–10% reduction in work-related energy use by taking simple steps.⁴⁴ Switching to fluorescent lighting, use of energy star appliances, using motion detector light switches that switch off in the absence of motion, turning off lights and non-essential electronic devices when not in use, buying newer more energy-efficient appliances, and use of timed thermostats are all simple steps that when taken together achieve noticeable reductions in energy use and reduce carbon emissions.⁴⁵⁻⁴⁷

This can all be done both in small medical practices and in larger institutions as well; the larger the institution, the greater the potential for energy savings. One Philadelphia academic medical center with a large family medicine training program held its energy use constant during a period of substantial building expansion.⁴⁸ This resulted in substantial monetary savings.

Recycling

Recycling has been one of the key objectives of environmental policy for decades. "Reduce, reuse, recycle" is an oft-repeated slogan of the environmental movement. What does it mean in the context of a typical medical practice? Recycling can be approached from two sides—from the point of view of purchasing and from the point of view of disposal.

Practitioners can support recycling by purchasing recycled paper products and recycling their own materials. Available for purchase are recycled paper towels, toilet paper, file folders, notebooks, and exam table covers in addition to recycled copy machine paper. These purchases promote recycling

by expanding the market for these products.

Some regions have well-developed systems for recycling paper, including magazines, file folders, and cardboard. Where proper handling of confidential records is a concern, private recycling vendors are available to address this issue. Some vendors recycle computers, which reduces dumping of dangerous chemicals on third-world countries that are the recipients of computer detritus.⁴⁹

Of course, it is possible to go even further out of concern about environmental hazards. In his recently opened office, one conscientious physician assured that the cabinets contained no formaldehyde, and the paint on the walls was free of volatile organic compounds. Ceiling tiles, lighting fixtures, carpeting, and waiting room furniture were selected to minimize their environmental effects. Instead of environmentally harsh disinfectants, he asked cleaning staff to use environmentally friendly, less toxic cleaners on glass, floors, and bathrooms. He also advocates use of mercury-free thermometers and blood pressure cuffs since this mercury is spread easily through incineration processes and ultimately may pollute waterways leading to diminished fish supplies and/or damage to human health.⁴⁴

Some institutions have a head start at the institutional level. More than 150 hospitals have joined the Environmental Leadership Council, which means that they have integrated sustainable environmental programs into their core missions. These are recycling more than 25% of their waste, using safer materials, and making choices that have less negative impact on the environment. When the objective is to make beneficial change at the institutional level, organizations such as Health Care Without Harm are contributing by holding "Clean Med" conferences across the country to demonstrate

the potential for attaining meaningful improvements in efficiency and waste reduction.

Hospitals and health care practices can be part of the "2% Solution" to climate change, which was touted in January 2008 in a nationwide Webcast to 1,700 college campuses across the country. This approach is to establish the target of reducing the national carbon footprint by 2% per year to achieve an 80% reduction in the national carbon footprint in 40 years.⁵⁰ Every business, building, and institution can play an active role in achieving that goal. To the extent that physicians are business owners, this is within their purview. To the extent that physicians are influential actors in medical institutions, their inquiries and their interest can initiate or speed the process of seeking compliance with such goals.⁵¹

Communication About Climate Change

Physicians are often seen as trusted communicators in our communities. Their opinions have credence and will help build public consensus that is needed at a time when politics have blurred truth from reality on this subject of pressing concern. Environmental magazines in the waiting room will convey a general message and specific information to patients as they wait for their appointments. Educational pamphlets from public health groups or environmental organizations that instruct patients about energy efficiency, recycling, and waste reduction, as well as means to protect themselves and their families from known environmental hazards, indicate the physician's endorsement of these efforts.

Physicians are connected to each other through professional societies at the local, statewide, and national levels. These connections provide avenues for consensus building. Physicians will benefit from a

chance to talk to their colleagues in formal and informal settings about their contribution to addressing this environmental challenge. Time should be allocated for such education and discussion sessions during planning meetings.

Polls are showing that Americans still think mostly about ice caps and polar bears when the topic of climate change comes up.⁵² While it is true that ice caps and polar bears are threatened, climate change is ultimately about all of us. It is about our lives and our communities and our future. Physicians should take a role in the national conversation.

Climate Change and Disease Surveillance

Surveillance for indicator conditions is a familiar role for physicians. Reports of infectious diseases such as rabies or tuberculosis are combined on a widespread basis with data from clinical laboratories to contribute to ongoing national surveillance and tracking, and the Food and Drug Administration asks physicians to report adverse medication reactions.

Similar in concept to the aforementioned surveillance activities, the CDC has an environmental health tracking system. The set of reportable conditions linked to climate change is not explicitly defined, but vector-borne, water-borne, and food-borne illnesses related to environmental conditions and precipitated by climate change warrant monitoring. In the near future, the CDC or state-level environmental health departments will have specific recommendations regarding surveillance for climate change-related illnesses, and physicians should be on the alert for these recommendations and participate in reporting.

Influencing Public Policy

Physicians have influence in halls of government at the local, state, and national levels. Through medical societies at the state, lo-

cal, and national levels, physicians could take an active interest in issues related to climate change.

Currently, however, medical organizations are minimally represented in these policy efforts. The solutions to climate change will have the potential not just to influence global warming—they will also help to ameliorate chronic medical conditions and risk factors for those conditions. Environmentalists refer to these policies as having “co-benefits.”⁵³ For example, establishing and using walking trails, bike trails, and tree canopies can reduce automobile exhaust and excessive heat, while simultaneous reducing inactivity and the concomitant problems of obesity, diabetes, and pollution-induced pulmonary problems.⁴⁷

Increased access to public transportation is another key issue in the public policy arena. Public transportation that is convenient to the places where people live and work encourages healthy physical activity, and it reduces the use of automobiles. Recycling and purchase of recycled products is another issue addressed at the public policy level. Building codes, zoning ordinances, and urban layouts are addressed through public policy via planning boards and zoning commissions. Physicians play varied and influential roles in many communities. Expressions of support for policies such as these are likely to be influential with individuals who hold sway in these other spheres.

Conclusions

It is time for physicians to take initiative and engage in discussion with their colleagues and their communities about the fact that climate change is about us and our future. Awareness is the cornerstone on which all the other actions rest. At a minimum, since physicians are purveyors of information to an extensive audience, they should have knowledge that will permit them to fulfill their role as trusted

communicators to their patients and their communities. As the effects of climate change on our country and the world become more apparent, the public will need guidance to help them understand, avoid, and minimize the potential health effects of the changing climate. They will need encouragement to make behavior changes that are necessary to mitigate the problem.

Leading by example is a time-respected approach. Medical society meetings, hospital staff meetings, and continuing medical education channels provide well-known effective channels for discussion, consensus development, and dissemination of useful information across the country. These avenues should be used without delay.

Corresponding Author: Address correspondence to Dr Sarfaty, 1015 Walnut Street, Curtis 115, Philadelphia, PA 19107. 215-955-2797. Fax: 215-923-7583. mona.sarfaty@jefferson.edu.

REFERENCES

- Climate change: our health in the balance. www.nphw.org/nphw08/default.htm. Accessed September 18, 2008.
- IPCC Fourth Assessment Report: Working Group II Report, “Impacts, adaptation and vulnerability.” www.ipcc.ch/ipccreports/ar4-wg2.htm. Accessed September 2, 2008.
- Patz JA, McGeehin MA, Bernard SM, et al. The potential health impacts of climate variability and change for the United States: Executive Summary of the Report of the Health Sector of the US National Assessment. *Environ Health Perspect* 2000;108(4):367-76.
- Ebi KL, Paulson JA. Climate change and children. *Pediatr Clin North Am* 2007;54(2):213,26, vii.
- Knowlton K, Lynn B, Goldberg RA, et al. Projecting heat-related mortality impacts under a changing climate in the New York City region. *Am J Public Health* 2007;97(11):2028-34.
- Morens DM, Fauci AS. Dengue and hemorrhagic fever: a potential threat to public health in the United States. *JAMA* 2008;299(2):214-6.
- American College of Preventive Medicine. www.acpm.org. [www.acpm.org/2007-047\(H\).html](http://www.acpm.org/2007-047(H).html). Accessed February 1, 2008.
- Shea KM, American Academy of Pediatrics Committee on Environmental Health. Global climate change and children’s health. *Pediatrics* 2007;120(5):e1359-67.
- APHA: Policy Statement Database. www.apha.org/advocacy/policy/policysearch/default.htm?id=1350. Accessed September 18, 2008.
- Frumkin H. Urban sprawl and public health. *Public Health Rep* 2002;117(3):201-17.
- Frumkin H, Hess J, Luber G, Malilay J, McGeehin M. Climate change: the public health response. *Am J Public Health* 2008;98(3):435-45.
- Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. [see comment]. *Nature* 2005;438(7066):310-7.
- Epstein PR. Climate change and human health. *N Engl J Med* 2005;353(14):1433-6.
- McMichael AJ, Woodruff RE, Hales S. Climate change and human health: present and future risks. [see comment] [erratum appears in *Lancet* 2006;368(9538):842]. *Lancet* 2006;367(9513):859-69.
- Haines A, Patz JA. Health effects of climate change. *JAMA* 2004;291(1):99-103.
- Ebi KL, Mills DM, Smith JB, Grambsch A. Climate change and human health impacts in the United States: an update on the results of the US national assessment. *Environ Health Perspect* 2006;114(9):1318-24.
- WHO. Protecting health from climate change: report for World Health Day 2008. www.who.int/global-change/publications/CC_Report_WHD2008/en/index.html. Accessed September 2, 2008.
- WHO. Climate change and human health—risks and responses. www.who.int/global-change/publications/cchbook/en/print.html. Accessed September 2, 2008.
- Earth observatory features: tango in the atmosphere: ozone and climate change. <http://earthobservatory.nasa.gov/Study/Tango/>. Accessed September 19, 2008.
- IPCC Fourth Assessment Report: Working Group I Report “The physical science basis.” www.ipcc.ch/ipccreports/ar4-syr.htm. Accessed September 2, 2008.
- Ault A. Report blames global warming for rising asthma. *Lancet* 2004;363(9420):1532.
- WHO. Climate change and human health: impact and adaptation. www.who.int/global-change/publications/en/index.jhtml. Accessed September 2, 2008.
- Babin SM, Burkom HS, Holtry RS, et al. Pediatric patient asthma-related emergency department visits and admissions in Washington, DC, from 2001–2004, and associations with air quality, socio-economic status, and age group. *Environ Health* 2007;6:9.
- Babin S, Burkom H, Holtry R, et al. Medicaid patient asthma-related acute care visits and their associations with ozone and particulates in Washington, DC, from 1994–2005. *Int J Environ Health Res* 2008;18(3):209-21.
- Tolbert PE, Mulholland JA, MacIntosh DL, et al. Air quality and pediatric emergency room visits for asthma in Atlanta, Georgia, USA. *Am J Epidemiol* 2000;151(8):798-810.
- Ziska LH, Gebhard DE, Frenz DA, Faulkner S, Singer BD, Straka JG. Cities as harbingers of climate change: common ragweed, urbanization, and public health. *J Allergy Clin Immunol* 2003;111(2):290-5.
- Curriero FC, Patz JA, Rose JB, Lele S. The association between extreme precipitation and waterborne disease outbreaks in the United States, 1948–1994. *Am J Public Health* 2001;91(8):1194-9.

28. Rose JB, Epstein PR, Lipp EK, Sherman BH, Bernard SM, Patz JA. Climate variability and change in the United States: potential impacts on water- and foodborne diseases caused by microbiologic agents. *Environ Health Perspect* 2001;109 Suppl 2:211-21.
29. Kistemann T, Classen T, Koch C, et al. Microbial load of drinking water reservoir tributaries during extreme rainfall and runoff. *Appl Environ Microbiol* 2002;68(5):2188-97.
30. D'Souza RM, Becker NG, Hall G, Moodie KB. Does ambient temperature affect foodborne disease? *Epidemiology* 2004;15(1):86-92.
31. TDR Publications. Globalization and infectious diseases: a review of the linkages. www.who.int/tdr/publications/publications/seb_topic3.htm. Accessed September 23, 2008.
32. Epstein PR. West Nile Virus and the climate. *J Urban Health* 2001;78(2):367-71.
33. WHO. Climate and health. www.who.int/mediacentre/factsheets/fs266/en/print.html. Accessed September 2, 2008.
34. Subak S. Effects of climate on variability in Lyme disease incidence in the Northeastern United States. *Am J Epidemiol* 2003;157(6):531-8.
35. Ebi KL, Kovats RS, Menne B. An approach for assessing human health vulnerability and public health interventions to adapt to climate change. *Environ Health Perspect* 2006;114(12):1930-4.
36. Epstein PR. Framework for an integrated assessment of health, climate change, and ecosystem vulnerability. *Ann N Y Acad Sci* 1994;740:423-35.
37. Imhoff JC, Kittle JL Jr, Gray MR, Johnson TE. Using the climate assessment tool (CAT) in US EPA BASINS integrated modeling system to assess watershed vulnerability to climate change. *Water Sci Technol* 2007;56(8):49-56.
38. Kalkstein LS. Saving lives during extreme weather in summer. *BMJ* 2000;321(7262):650-1.
39. Riedel D. Human health. In: Lemmen, Warren FJ, eds. *Climate change impacts and adaptation: a Canadian perspective*. Government of Canada, 2004.
40. Pengelly D, Cheng D, Campbell M. Differential and combined impacts of winter and summer weather and air pollution due to global warming on human mortality in South-Central Canada. Toronto: Toronto Public Health, 2005.
41. Bernard SM, Samet JM, Grambsch A, Ebi KL, Romieu I. The potential impacts of climate variability and change on air pollution-related health effects in the United States. *Environ Health Perspect* 2001;109 Suppl 2:199-209.
42. Hampton T. Hospitals and clinics go green for health of patients and environment. *JAMA* 2007;298(14):1625-9.
43. Nadel S, Shipley A, Eliot RN. The technical, economic, and achievable potential for energy efficiency in the US. A meta-analysis of recent studies. Proceedings of the American Council for an Energy Efficient Economy Summer Study of Efficiency in Buildings. American Council for an Energy-Efficient Economy, 2004.
44. ACP Internist. Improving your patient's health without hurting the planet. www.acpinternist.org/archives/2008/09/green.htm. Accessed October 14, 2008.
45. Read C, Stott R. Climate change—thinking widely, working locally, acting personally. *BMJ* 1997;315(7111):758-9.
46. Stott R, Godlee F. What should we do about climate change? Health professionals need to act now, collectively and individually. *BMJ* 2006;333(7576):983-4.
47. Wilkinson P, Smith KR, Beevers S, Tonne C, Oreszczyn T. Energy, energy efficiency, and the built environment. *Lancet* 2007;370(9593):1175-87.
48. National Public Health Week, April 9, 2008.
49. Basel Action Network (BAN). www.ban.org. Accessed October 14, 2008.
50. Focus the nation. www.focusthenation.org/. Accessed September 18, 2008.
51. Practice green health. <http://practicegreen-health.org>. Accessed October 14, 2008.
52. Lierowitz A. Yale School of Forestry and the environment. Meeting on communication climate change personal communication. George Mason University, January 8, 2008.
53. Balbus J. Urban heat islands: building cities differently to reduce heat stress. Presentation at the annual meeting of the American Public Health Association, November 2007.