A Human Health Perspective On Climate Change

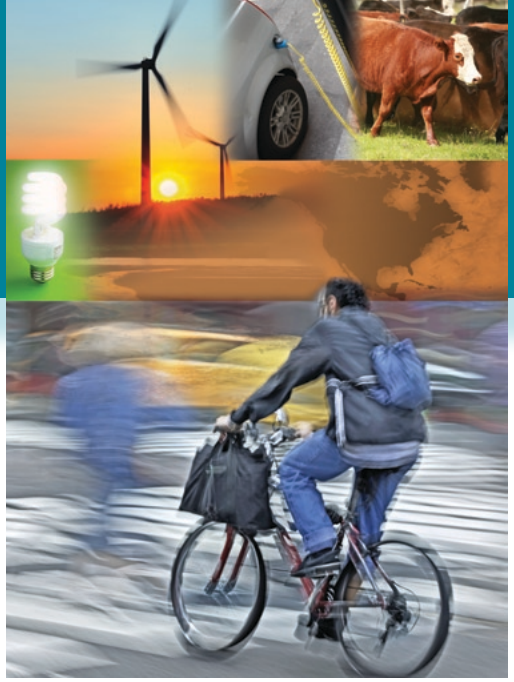
A Report Outlining the Research Needs on the Human Health Effects of Climate Change

In a world of myriad "what if" scenarios surrounding climate change, it becomes very complicated to create wise health policies for the future because of the uncertainty of predicting environmental change and human decisions. The need for sound science on which to base such policies becomes more critical than ever.

There is abundant evidence that human activities are altering the earth's climate and that climate change will have significant health impacts both domestically and globally. While all of the changes associated with this process are not predetermined, the actions we take today will certainly help to shape our environment in the decades to come. Some degree of climate change is unavoidable, and we must adapt to its associated health effects; however, aggressive mitigation actions can significantly blunt the worst of the expected exposures. Still, there will be effects on the health of people in the United States, some of which are already underway. As great as the domestic risks to U.S. public health are, the global risks are even greater.

Climate change and health issues transcend national borders, and climate change health impacts in other countries are likely to affect health in the United States as well. Famine, drought, extreme weather events, and regional conflicts—all likely consequences of climate change—are some of the factors that increase the incidence and severity of disease, as well as contributing to other adverse health impacts, making it imperative to address climate change-related decision making at local, regional, national, and global levels. The complicated interplay of these and other factors must be considered in determining the scope and focus of both basic and applied research on climate change and health.

A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change was developed by an ad hoc Interagency Working Group on Climate Change and Health (IWGCCH). The report identifies relevant federal research and science needs, including research on mitigation and adaptation strategies. These needs encompass basic and applied science, technological innovations and capacities, public health infrastructure, and communication and education. The report is organized around 11 human health categories likely to be affected by climate change. This approach highlights direct links between climate change and federal research priorities that are often disease- or outcome-specific, and enables a holistic approach to exploring climate change-related health impacts.



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Next Steps

Recently, the National Research Council issued a report addressing how federal research and science could be improved to provide support for decision and policy making on climate change and human health.[12] Specifically, the report calls for a more complete catalogue of climate change health impacts, increasing the power of prediction tools, enhancing integration of climate observation networks with health impact surveillance tools, and improving interactions among stakeholders and decision makers. The IWGCCH approached this research needs assessment with these goals in mind. The next step will be for federal agencies to discuss the findings of this white paper with stakeholders, decision makers, and the public as they work to incorporate and prioritize appropriate research needs into their respective science agendas and collaborative research efforts. A coordinated federal approach will bring the unique skills, capacities, and missions of the various agencies together to maximize the potential for discovery of new information and opportunities for success in providing key information to support responsive and effective decisions on climate change and health.

REFERENCES

1 Bytomski, Jr, et al., Curr Sports Med Rep, 2003. 2(6): p. 320-4.

2 National cancer institute. What is cancer?, 2009 [cited 2009 July 21]; available from: http://www.cancer.gov/ cancertopics/what-is-cancer.

3 american Heart association. cardiovascular disease statistics, 2006, 2009 [cited 2009 July 22]; available from: http://www.americanheart.org/presenter.jhtml?identifier=4478.

4 Mead, PS, et al., Emerg Infect Dis, 1999. 5(5): p. 607-25.

5 United Nations Department of economic and social affairs Population Division World Urbanization Prospects: The 2005 revision, PD United Nations Department of economic and social affairs, editor. 2006, United Nations Department of economic and social affairs, Population Division: Geneva.

6 Centers for Disease Control and Prevention, http://www.cdc.gov/ncbddd/bd/.

7 Kessler, RC, et al., Arch Gen Psychiatry, 2005. 62(6): p. 617-27.

8 Lefebvre, KA, et al., Toxicol Sci, 2009. 107(1): p. 65-77.

9 Orenstein, WA, et al., Health Aff (Millwood), 2005. 24(3): p. 599-610.

10 Mathers, C, et al. 2008, Geneva, Switzerland: World Health Organization. vii, 146 p. 43.

11 Burton, M, et al., Hurricane Katrina: Preliminary estimates of commercial and public sector damages. 2005, Center for Business and Economic Research, Marshall University: Huntington, WV.

12 National Research Council (U.S.). Committee on Strategic Advice on the U.S. Climate Change Science Program., et al. 2009, Washington, D.C.: National Academies Press. xii, 254 p.

Human Health Consequences

1 Asthma, Respiratory Allergies, and Airway Diseases

Respiratory allergies and diseases may become more prevalent because of increased human exposure to pollen (due to altered growing seasons), molds (from extreme or more frequent precipitation), air pollution and aerosolized marine toxins (due to increased temperature, coastal runoff, and humidity) and dust (from droughts). Mitigation and adaptation may

significantly reduce these risks. Research should address the relationship between climate change and the composition of air pollutant mixtures to produce models to identify populations at risk.

Allergic diseases impact approximately 50 million individuals within the United States, and are associated with significant health care costs and lost productivity.[1]

2 Cancer

Many potential direct effects of climate change on cancer risk, such as increased duration and intensity of ultraviolet (UV) radiation, are well understood; however the potential impact of changes in climate on exposure pathways for chemicals and toxins requires further study. Science should investigate the effects of mitigation and adaptation measures on cancer incidence so that the best strategies can be developed and implemented; for example, research to inform understanding of the benefits of alternative fuels, new battery and voltaic cells, and other technologies, as well as any potential adverse risks from exposure to their components and wastes. Better understanding of climate change impacts on the capacity of ocean and coastal systems to provide cancer curative agents and other health-enhancing products is also needed.

Cancer is the second leading cause of death in the United States, killing more than half a million people every year.[2]

3 Cardiovascular Disease and Stroke

Cardiovascular disease is the leading cause of death in the United States. Climate change may exacerbate existing cardiovascular disease by increasing heat stress, increasing the body burden of airborne particulates, and changing the distribution of zoonotic vectors that cause infectious diseases linked with cardiovascular disease. Science that addresses the effects of higher temperatures, heat waves, extreme weather, and changes in air quality on cardiovascular health is needed. This new information should be applied to development of health risk assessment models, early warning systems, health communication strategies targeting vulnerable populations, land use decisions, and strategies to meet air quality goals related to climate change. Some cardiovascular and stroke risks from climate change could be offset by reductions in air pollution by climate change mitigation.

Approximately 80 million Americans have some form of cardiovascular disease including hypertension, coronary artery disease, heart attack, or stroke.[3]

4 Foodborne Diseases and Nutrition

Climate change may be associated with staple food shortages, malnutrition, and food contamination (of seafood from chemical contaminants, biotoxins, and pathogenic microbes, and of crops by pesticides). Research needs in this area include better understanding of how changes in agriculture and fisheries may affect food availability and nutrition, better monitoring for disease-causing agents, and identifying and mapping of complex food webs and sentinel species that may be vulnerable to climate change. This research could be used to prepare the public health

and health care sectors for new illnesses, changing surveillance needs, and increased incidence of disease, as well as to develop more effective outreach to affected communities.

It is estimated that there are 38 million cases of foodborne illness in the United States each year, resulting in over 180,000 hospitalizations and 2,700 deaths.[4]

5 Heat-Related Morbidity and Mortality

The health outcomes of prolonged heat exposure include heat exhaustion, heat cramps, heat stroke,

and death. Extreme heat events cause more deaths annually in the United States than all other extreme weather events combined. Heat-related illness and deaths are likely to increase in response to climate change, but aggressive public health interventions such as heat wave response plans and heat early warning systems can minimize morbidity and mortality. Additional science should focus on developing these tools by defining environmental risk factors, identifying vulnerable populations, and developing effective risk communication and prevention strategies, and expanding their use in different geographic regions.

It is estimated that 60% of the global population will live in cities by 2030, greatly increasing the total human population exposed to extreme heat.[5]

6 Human Developmental Effects

Potential consequences of climate change that would affect normal human development include: malnutrition, particularly during the prenatal period and early childhood as a result of decreased food supplies, and exposure to toxic contaminants; and biotoxins resulting from extreme weather events, increased pesticide use for food production, and increases in harmful algal

blooms in recreational areas. Research should examine effects on human development of adaptations to climate change such as agriculture and fisheries changes that may affect food availability, increased pesticide use to control for expanding disease vector ranges, and prevention of leaching from toxic waste sites into floodwaters during extreme weather events.

About 3% of all children born in the United States have a birth defect, some of which can be attributed to environmental causes.[6]

# of Climate Change

7 Mental Health and Stress-Related Disorders

By causing or contributing to extreme weather events, climate change may result in geographic displacement of populations, damage to property, loss of loved ones, and chronic stress—all of which can negatively affect mental health, particularly in vulnerable communities already experiencing social, economic, and environmental disruption. Research needs include and understanding how psychological stress acts synergistically with other forms of environmental exposures to cause adverse mental health effects and identifying vulnerable populations, identifying and incorporating key mental health outcomes in health impact assessments under a range of climate change scenarios, and developing migration monitoring networks to help ensure the availability of appropriate health care support.

An estimated 26.2% of Americans over the age of 18 suffer from a diagnosable mental health disorder in a given year.[7]

8 Neurological Diseases and Disorders

The United States has seen an increasing trend in the prevalence of neurological diseases and

deficits such as Alzheimer Disease, Parkinson Disease, and learning disabilities in children. Climate change, as well as attempts to mitigate and adapt to it, may further increase the number of neurological diseases and disorders. Research in this area should focus on identifying vulnerable populations and understanding the mechanisms and effects of human exposure to neurological hazards such as biotoxins (from harmful algal blooms), metals (found in new battery technologies and compact fluorescent lights), and pesticides (used in response to changes in agriculture), as well as the potentially exacerbating effects of malnutrition and stress.

Even a single low-level exposure to algal toxins can result in physiological changes indicative of neurodegeneration.[8]

9 Vectorborne and Zoonotic Diseases

Risk of infectious diseases such as malaria, hantavirus pulmonary syndrome, rabies, and Lyme disease may increase as a result of climate change due to expansions in vector ranges, shortening of pathogen incubation periods, and disruption and relocation of large human populations. Research should enhance the existing pathogen/vector control infrastructure including vector and host identification; integrate human with terrestrial and aquatic animal health surveillance systems; incorporate ecological studies to provide better

predictive models; and improve risk communication and prevention strategies.

In the absence of technologies to treat or vaccinate against many VBZD, some experts believe, population-level mortality from certain disease outbreaks could reach as high as 20–50%.[9]

10 Waterborne Diseases

Increases in water temperature, precipitation frequency and severity, evaporation-transpiration rates, and changes in coastal ecosystem health could increase the incidence of water contamination with harmful pathogens and

chemicals, resulting in increased human exposure. Research should focus on understanding where changes in water flow will occur, how water will interact with sewage in surface and underground water supplies as well as drinking water distribution systems, what food sources may become contaminated, and how to better predict and prevent human exposure to waterborne and ocean-related pathogens and biotoxins.

WHO estimates that 4.8% of the global burden of disease and 3.7% of all environment-related death is due to diarrheal disease, largely from water contamination.[10]

11 Weather-Related Morbidity and Mortality

Increases in the incidence and intensity of extreme weather events such as hurricanes, floods, droughts, and wildfires may adversely affect people's health immediately during the event or later following the event. Research aimed at improving the capabilities of healthcare and emergency services to address disaster planning and management is needed to ensure that risks are understood and that optimal strategies are identified, communicated, and implemented.

Poor preparedness and response to Hurricane Katrina led to increased illness and death, as well as economic costs of recovery in excess of $150 billion.[11]

Crosscutting Issues

Crosscutting issues relevant to preventing or avoiding many of the potential health impacts of climate change include identifying susceptible, vulnerable, and displaced populations; enhancing public health and health care infrastructure; developing capacities and skills in modeling and prediction; and improving risk communication and public health education. Such research will lead to more effective early warning systems and greater public awareness of an individual's or community's health risk from climate change, which should translate into more successful mitigation and adaptation strategies.