

# Climate Change: Adverse Health Impacts and Roles of Health Professionals

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The fourth assessment report (2007) of the Intergovernmental Panel on Climate Change (IPCC) has confirmed the strong evidence of climate change, which represents one of the defining challenges of the 21<sup>st</sup> century. The anthropogenic accumulation of carbon dioxide and other greenhouse gas emissions in the atmosphere are responsible for these changes. In 2008, at the World Health Assembly, the World Health Organization (WHO) has urged the global community to engage more actively responding to climate change and the impending health risk, particularly in vulnerable geographic regions and in poorly resourced populations.<sup>1</sup> The world's poor are likely to be the most vulnerable to predicted climate changes due to; 1) absence of well-functioning socio-political and economic infrastructures and good governance that would facilitate adaptation to climate perturbations; and 2) inherent low capacity of the poor to adapt to changes in the biological and physical systems on which they depend for their basic livelihoods.

Risks of health on account of climate change, arise by complex direct and indirect pathways. The risks usually reflect changes in both average climate conditions and climate variability as well. The main risks are:

**Temperature-related morbidity and mortality:** The adverse health effects of rising temperature get worsen in situations where extreme heat is sustained over a longer period, as in heat waves. Usually people cannot acclimatize rapidly to

extreme heat, particularly when it occurs early in the season. The effects of heat waves are greater when there is associated high humidity and less night-time cooling. People living in temperate climates are more vulnerable for lack of adaptation capacity. Urban sprawls get hotter than suburban and rural areas, due to concrete, asphalt and high density of roofs, which retain heat and eventually creating the *heat island effect*. The very young, elderly people, those in ill health, and poor people are most likely to be affected by this effect.

**Extreme events:** There are reports of more extreme weather events such as storms, hurricanes, flooding, ice-storm and damaging public health infrastructure including contamination of food and water, injuries and illnesses. Sea temperature rise has led to rise of water vapor levels resulting in increase in peak wind-speed, rainfall and high intensity of hurricanes/tropical cyclones. Between 1992 and 2001, floods affected more than 1.2 billion people worldwide and caused almost 100 000 deaths. When Hurricane Katrina struck the southern US coast in 2005, it caused more than 1300 deaths—almost 45% of the victims were over 75 years old.<sup>2</sup> Rising spell of dry temperature often results in forest fires, as we have witnessed in western US and Canada, Australia, Spain and Russia. The extreme events cause loss of crops and grazing land, destroy shrubs and plants (used as fodder for livestock), reduce the quantity and quality of water resources, as well as fish species; lead to displacement of population

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(also termed as *climate refugees*), loss of habitat and livelihood and social unrest.<sup>3</sup> Displaced population, particularly women, encounter anxiety, depression and post-traumatic stress disorder (PTSD). In this regard, the developing countries are more vulnerable for lack of adaptive capacity and inequality.

**Low food production:** The fourth assessment report of the IPCC has indicated that climate change will have significant impact on crop production and water management systems in coming decades. According to the Food and Agriculture Organization (FAO), the daily and inter-annual variations in precipitation are most crucial for rainfed and runoff for irrigated production. In other words, the day-to-day abnormal variability of rainfall associated with weather is an important risk factor for most forms of agriculture. In fact, reduced soil moisture, crop damage and crop disease are all driven by erratic rainfall and associated humidity.<sup>4</sup> Crop, like rice, is particularly vulnerable to climate change. As rice is grown in vast low-lying deltas and coastal areas, sea-level rise will make it most vulnerable to climate change. Sea-level rise will also bring saline water further inland and expose more rice-growing areas to salty conditions. Yields of rice can be reduced when salinity is present in soil as the crop is only moderately tolerant of salt. Although rice can thrive in wet conditions, uncontrolled flooding (due to tropical storms) will likely hinder its production. Increases in both carbon dioxide levels and temperature will also affect rice production. The International Rice Research Institute (IRRI) suggests that a rise in night-time temperature by 1 °C may reduce rice yields by about 10%. Lastly, water shortages, irregular rainfall patterns, and related water stresses increase the intensity of some diseases of rice, such as brown spot and blast.<sup>5</sup>



Ice chunks from a glacier are now about to hit the waters of Yakutat bay.

**Water-borne diseases:** Global warming causes receding of glaciers in the major mountains and subsequently threatening to disrupt the flow of major rivers that provide a lifeline to over billions of people. For instance, accelerated melting of glaciers has great implications for both quality and quantity of water resources on which not only millions of mountain population in the greater Himalayan region, but billions others in downstream river basins in South and South-East Asia, including China are dependent.<sup>6</sup> Furthermore, extreme weather such as flood deteriorates the quality of scarce drinking water sources. Rising temperature will also enhance the survival of several pathogenic microorganisms in environment, particularly in the temperate areas, commonly known as low risk for water-borne diseases. Despite some uncertainties in quantitative estimation, several global studies have shown the relationship between temperature rise and increased prevalence of diarrhea.<sup>7</sup>

**Vector-borne diseases:** Nature and progress of vector-borne diseases are dependent on life cycle of the infectious

agent and the interactive effects of the entire ecosystem—physical environment, host animals, their predators, their habits and state of health of the people who inhabit the specific region. For example, increased temperature and precipitation could facilitate the emergence and persistence of *Anopheles* mosquitoes—vector for malaria. Mosquitoes ranges increase with increased temperature by invading the erstwhile temperate regions. Therefore, thorough knowledge of where malaria vectors especially occur and will potentially occur in the future under climate change scenarios is very essential.<sup>8</sup>

**Air pollution-related diseases:** Ground level or tropospheric ozone and particulate matter are the two main components of smog. Ozone is formed by complex chemical reactions in the air, from two primary pollutants, oxides of nitrogen ( $\text{NO}_x$ —products of fossil fuels combustion) and volatile organic compounds (naturally by vegetation and forests, and from transportation and solvent use). Smog formation is linked to climate change as this aero-chemical reaction is dependent on sunlight and temperature. Smog episodes, with elevated ozone levels, occur in summer time on warm, sunny days with the episodes usually extending over a number of days. Smog causes inflammation and oxidative damage to airways and initiates asthmatic episodes. People with existing asthma show an increased inflammatory response and are more sensitive to various allergens following exposure to ozone. There is some evidence that increases in temperature will lead to higher levels of particulate matter due to drying of soil and forest fire (evidenced in Indonesia). As carbon dioxide levels increase, and the plants growing season becomes longer (earlier flowering leading to longer pollen and spore season), levels of aero-allergens may increase, possibly leading to an increase in both allergic rhinitis and asthma.

Even if most stringent measure is taken to curb greenhouse emission, it would take several decades to undo the damage caused to our planet earth. Therefore, more realistic measures would be to plan for adaptation, *i.e.*, making changes to avoid the worst, or to prepare for the unavoidable health impacts of climate change. We have to focus on the public health adaptation responses, although many of the adaptive strategies lie in other spheres such as policy development, infrastructure, resource management, *etc.* Unfortunately, in spite of growing awareness among the people around the world, physicians and the health care sector in general have been relatively inactive on this issue that has major impacts on the health of the people they serve and in the communities in which they practice.

Physicians and other health professionals can play significant roles to promote adaptive strategies. The suggested broad roles are:

**Improvement of public health systems:** This includes strengthening primary health care, preventive program (*e.g.*, vaccination, vector control, nutrition supplementation, food hygiene, water and sanitation), special attention towards the vulnerable communities and regions, encourage community participation in grass root planning, emergency preparedness and mitigation (for extreme climate conditions), surveillance of disease and its key risk factors (*e.g.*, vectors, microbes, smog, particulate matters, *etc.*), capacity to forecast future health risks from projected climate change, and human resource development (*e.g.*, workforce training and in-career development).

**Advocacy:** This includes participating actively at international, regional and national level bodies involved in policy implementation, partnerships with diverse stakeholders (such as urban planning, agriculture, meteorology, environment and

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forestry, information and broadcasting, etc), development of national/regional level special health workforce for disaster management, and public awareness.

**Research and education:** We should motivate health researchers to engage in climate change-related research, enhance funding/fellowships and define career goal to attract young researchers, incorporate climate change in regular medical and nursing curricula and school health program.<sup>1,2,9</sup> We have to remember that the climate change is unlikely to cause entirely new diseases (except emergence of new strains of microbes); however, it will alter the incidence, range, and seasonality of many existing health disorders. Climate change will also exacerbate inequities between rich and poor as it will have disproportionate impact on the world's poorest nations; ironically, those who have contributed least to its cause.<sup>10</sup> Therefore, capacity of existing public health systems should be enhanced to provide an appropriate starting point for adaptive strategies to lessen adverse health effects.

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