Climate Change and Emerging Diseases*

Somchai Bovornkitti†

greenhouse gases ⟶ global warming /
climate change ⟶ health impacts

A number of definitions must be furnished in consideration of the designated topic *"Health and Emerging Diseases,"* which is considered under the theme of the Conference *"Climate Change and Physical Impact on Thailand."*

Global warming and climate change[1] are words with exact literal implications. However, their meanings are different in that global warming refers to the phenomenon of increased average near surface air and ocean temperatures of the Earth since the mid-20th century and their projected continuation, whereas the term climate change encompasses – beyond withering weather – changes in regional characteristics, including temperature, humidity, rainfall, wind, and severe weather events.

An ***emerging disease***[2] is one that has appeared in a population for the first time or that may have existed previously but is rapidly increasing in incidence or geographic range. This would cover a wide array of conditions, infectious and non-infectious, but frequently focuses on infectious disease.

An ***emerging infectious disease (EID)***[3] is an infectious disease, the incidence of which has increased in the past 20 years and threatens to increase in the near future. EIDs include diseases caused by a newly identified microorganism or newly identified strain of a known microorganism (e.g. SARS, AIDS); new infections resulting from changes in or evolution of an existing organism (e.g. influenza); a known infection which spreads to a new geographic area or population (e.g. West Nile virus); newly recognized infection in an area undergoing ecologic transformation (e.g. Lyme disease); and pre-existing and recognized infections re-emerging due to the drug resistance of their agent or to a breakdown in public health (e.g. tuberculosis). Also of growing concern is adverse synergistic interaction among emerging diseases, as humankind interacts with other infectious and non-infectious conditions that lead to the development of novel "syndemics."

Speculation on the potential impact of climate change on human health frequently focuses on emerg-

**Invited paper presented at a scientific forum on "Prediction of Physical Impact on Thailand's Climate Change", held by the S & T Postgraduate Education and Research Development Office, the Higher Education Commission's at the Siam City Hotel, Bangkok, September 8, 2010.*

†The Academy of Science, the Royal Institute, Bangkok, Thailand

ing vector-borne diseases, such as West Nile disease and malaria.

Other examples of emerging infectious diseases[4] include the following:

- Ebola virus (first outbreaks occurred in 1976; the causative virus was identified in 1977);

- HIV (the human immunodeficiency virus that causes AIDS was first isolated in 1983);

- Hepatitis C (first identified in 1989, now known to be the most common cause of post-transfusion hepatitis worldwide);

- Influenza A (H5N1) virus (a well-known pathogen in birds but first isolated in humans in 1997);

- *Legionella pneumophila* (the first outbreak occurred in 1976, which gave it its name Legionnaires' Disease; since then it has been associated with similar outbreaks linked to poorly maintained air-conditioning systems);

- *Escherichia coli* O157:H7 (first detected in 1982). *E.Coli* is often transmitted through contaminated food; it has caused outbreaks of hemolytic uremic syndrome);

- *Borrelia burgdorferi* (first detected in 1982 and identified as the cause of Lyme disease);

- The new variant of Creutzfeldt-Jakob disease (first described in 1996, the agent is considered to be the same as that causing bovine spongiform encephalitis).

Climate Change, and Health and Emerging Diseases[5-12]

For the sake of simplicity, the terms "greenhouse effect," "global warming" and "climate change" will be considered as referring to the same environmental problem, and causing significant impacts in every country on the planet, such as increasingly frequent climate-related catastrophes, including droughts, floods, storm surges, heat waves, and wildfires. Nevertheless, the extent and nature of climate change impacts on human health vary by region, by the relative vulnerability of population groups (according to their genetic makeup, nutritional status, emotional well-being, age, sex, and economic status), by the extent and duration of exposure to climate change itself, and by the ability of a society to adapt to or cope with the change.

Factors related to climate change that influence human health may be categorized as direct temperature effects, extreme events, climate-sensitive diseases, and air quality, among other health linkages.

Direct temperature effects

Rising average global temperatures are predicted to increase the incidence of heat waves and hot extremes. Particular segments of the population, such as those with heart problems, asthma, chronic obstructive pulmonary disease, the elderly, the very young, and the homeless, can be especially vulnerable to extreme heat, suffering heat stroke for example.

Extreme events

Extreme events endanger human health and well-being. An increase in the frequency of extreme events, such as earthquakes, storm surges, and floods,[13] may result in more deaths, injuries, infectious diseases, and stress-related disorders.[14]

Climate-sensitive diseases

The potential impact of climate change on human health frequently focuses on the increased risk of some "vector-borne" diseases, including malaria, dengue fever, yellow fever, and encephalitis. Because the mosquitoes that carry such diseases do not thrive in cooler climes, a link between the rise in incidence of these diseases and climate change is suggested.

Malaria,[10-12] the most important parasitic disease in humans, is caused by five species of Plasmodium, namely, *P. falciparum, P. malariae, P. vivax, P. ovale,* and *P. knowlesi*.

Owing to the fact that, within the range of survivable temperatures, warmer temperatures reduce the duration of the "sporogonic" or "extrinsic" cycle of malaria parasites (the time when they multiply inside the mosquito), higher temperatures should result in higher rates of malaria transmission. In other words, as temperatures increase, the number of days required to complete that cycle decreases, enabling increased frequency of blood meals and egg-laying by the mosquito. Therefore, increases in rainfall, temperature and humidity will also favor the spread of malaria-transmitting mosquitoes over a wider range and to higher altitudes. Mathematical model estimations also suggest that malaria will worsen and its range will spread as the Earth gets warmer and more deaths will be attributable to malaria. These facts may also apply to other insect-transmitting infections, including dengue hemorrhagic fever.

Paradoxically, however, a recent study on global malaria by Peter Gething and his collegues[15] provided findings that, during the past 100 years, the protective effects of socioeconomic development and disease control have been significantly greater than the transmission-enhancing effects of increasing temperatures. Hence, the obsessive emphasis on "climate change" as a dominant parameter of the prevalence and incidence of malaria is indefensible. It remains necessary for effective control campaigns to be carried out, and for creative and organized searches for new strategies to be conducted. In recent years massive control efforts have been implemented and these have had varying degrees of success; such preventive measures are applicable for all infectious diseases, particularly for those that affect populations in underdeveloped, poor countries such as may be found in parts of Africa.

Legionellosis[16-18] is a serious and sometimes fatal form of pneumonia; Pontiac fever is a milder non-pneumonic form. It is caused mostly by inhaling an aerosol containing the Gram-negative bacterium *Legionella pneumophila* and on occasion other species. The causative agents, legionellae, live in water and colonize hot water systems at ideal temperatures between 35° and 46°C (growth range 20-50°C); they are found in aquatic environments worldwide, but also in artificial water systems which sometimes provide environments conducive to their growth. These bacteria survive as parasites of free-living protozoa and within biofilms which develop in water systems.

Legionella, being a thermophilic organism, may be expected to thrive in a situation characterized by global warming. Warmer temperatures would facilitate a wider range of bacterial sources in natural hot springs, ponds, streams, canals, and possibly heighten the infectivity of the public water supply, as well as domestic water distribution systems, e.g. cooling towers, swimming pools, and similar disseminators, including garden sprinklers and public fountains.

Melioidosis[19] is an infectious disease in humans; it is caused by the motile Gram-negative bacillus *Burkholderia pseudomallei*, which is found in muddy soil. Human infections are mostly acquired by contamination of surface wounds or other skin lesions, by aspiration or ingestion of muddy water, or by inhalation of dust. It is a sporadic disease of warm climates, mostly confined to latitudes within 20° of the Equator, principally in Southeast Asia.

Increased rainfall as a result of climate change and a prolonged wet season may result in extension of the disease-transmission period, with more cases occurring as a consequence.

Also, algal blooms, which flourish as tempera-

tures warm, particularly in areas with polluted water, may enhance the incidence of certain diseases such as ***cholera***.

Tetrodotoxinosis and saxitoxinosis[20,21]

Consumption of *tetrodotoxin* contained in pufferfish and horseshoe crab, among other marine life, results in one of the most violent forms of intoxication and death caused by marine species. However, the toxin seems not to be synthesized by the animals themselves, but by symbiotic bacteria which are ingested, thereby making available the toxin through the food chain. These toxin-bearing organisms include starfish, gastropods, crustaceans, flatworms, and ribbon worms.

A less powerful biotoxin called *saxitoxin* causes paralytic shellfish poisoning. The toxin is usually ingested by consumption of shellfish contaminated by toxic algal blooms, but it can also be found in pufferfish.

Radon gas and lung cancer[22] The natural soil gas, radon, is an indoor contaminant claimed to be a potential cause of lung cancer. Although the matter remains controversial, the association between the two has been advocated strongly by international authorities and in reports from international as well as local researchers. The claim is that indoor radon is another important cause of lung cancer, second only to cigarette smoking.

Increased surface temperatures caused by global warming may increase the release of radon from underground sources into the ambient atmosphere,[23] resulting in increased incidence of lung cancer.

Postscripts

Basically prevalence of some diseases and other threats to human health depend largely on the local climate and socioeconomic status of communities. Climate-related catastrophes which are hazardous to the environment and lives, have a minimal impact on developed countries in terms of survival and redevelopment. Likewise, climate-induced increases in infectious diseases are particularly burdensome only to citizens in underdeveloped and certain developing countries where the exercise of disease control and sanitation is inappropriate.

References

1. Bovornkitti S. Global warming vs. climate change. J Hlth Syst Res 2009;3:320-2.
2. WHO 2010: available from: http://www.who.int/topics/emerging diseases/en/... 8/28/2010
3. Emerging infectious disease - Wikipedia, the free encyclopedia. Available from: http://en.wikipedia.org/wiki/Emerging_infectious_disease... 8/28/2010
4. Emerging infectious disease definition. Available from: http://www.medterms.com/script/main/art.asp?articlekey=22801...8/28/2010
5. Pushpakom R, Bovornkitti S. Global warming and illnesses. Siriraj Hosp Gaz 1996;48:202-3.
6. Sirirajpiriya O, Menasveta P, Bovornkitti S. Global warming and health problems. J Roy Inst Thai 2007;32:828-38.
7. Hengpraprom S. Global warming and infectious diseases. J Hlth Syst Res 2009;3:363-9.
8. Crisis or opportunity: climate change and Thailand. Available from: http://www.greenpeace.org/international/en/publications/reports/crisis-or-opport... 7/28/2010
9. Climate change - health and environmental effects. Available from: http://74.6.116.140/search/srpcache?ei=UTF-8&p=climate+and+health&fr=slv8... 8/24/2010
10. New study on malaria and climate change. Available from: http://climatehealth.wordpress.com/... 8/25/2010
11. Thongrungkiat S, Kaewviset S, Bovornkitti S. Global warming and malaria. J Hlth Syst Res 2009;3:506-9.
12. Bovornkitti S. Global warming and malaria update. J Hlth Syst Res 2010;4:164-5.
13. Bovornkitti S, Uksornkaew S, Menasaveta P, Yoksan S, Saipet N, Witayarat P, et al. Natural disasters. J Hlth Sci 2004;13:901-10.

14. Kongsakon R. Post traumatic stress disorder PTSD. 1st.ed. Bangkok: Sahaprachapanich Press; 2005.124 pages. (See also Samanwongthai U, Kulkantarakorn K, Bovornkitti S. Post-traumatic stress disorder. Thammasat Med J 2006;6:267-72).
15. Gething PW, Smith DL, Patil AP, Tatem AJ, Snow RW, Hay SI. Climatic change and the global malaria recession. Nature 2010; 465:342-5.
16. Bovornkitti S, Legillonellosis. Thammasat Med J 2009;9:436-41.
17. Legionellosis. Available from: http://www.who.int/mediacentre/factsheets/fr285/en/index.html... 8/29/2010.
18. Legionella. Available from: http://en.wikipedia.org/wiki/Legionella... 8/29/2010.
19. Leelatasmee A, Bovornkitti S. Melioidosis: review and update. Rev Infect Dis 1989;2:413-25.
20. Techarak V, Bovornkitti S. Horseshoe crab. Srisangwan Hosp J 2004-5;13-14:6.
21. Bovornkitti S, Menasveta P. Pufferfish poisoning. Thammasat Med J 2007;7:305.
22. Bovornkitti S. Radon gas in Thailand. Thammassat Med J 2008;8:249-52.
23. Wanapongse P, Harnwongse T, Sriratanabal A, Tokonami S, Bovornkitti S. Seasonal variation of ambient radon levels: a study in Mae Hong Son Province. Intern Med J Thai 2004;2:104-7.