

Planet Earth, getting too hot for health?

Global warming — an increase in the average temperature of the planet because of human activities that are raising greenhouse gas levels in the atmosphere — will present public health officials worldwide with an unprecedented challenge, if scientists who study the issue are right. Bruce Agnew reports.

Most climatologists now believe that the Earth's atmosphere is warming, but no one knows how high, or how fast, temperatures may rise. And even though several national and international studies this year predicted that tropical diseases such as malaria and dengue may extend their ranges as the world warms — and that disrupted storm and rainfall patterns may raise threats of everything from crop failures to cholera — no scientific consensus exists on precisely what ecological upsets will hit which countries, where, in the coming decades. Climate computer models cannot fine-tune their projections to regional levels that could tell local officials, for example, whether to prepare for droughts, or floods, or both.

But several major conclusions are clear. “What needs to be recognized is that there is very little doubt among leading scientists [who have taken part in recent studies] that climate change is a reality,” says WHO environmental health expert Dr Carlos Corvalan. “We don't yet know how severe the impacts are going to be or how accurate the predictions of environmental change are, but the evidence is accumulating, and ecological and human health impacts are expected. We are also concerned that the health impacts of global warming will strike hardest at developing nations, particularly the poorest.”

A nation's ability to adapt to climate change “depends on such factors as wealth, technology, education, information, skills, infrastructure, access to resources, and management capabilities,” says the Third Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC), released early this year. “The developing countries, particularly the least developed countries, are generally poorest in this regard.”

It is also clear that preparing for global warming is going to be an immensely complex task. Global warming “will require attention on many fronts,” says Dr Jonathan



Flooding, as in this Mozambican village in March 2000, could become more common as the planet heats up.

AP/Pool Otd Andersen

Patz, director of the programme on health effects of global environmental change at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland, USA.

In particular, global warming will place huge new demands on public health officials and governmental health ministries, says Dr Bettina Menne, global change officer of the WHO European Centre for Environment and Health in Rome. Up until now, she says, most studies of the multiple, interlocking risk factors posed by warming have been driven “not by the public health people but by [computer] modellers, mathematicians and climatologists or economists.” The public health community must become more deeply involved in these assessments, she says.

At least, the modellers, mathematicians and climatologists have filled in the background. The IPCC’s report projected that unless world governments take steps to stabilize emissions of carbon dioxide and other greenhouse gases, the global average surface temperature will rise by 1.4 °C to 5.8 °C (2.5 °F to 10.8 °F) between 1990 and 2100 — a pace of warming that the report said is “very likely” unprecedented over the past 10 000 years.

The IPCC’s Working Group I, which involved nearly 1000 scientists, predicted these changes: land areas will warm more rapidly than the oceans, particularly at high latitudes; precipitation will increase globally, with heavy precipitation over most land areas; in some areas precipitation will decline; and the sea level will rise by 9–88 centimetres between 1990 and 2100. “Extreme weather events” — such as heatwaves, heavy rains, floods, droughts, more ferocious hurricanes and typhoons, and drying out of soil at mid-latitudes — will likely increase, but current climate models cannot tell precisely where they will strike, the IPCC report said.

These projections are based on computer models that still have some gaps and uncertainties, but the scientific consensus supporting the forecast of a warmer world has become overwhelming. Even in the US, where global warming at times has been a political issue, the influential National Academy of Sciences signed on to the IPCC warming projections in June. After a review requested by US President George Bush, a National Academy of Sciences committee reported: “The body of the [IPCC Working Group I] report is scientifically credible and is not unlike what would be produced by a comparable group of only US scientists working with a similar set of emission scenarios, with perhaps some normal differences in scientific tone and emphasis.”



AP/Wide World

A 1999 protest against air pollution in Hong Kong — “Air pollution in urban areas would likely rise as air temperatures warm — particularly the concentration of ground-level ozone, which is damaging to respiratory health and is a main component of urban smog”.

Assessing what global warming will mean for human health, however, is a hugely complex task, clouded by uncertainties. “One of the difficulties,” says Patz, “is that we are talking about complex modes of exposure to the risk factors, and we’re talking about long-term risk factors.”

“If you raise the temperature a few degrees,” Patz explains, “not only will that have an immediate physical effect on humans — especially on the elderly in urban areas — but raising the temperature changes atmospheric chemistry, which then can affect air pollution, especially tropospheric [low-level] ozone. Changes in temperature and precipitation can affect ecology and habitat for insect vectors of diseases. Warmer air holds more moisture, causing more extremes in the water cycle, giving you both droughts and flooding, affecting run-off and contamination, for example, from agriculture.”

Nevertheless, a series of international and national studies — and not a few individual scientists — have tried to puzzle out global warming’s likely health effects. In addition to the IPCC effort, these include a WHO study last year titled “Climate change and human health: impact and adaptation”, as well as government-sponsored national assessments in the UK, the US and several other countries. The US National Academy of Sciences, too, conducted a separate study on global warming and infectious diseases that was published in April. Among the climate-triggered health threats that the studies spotlight are these:

- Vector-borne infectious diseases — such as malaria, dengue, schistosomiasis, leishmaniasis and encephalitis — may alter their geographical ranges and seasonality, spreading into new regions and declining in others. But some vector-

borne disease experts say too many factors are involved in insect and disease organism life cycles to make projections based primarily on climatic changes.

- Heat-related deaths could rise in response to more frequent and more intense heat-waves, particularly in temperate-zone cities and among the elderly and urban poor who lack adequate air conditioning. But little research has been conducted on heat stress in developing countries, and scientists are only now beginning to examine heat morbidity — illness and disability short of death.
- Cold-related mortality might decline. In at least some temperate-zone countries, this reduction in cold-weather deaths might offset the increase in heat-stress mortality. But Johns Hopkins' Patz suspects that the lives saved wouldn't balance lives lost.
- Air pollution in urban areas would likely rise as air temperatures warm — particularly the concentration of ground-level ozone, which is damaging to respiratory health and is a main component of urban smog. At the same time, if current scientific understanding is correct, warming of the atmosphere at low levels would actually cool the stratosphere, accelerating the destruction of the stratospheric ozone that protects the planet from damaging ultraviolet radiation. Shifts in local weather also could alter regional pollution patterns and the spread of airborne allergens such as pollens and mould spores.
- Extreme weather events could "play a more significant role than even the warming itself in creating conditions conducive to outbreaks of disease," says Dr Paul Epstein, associate director of the Center for Health and the Public Environment at the Harvard Medical School in Boston, Massachusetts, USA. In addition to direct injury and loss of life, violent weather can destroy shelter, contaminate water supplies, cripple food production, foster myriad infectious diseases, and tear apart existing health service infrastructures.
- Population displacement, forced by rising sea levels or extreme weather or agricultural collapse, would complicate the public health challenge. Large numbers of refugees moving into already populated areas, crowded together, hungry and perhaps starving, without shelter or adequate sanitation, is a formula for spreading infectious disease and promoting social conflict. "Personally I think that population displacement will be

the iceberg under the tip of this problem," says Patz. "The displaced population issue could be the toughest and largest public health issue of climate change, yet it is without doubt the most difficult to put our arms around."

- Malnutrition risks, and the diseases that accompany malnutrition, would rise as agricultural practices adapt to new patterns of temperature, rainfall and soil-moisture conditions. Improved farm production in some regions, including northern Europe, might balance losses elsewhere. "But the risk of reduced food yields is greatest in developing countries — where 790 million people are estimated to be undernourished at present," the IPCC report says.
- Warming oceans could promote more frequent toxic algal blooms, increase the incidence of diarrhoeal diseases, and spread the risk of poisonings from fish and shellfish toxins that now are mostly limited to tropical waters.
- Emerging infectious diseases — not just known diseases such as Ebola haemorrhagic fever but also new diseases that science has not yet recognized — might be set free by ecosystem changes in response to shifting local weather conditions, providing new niches for non-native micro-organisms. Ecological systems that are upset might also spur the evolution of new strains of disease organisms, according to the US National Academy of Sciences study of linkages between climate, ecosystems and infectious disease in the United States.

"More people are expected to be harmed than benefited by climate change, even for global mean temperature increases of less than a few degrees," says the IPCC report. (And citizens of the poorer nations worst of all. Patz bristles at "the incredible inequity of this problem. The developed countries that are burning the most fossil fuel are the root of the problem, and yet it's the small island nations, the developing countries, that are really going bear its brunt.")

So what's to be done?

At this early stage in science's understanding of global warming and its effects, no one seems to have a good answer to that question. Or at least, no one knows enough, yet, about the specific health problems that global warming may bring, to propose any detailed answers now. But there are a lot of wish-lists.

More research is first on every list: meteorological studies and development

of better computer models to narrow down the specific, regional weather effects of climate change; improved surveillance of diseases like malaria and dengue, both to create a good database on their extent and to provide early warning of any spread of their ranges; new studies of the transmission dynamics of vector-, rodent- and water-borne diseases; and "integrative research" that takes into account the complex interactions within (and between) physical, ecological and societal systems that may make them vulnerable to climate change. The list of potential research subjects goes on and on.

"There's a lot of research that needs to be done, and some practical problems to study," says Harvard's Epstein. For example, "given what we already know about floods and mosquito-borne diseases, floods and cholera and waterborne diseases, there's a lot that we should be doing some real field work on."

It's also important now "to consider not just the potential impacts but to begin addressing adaptation measures", says WHO's Corvalan. "There's a realization that countries will need to take measures, as early as possible, to adapt to the potential changes, including changes to the health sector and delivery of health services. We need 'no-regrets' solutions, where benefits are achieved regardless of the magnitude of predicted impacts." This was the objective of a recent WHO workshop on small island countries organized in Samoa by Corvalan, Patz and Dr Hisashi Ogawa from WHO's Western Pacific regional office.

In addition, WHO's European regional office is conducting a three-year, 25-nation study of whether the preventive mechanisms are in place to cope with climate change. But Menne says the question of adaptation must be raised globally.

Adaptation will be costly. That's why developing nations are expected to have a harder time than the richer industrialized nations that can afford, and that already have, elaborate public health infrastructures.

But there may be a silver lining.

"Most of the actions that are needed to adapt to the impacts of climate change — such as stepped-up vector-control efforts, improved water treatment systems and enhanced disaster-relief capability — would improve our health," says Dr Pim Martens, director of the Global Assessment Centre of Maastricht University's International Centre for Integrative Studies in the Netherlands, "even without global warming." ■

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