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Monitoring the Health Effects of Climate Change

Both the detection and measurement of health effects of climate change are necessary as evidence underpinning national and international policies relating to measures to protect public health. Those measures include mitigation of greenhouse gas emissions.

Good evidence requires good data. The climate varies naturally as well as in response to human influences, and, in turn, climate is only one of many determinants of population health. Therefore, assessing the health impacts of climate change poses challenges. Further, the process of climate change is detectable only over decades, and the resultant health impacts will be similarly slow to emerge.

Monitoring is “the performance and analysis of routine measurements aimed at detecting changes in the environment or health of populations”⁷¹. In many public health investigations, it is possible to measure changes in a defined health impact and to attribute this trend to changes in a directly-acting risk factor. However, the monitoring of the impacts of climate change on health is more complex. There are three main issues:

(i) Distinguishing apparent from real “climate change”

Climate is always fluctuating naturally, and many indices of health show seasonal and inter-annual fluctuation. The demonstration of such a relationship provides no direct evidence that climate change per se has occurred — rather, it merely confirms that these diseases have a seasonal or climatic dependence. An excess of heat-related deaths in a particularly hot summer, or even a succession of hot summers, indicates the potential for climate change to increase mortality, but it

does not prove that mortality has increased as a result of climate change. That would require evidence of a change in the ‘baseline’ climate conditions – i.e. that the sequence of hot summers was exceptional, and due to climate change rather than random variation.

(ii) Attribution

Since climate is one of many influences on health, the attribution of an observed change in population health to an associated change in climate is not straightforward. The influence of concurrent changes in other environmental, social or behavioural factors must be first allowed for.

(iii) Effect modification

Over time, as the climate changes, other changes may also occur that alter the population’s vulnerability to meteorological influences. For example, vulnerability to extreme weather events, including floods and storms, will depend on where and how residential housing is built, what flood protection measures are introduced, and how land-use is changed. Effective monitoring must include parallel measurements of population and environmental data, to allow study of potential modifying influences.

General Principles

The principal criteria for selecting diseases and settings for monitoring should include the following:

- Evidence of climate sensitivity - to be demonstrated through either observed health effects of temporal or geographical climate variation, or evidence of climate effects on components of the disease transmission process in the field or laboratory.
- Significant public health burden - monitoring should be preferentially targeted towards significant threats to public health. These may be diseases with a high current prevalence and/or severity, or considered likely to become prevalent under conditions of climate change.
- Practicality – logistical considerations are important given that monitoring requires dependable and consistent long-term recording of health-related indices and other environmental parameters. Monitoring sites should be chosen where change is most likely to occur, but where appropriate capacity for reliable measurement exists.

Data Requirements and Sources

The data needed for monitoring climate effects on health comprise: (i) climatic variables; (ii) population health markers; and (iii) other non-climatic explanatory factors (Table 10.1).

The choice of non-climatic variables will depend on the specific disease, but the principal categories of confounding or modifying factors include:

- age structure of population
- underlying rates of disease, especially cardiovascular and respiratory disease and diarrhoeal illness
- level of socio-economic development
- environmental conditions, e.g. land-use, air quality, housing conditions
- quality of health-care
- specific control measures, e.g. vector control programmes.

Specific Categories of Health Impacts: Data Needs, Opportunities

To monitor the health effects of thermal extremes, reliable long

time-series of temperature and mortality/morbidity data are available in many countries. An important focus of research data should be the assessment of how the temperature-mortality/morbidity relationship is modified by individual, social and environmental factors. Existing databases (e.g. EM-DAT) for extreme weather events may be a key resource. To maximize their usefulness, complete and consistent reporting of extreme weather events across a wide geographical area, along with standard definitions of events and methods of attribution, is needed. Current monitoring data can provide only a broad quantification of the relationship between climate

and most vector-borne disease. Assessment of the climate contribution to long-term trends requires linked data on factors such as land-use, host abundance and intervention measures. Clearer understanding of relationships should result from high-quality serial data on vectors at a modest number of sites within or at the margins of endemic areas. Data from sites along specified transects could indicate changing vector distributions (including altitude). Geographical comparisons based on remote sensing data may give additional insights into disease trends.

Conclusion

With all forms of monitoring, interpretation of evidence will be strengthened by procedures for standardization, training and quality assurance/quality control. Long time-series of health changes in populations in relation to steep (i.e. sensitive) climate-disease relationships will be the most informative. Such monitoring will become more effective through international collaboration and integration with existing surveillance networks.

Figure 10.1 Data required to monitor climate impacts on health

	Principal health outcomes	Which populations/ locations to monitor	Sources and methods for acquiring health data	Meteorological data	Other variables
Thermal extremes	Daily mortality; hospital admissions; clinic/emergency room attendance;	Urban populations, especially in developing countries	National and sub-national death registries (e.g. city specific data)	Daily temperatures (min/max or mean) & humidity	Confounders: influenza & other respiratory infections; air pollution Modifiers: housing conditions (e.g. household/workplace air conditioning), availability of water supplies
Extreme weather events (floods, high winds, droughts)	Attributed deaths; hospital admissions; infectious disease surveillance data; (mental health); nutritional status	All regions	Use of sub-national death registries; local public health records	Meteorological event data: extent, timing & severity	Disruption/contamination of food & water supplies; disruption of transportation. Population displacement The above parameters will have an indirect impact on health
Food- & water-borne disease	Relevant infectious disease deaths & morbidity	All regions	Death registries; national & sub-national surveillance notifications	Weekly/daily temperature; rainfall for water-borne disease	Long term trends dominated by host-agent interactions (e.g. S enteritidis in poultry) whose effects are difficult to quantify. Indicators may be based on examination of seasonal patterns.
Vector-borne disease	Vector populations; disease notifications; temporal and geographical distributions	Margins of geographical distribution (e.g. changes with latitude, altitude) and temporality in endemic areas	Local field surveys; routine surveillance data (variable availability)	Weekly/daily temperature, humidity and rainfall	Land use; surface configurations of freshwater