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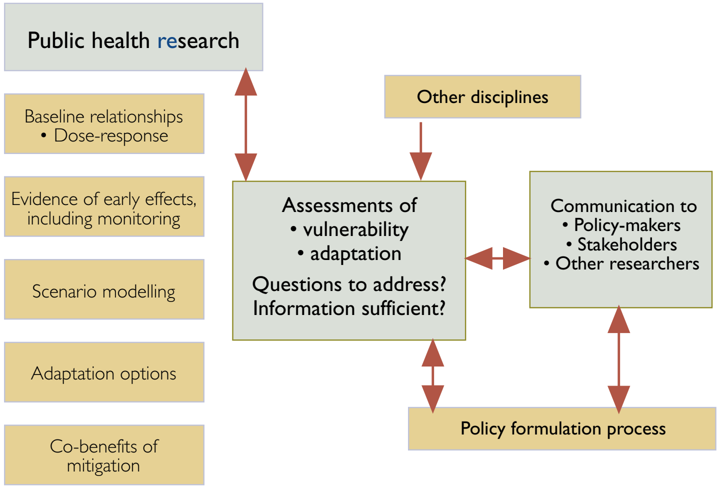
Looking to the Future: Challenges for Scientists Studying Climate Change and Health

Research on climate change and health spans basic studies of causal relationships, risk assessment, evaluation of population vulnerability and adaptive capacity, and the evaluation of intervention policies (Figure 4.1).

Figure 4.1 Tasks for public health science



The challenges in identifying, quantifying and predicting the health impacts of climate change entail issues of scale, "exposure" specification, and the elaboration of often complex and indirect causal pathways.[1] First, the geographic scale of climate-related health impacts and the typically wide time-spans are unfamiliar to most researchers. Epidemiologists usually study problems that are geographically localised, have relatively rapid onset, and directly affect health. The individual is usually the natural unit of observation.

Second, the "exposure" variable – comprising weather, climate variability and climate trends – poses difficulties. There is no obvious "unexposed" group to act as baseline for comparison. Indeed, because there is little difference in weather/climate exposures between individuals in the same geographic locale, comparing sets of persons with different "exposures" is usually precluded. Rather, whole communities or populations must be compared – and, in so doing, attention must be paid to inter-community differences in vulnerability. For example, the excess death rate during the severe 1995 Chicago heatwave varied greatly between neighbourhoods because of differences in factors such as housing quality and community cohesion.

Third, some health impacts occur via indirect and complex pathways. For example, the effects of temperature extremes on health are direct. In contrast, complex changes in ecosystem composition and functioning help mediate the impact of climatic change on transmission of vector-borne infectious diseases and on agricultural productivity.

A final challenge is the need to estimate health risks in relation to *future* climatic-environmental scenarios. Unlike most recognized environmental health hazards, much of the anticipated risk from global climate change lies years to decades into the future.

Research strategies and tasks

While much health-impacts research focuses on future risk, empirical studies referring to the recent past and present are important. Standard observational epidemiological methods can illuminate the health consequences of local climatic trends in past decades – if the relevant data-sets exist. Such information enhances our capacity subsequently to estimate future impacts. Meanwhile, we should also seek evidence of the early health effects of climate change, since change has been underway for several decades.

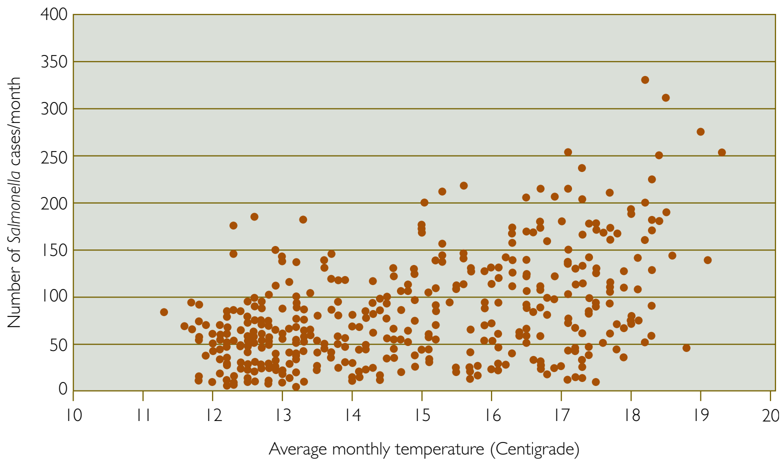
The health impacts of future climate change, including changes in climatic variability, can be estimated in two main ways. First, we can extrapolate from analogue studies that treat recent climatic variability as a foretaste of climate change. Second, we can use predictive computer models based on existing knowledge about relationships between climatic conditions and health outcomes. Such models cannot predict exactly what *will* happen, but they indicate what *would* occur if certain future climatic (and other specified) conditions were fulfilled.

The five main tasks for researchers are:

1. Establishing baseline relationships between weather and health

There are many unresolved questions about the sensitivity of particular health outcomes to weather, climate variability, and climate-induced environmental changes. For example, the major pathogens that cause acute gastroenteritis multiply faster in warmer conditions. Do higher ambient temperatures cause more illness? Apparently so – as is evident from the monthly salmonella infection count in New Zealand in relation to average monthly temperature (Figure 4.2).

Figure 4.2 Relationship between mean temperature and monthly reports of Salmonella cases in New Zealand 1965 - 2000



2. Seeking evidence of early effects of climate change

There have been many, coherent, observations on physical and ecological changes attributable to recent global warming – but few indications yet of human health effects. Amongst these are changing patterns of infectious disease (such as tick-borne encephalitis[2] and cholera[3]). Health researchers must allow for the fact that humans have many coping strategies, ranging from planting shade trees, to changing work-hours, to installing air-conditioning.

The challenge is to pick the settings, populations and health outcomes with the best chance of: (i) detecting changes, and (ii) attributing some portion of these to climate change. Impacts are likely to be clearest where the exposure-outcome gradient is steepest, the local population's adaptive capacity is weakest, and when there are few competing explanations for observed relationships.

3. Scenario-based predictive models

Unlike most other environmental exposures, we know that the world's climate will continue to change for at least several decades. Climatologists now can satisfactorily model the climatic consequences of future scenarios of greenhouse gas emissions. By linking these climate scenarios with health impact models, we can estimate the likely impacts on health.

Some health impacts are readily quantified (deaths due to storms and floods for instance); others are more difficult to quantify (e.g., the health consequences of food insecurity). We need models with sufficient representation of the multi-faceted future world to provide useful, or credible, estimates of future health risks. Where possible, we should use a high level of "integration" to achieve realistic modelled forecasts of impact in a world that will have undergone various other demographic, economic, technological and social changes.

4. Evaluating adaptation options

Adaptation means taking steps to reduce the potential adverse impact of environmental change. (See section 11 below).

5. Estimating the co-incidental benefits and costs of mitigation and adaptation.

Steps to reduce GHG emissions (mitigation) or to lessen health impacts (adaptation) may have other coincidental health effects. For example, promotion of public transport relative to private vehicles may not only reduce CO_2 emissions, but also improve public health in the near-term by reducing air pollution and road traffic injuries and increasing physical activity. Information about these "ancillary" costs and benefits is important for policy-makers. Note, however, for impacts that are either deferred in time or that extend into the distant future, the costing is not straightforward.

General issues concerning uncertainty

Researchers should describe, communicate and explain all relevant uncertainties. This gives the decision-maker important insight into the conditions needed for a particular outcome to occur. Since environmental risk perception varies with culture, values and social status, "stakeholders" should assist both in shaping the assessment questions and in interpreting the risk.