Editorial

Climate change and infectious diseases in Australia

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The mechanisms of global climate change are the subject of extended debate, but the fact that it is happening and our major part in its causation are generally accepted. The potential link between climate change and disease risk has been widely reported and reflects a growing concern about the health impacts of global warming.[1]

In the last decade analysis of detailed epidemiological, geographical and meteorological data has improved substantially, generating new insights into the interaction between complex weather systems and human disease. Some notable correlations between weather systems and specific infectious diseases have already been described, such as the correlation between the El Niño Southern Oscillation and cholera in Bangladesh.[2] Smaller scale events, such as a possible association between El Niño and outbreaks of highland malaria, are more difficult to attribute to climate change.[1,3] The effects of changing weather systems are difficult to show conclusively when non-climate factors such as human population density, migration and insect vector dynamics add to the risk of disease.

Closer to home, epidemiological studies have shown an association between high daytime temperatures, a low UV index, and presentations with gastroenteritis in children.[4] The major source of inter-annual climate variation in our region is the 3–6 yearly El Niño Southern Oscillation cycle, which affects temperature, rainfall and the probability of storms, floods and droughts. In north-western Australia some locations have recorded a doubling of the annual rainfall over two decades, and cyclical rainfall variation has been observed.[5] It is difficult to predict precisely how these complex changes are likely to impact on endemic infectious disease for which only limited environmental surveillance data are available.

The addition of an insect vector to the equation adds another layer of ecological complexity. Ross River virus disease is the most common and widespread mosquito-borne infection in Australia. A recent investigation found that rainfall, temperature and high tides were determinants of Ross River virus transmission, but that the nature and scale of the interrelationship between disease, mosquito density and climate variability varied with geographic location and socioeconomic conditions.[6] A predictive model based on surveillance data from Darwin found that a combination of rainfall, minimum temperature and three mosquito species predicted disease prevalence effectively. The model indicated that climate change may result in increased Ross River virus infections.[7]

Empiric data from the Northern Territory also show a clear correlation between the occurrence of acute melioidosis and the onset of the wet season.[8] This has been attributed to the wetting of soil and regeneration of surface water collections contaminated by the causal agent, *Burkholderia pseudomallei*. However, recent photobiology experiments raise the possibility of an alternative explanation – the loss of decontaminating ultraviolet light due to cloud cover.[9]

Looking to the future, we can predict that there will be an increase in the population at risk of dengue. This may translate to an increased frequency of dengue outbreaks in northern Australia and an extension of the at-risk area. Other arbovirus* diseases including Ross River virus, Barmah Forest and Kunjin virus infections, and Murray Valley encephalitis are likely to be affected by climate change, but the complex ecology of virus transmission makes location-specific prediction difficult.[6]

* arthropod-borne virus

In this issue…

The emergence of a new strain of influenza virus (H1N1) in Mexico has raised concerns about a pandemic. Prompt detection of cases is important, so the review of rapid tests for influenza by Hong Foo and Dominic Dwyer is timely.

Changes in the pattern of infectious diseases may result from changes in the global environment. A warming climate will have an effect on prescribing. In addition to the impact on infectious diseases discussed by Timothy Inglis, there will be implications for how medicines are stored and used.

Pharmacogenetic testing has the potential to influence how warfarin is used. Although knowing the patient's genome can help with predicting and adjusting the dose of warfarin, Jennifer Martin explains that pharmacogenetic testing is not yet ready to be part of routine management.

The re-emergence of malaria in Australia is more difficult to predict, though receptive mosquito species in northern Australia can propagate localised outbreaks after *Plasmodium* species parasites have been introduced by international travellers.[10,11] There is a clear consensus that the future spread of malaria within Australia can be minimised by a combination of surveillance and public health interventions.

Increased coastal flooding may lead to cholera and marine vibrio infections, and possibly increased melioidosis. Climate change-related increases in temperature will increase the risk of food-borne infections such as salmonellosis and listeriosis, and may also raise the risk of sporadic amoebic meningo-encephalitis. A greater reliance on seasonal air conditioning may lead to an increase in cases and outbreaks of Legionnaires' disease. These are all direct effects of a changing climate. More subtle are the indirect effects such as population shift due to changing land use, a changing epidemiology of zoonotic infections through major relocations of livestock, and a possible shift in avian-mediated viral infections due to shifts in the migratory flyways.

Changes in regional and global climates are fortunately not enough to cause catastrophic, immediately evident infectious disease outcomes. However, medical practitioners need to keep contemporary disease intelligence in view, while maintaining a low threshold of suspicion for unusual, and common but out-of-context infections. Any patient who presents with a fever or localised infection of unknown cause after travel within Australia needs to be asked about their recreational and occupational activities. Soil or water exposure, biting insect or animal contact, severe weather or air conditioning are all potentially relevant. Prolonged incubation periods (up to an extreme of 63 years in the case of latent melioidosis[12]) can cause diagnostic difficulties.

Some infections of the Australian tropics are not notifiable in some jurisdictions, but general practitioners, infectious disease specialists and public health authorities will all want to know if a group has been affected by a within-Australia travel-related infection.

Antiviral drugs are ineffective against the arbovirus diseases. Acute, septicaemic melioidosis can be rapidly fatal and presumptive intravenous antimicrobial drugs must be commenced as quickly as possible in accordance with the Antibiotic Guidelines (either meropenem or ceftazidime, then followed with prolonged eradication therapy).[13] Legionnaires' disease should be treated promptly with a macrolide (azithromycin or erythromycin plus either rifampicin or ciprofloxacin in severe cases). Diarrhoeal or food-borne infections can often be treated symptomatically without the need for antibiotics.

Although climate change is likely to change the risk of contracting many infectious diseases, neither surveillance data nor predictive modelling allow accurate forward prediction of time, place and specific infectious disease. Australian practitioners should maintain a high index of suspicion for changes in conventional epidemiology, and remain alert to exotic infections following travel within Australia. The predicted disease consequences of climate change can most likely be minimised by forward planning and public health measures.

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References

1. McMichael AJ, Woodruff RE, Hales S. Climate change and human health: present and future risks. Lancet 2006;367:859-69.
2. Lipp EK, Huq A, Colwell RR. Effects of global climate on infectious disease: the cholera model. Clin Microbiol Rev 2002;15:757-70.
3. Lindblade KA, Walker ED, Onapa AW, Katungu J, Wilson ML. Highland malaria in Uganda: prospectice analysis of an epidemic associated with El Niño. Trans R Soc Trop Med Hyg 1999;93:480-7.
4. Lam LT. The association between climatic factors and childhood illnesses presented to hospital emergency among young children. Int J Environ Health Res 2007;17:1-8.
5. Inglis TJJ, Levy A, Merritt AJ, Hodge M, McDonald R, Woods DE. Melioidosis risk in a tropical industrial environment. Am J Trop Med Hyg 2009;80:78-84.
6. Tong S, Dale P, Nicholls N, Mackenzie JS, Wolff R, McMichael AJ. Climate variability, social and environmental factors, and Ross River virus transmission: research development and future research needs. Environ Health Perspect 2008;116:1591-7.
7. Jacups SP, Whelan PI, Markey PG, Cleland SJ, Williamson GJ, Currie BJ. Predictive indicators for Ross River virus infection in the Darwin area of tropical northern Australia, using long-term mosquito trapping data. Trop Med Int Health 2008;13:943-52.
8. Currie BJ, Jacups SP. Intensity of rainfall and severity of melioidosis, Australia. Emerg Infect Dis 2003;9:1538-42.
9. Sagripanti JL, Levy A, Robertson J, Merritt A, Inglis TJ. Inactivation of virulent Burkholderia pseudomallei by sunlight. Photochem Photobiol 2009 Jan 19. [Epub ahead of print]
10. Hanna JN, Ritchie SA, Eisen DP, Cooper RD, Brookes DL, Montgomery BL. An outbreak of Plasmodium vivax malaria in Far North Queensland, 2002. Med J Aust 2004;180:24-8.
11. Russell RC, Currie BJ, Lindsay MD, Mackenzie JS, Ritchie SA, Whelan PI. Dengue and climate change in Australia: predictions for the future should incorporate knowledge from the past. Med J Aust 2009;190:265-8.
12. Ngauy V, Lemeshev Y, Sadkowski L, Crawford G. Cutaneous melioidosis in a man who was taken as a prisoner of war by the Japanese during World War II. J Clin Microbiol 2005;43:970-2.
13. Therapeutic Guidelines: Antibiotic. Version 13. Melbourne: Therapeutic Guidelines Limited; 2006.

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