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Climate science, denial and the Declaration of Delhi

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Abstract

Human-induced climate change is now the central health issue facing humanity. The World Medical Association recently adopted the Declaration of Delhi, committing the medical profession to mitigate and adapt to the effects of climate change. This is new professional territory for many doctors. Even so, the profession has often engaged with issues outside 'the health sector' when the stakes are high, for example leaded petrol, road safety, tobacco, and nuclear weapons.

The scientific basis to the declaration merits scrutiny in light of commonly used contrary arguments. Decisions in medicine, as elsewhere, must be taken on the evidence to hand, weighing up the risks, given that complete knowledge is seldom available and time is precious. There are strong analogies between clinical experience and our approach to planetary climate.

The relevant context for scientific observations on climate is the world's multi-gigatonne annual CO_2-equivalent greenhouse gas emissions. Emissions drive changes in concentrations of greenhouse gases, which matters when they are rapid or prolonged. The current variation in global temperature is alarming, even when within 'normal range'. Climate models inform and guide present-day decision-making, and perform well in explaining observed warming. They corroborate other evidence that tells us that CO_2 and other greenhouse gases are harmful at current atmospheric concentrations.

As a profession and as global citizens, we need to move beyond dissent and denial about anthropogenic climate change. The WMA correctly says that circumstances now require us all to take action.

Ten years into the third millennium, climate change looms as the central issue facing humanity's collective future. It should be no surprise that climate change now appears in our professional domain.[1,2]

Most of us will have attested at the start of our career to something like the World Medical Association (WMA) Declaration of Geneva,[3] which begins

> "I SOLEMNLY PLEDGE to consecrate my life to the service of humanity".

Although our day-to-day focus as clinicians is more on individual humanity, the pledge requires us to also consider the collective wellbeing of populations over time. That wellbeing strongly depends on climate and the environment, and so in October 2009 the World Medical Association adopted the Declaration of Delhi, "to provide a response ... to the challenges imposed on health and healthcare systems by climate change".[4]

The Delhi Declaration begins by noting the most likely effects predicted by the Intergovernmental Panel on Climate Change (IPCC, AR4).[5] The IPCC has "very high confidence" (its code for "at least a 9 out of 10 chance of being correct") that climate change currently contributes to the global burden of disease and premature death. These and related effects are "projected to progressively increase in all countries and regions".[4]

With this in mind, the WMA has committed the medical profession to actions to mitigate and adapt to the effects of climate change. These are summarised as advocacy, leadership, education and capacity building, surveillance and research, and collaboration. The WMA Declaration of Delhi is a global call to action for the entire medical community, and our colleagues are responding internationally.[6–9]

Most readers of this *Journal* devoted their education to what was viewed as 'the Health Sector'. We did not anticipate our interest in human welfare would require a good understanding of geophysics and politics. So it is understandable if many of us feel outside our professional comfort zone when we consider how the medical profession should respond to climate change.

Many times in the past the profession has engaged with issues outside the health sector when the stakes for health were high. Road safety, tobacco and nuclear weapons are three recent examples.

But climate is new territory, and many doctors will seek to increase their understanding of the background, particularly when dissenting voices are heard in the public media. Here we explore the scientific basis to the Declaration of Delhi, with reference to commonly used contrary arguments.

Due personal verification

The first challenge to the Declaration of Delhi is whether we should accept it. After all, the earlier Geneva Declaration on the Duties of Physicians enjoins that:

> "A PHYSICIAN SHALL certify only that which he/she has personally verified",[3]

and consequently we have had scepticism and resistance to *ex-cathedra* statements drummed into us from Day One of medical school. Scepticism means asking questions, not taking matters on face value, and not being swayed by authority unless we decide independently there is good reason to act.

But true scepticism does not mean refusing to act in the absence of certainty. Doctors are well aware that decisions must be taken on the evidence to hand, weighing up the risks, on the basis that complete knowledge is seldom available and time is precious. Our patients' well-being often demands we act on the basis of incomplete and emerging information.

What applies at the bedside is true also in the public domain. Our experience of medical controversy reminds us that science is frequently disputed, particularly when commercial interests are at stake. Think back, for example, to the arguments over the effects of lead on child health. For the better part of a century a few prominent scientists, supported by industry, advanced doubt as reason to delay removal of lead from paint and petrol.[10,11] In recent history, we as a profession have taken a stand on similar controversial issues, on the grounds that the evidence may not be perfect, but still sufficient for action. Examples include passive smoking, immunisations, and cardiovascular risk. The Declaration of Delhi puts the profession in such a position now with climate change.

It is fair to ask how we as doctors might personally verify[3] anthropogenic global warming, especially in the absence of our preferred evidentiary tool, the randomised controlled trial. The evidence mainly resides in a single incomplete case report, the geophysical history of planet Earth. A very short supporting case series is suggested by our neighbours Venus and Mars. Clearly verification must take a different form to how we would approach a controversy over drug therapy or food supplements.

Some contrary arguments

Arguments commonly cited against climate change were mooted in an open letter written in 2007 by "100 Prominent Scientists" to the Secretary-General of the United Nations.[12] This group claimed that recent observations of phenomena such as glacial retreats, sea-level rise and the migration of temperature-sensitive species are not evidence for abnormal climate change, "for none of these changes has been shown to lie outside the bounds of known natural variability".

The claim did not specify a time-scale, which means that the "bounds of natural variability" were potentially very wide. For example, the characteristic sea level for the planet, based on evidence from the last 500 million years, is about 100 metres higher than the present day.[13] Just because something falls within the bounds of known natural variability, does not mean it is desirable.

In clinical practice, variation of physiological parameters within a reference range may often be cause for concern. For example, in the case of human temperature, 700 recordings from 148 healthy subjects varied between 35.6°C and 38.2°C,[14] being a 2.6°C (7%) variation with a mean of 36.8°C and 37.7°C an upper limit of normal. Doctors commonly see rising temperatures within the normal range, and must judge whether this is "natural variability" or the first flicker of something more serious.

Another example is weight change. A 5 kg fall in a patient's weight might be within the bounds of normal, if it occurred over the course of a year. If the weight were lost over a month, we would tend to consider a potentially serious explanation. It is often the *rate* as much as the magnitude of change that is important.

The 100 Scientists also noted a recent apparent lull in global warming, saying that despite computer projections of temperature rises, there has been no net global warming since 1998. "That the current temperature plateau follows a late 20th-century period of warming is consistent with the continuation today of natural multi-decadal or millennial climate cycling."[12]

Such arguments fail to see the wood for the trees, in this case by picking an arbitrary short series of just the last 10 years and an abnormally warm single year (1998) as the starting reference point. Clinically this is akin to taking false reassurance from an isolated set of 'good' laboratory values (a false-negative), when looking at all results over time would show a more serious evolving pattern. The climate change deniers have used data selectively,[15] where the IPCC has assiduously used all available data to properly compare pre- and post-industrial trends.[16] The most recent global data, released by the World Meteorological Organisation, show that 2000-2009 has been the warmest decade ever since direct measurements began.[17]

The 100 Scientists concluded that "it is not possible to stop climate change, a natural phenomenon that has affected humanity through the ages." This insistence on an explanation in terms of natural phenomena is akin to 'diagnostic anchoring', in which data not compatible with a starting diagnostic assumption are systematically excluded from consideration.[18] We know in medicine that signs of pathology may often be modified or masked, so that 'natural appearances' become misleading. For example, factors such as age or treatment with corticosteroids or partially effective antibiotics may attenuate the fever response.

The same applies to the short-term climate trend, which may be damped down or reinforced by factors such as the El Nino Southern Oscillation (the periodic change in atmospheric conditions around the Pacific affecting rainfall patterns and temperatures world-wide.[19] Longer-term temperature increases are also being artificially masked by aerosols in the atmosphere.

In medicine, we have to recognise the underlying true febrile process even when it may be modified by other factors. Similarly, we have to recognise the climate's complexity when interpreting apparent lulls in global warming and likely future warming trends.

In the end, the most decisive tool for interpreting change tends not to be rate or magnitude but rather *context*. If the person whose temperature has just been recorded as 37.7°C is a possibly neutropenic oncology patient with malaise, the temperature should at the very least be rechecked within an hour. It would be a brave doctor who failed to act on a rising temperature in this context, simply on the grounds that it was still within the normal range.

If a person lost 5kg of weight over a month in the setting of an intensive diet and exercise programme, this might be explicable. But if that weight were lost in the context of fevers and night sweats, there would be a strong suspicion of something more sinister.

Although the analogy between clinical practice and planetary climate is necessarily imperfect, it reminds us to look for context. The relevant context for scientific observations on climate is the world's approximate 50 gigatonne annual CO_2-equivalent greenhouse gas emissions.[16]

Airborne aetiology

At the heart of the 100 Scientists' position lies a very simple idea, that "… carbon dioxide (CO_2), [is] a non-polluting gas that is essential to plant photosynthesis." This blanket claim (that CO_2 is non-polluting) must raise a red flag to doctors, conditioned as we are by Paracelsus' dictum that

> "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy".[20]

CO_2 and other greenhouse gases become increasingly polluting at elevated concentrations. By analogy, in the clinical setting, electrolytes such as potassium are vital at normal concentrations, but quickly become life-threatening when concentrations rise above normal.

With this in mind we review in detail the global 'greenhouse effect', and the part played by CO_2. (We are indebted in the following account to the work of Held and Soden, who have documented progress in understanding of greenhouse gases over the last century.[21])

In 1827, Fourier described the heat-trapping ability of the atmosphere, which functions in essence as a one-way filter. Visible frequencies of sunlight are transmitted freely and warm the Earth. The return journey as radiated heat is blocked because the atmosphere at these frequencies is highly absorbent.

In 1861, Tyndall discovered that atmospheric heat is absorbed mainly by water vapour and CO_2, trace gases making up less than 1% by weight. From his laboratory observations, he concluded that water vapour acted as "a blanket, more necessary to the vegetable life of England than clothing is to man". At the levels described by Tyndall, CO_2 is indeed a non-polluting gas essential to photosynthesis (albeit that when plants are stressed, including by heat, they photosynthesise less and move more to respiratory metabolism;[22] such a potential further positive feedback mechanism bodes poorly for the future climate).

Observational data suggesting that the climate could warm in response to atmospheric CO_2 were first published by Arrhenius at the end of the 19th century. The effect does not need to be strong; like compound interest on a loan it simply needs to persist over time.

In 1905, Chamberlin made a key interpretative advance in writing that water vapour,

> "… confessedly the greatest thermal absorbent in the atmosphere, is dependent on temperature for its amount, and if another agent, as CO_2, not so dependent, raises the temperature of the surface, it calls into function a certain amount of water vapour which further absorbs heat, raises the temperature and calls forth more vapour …".

Simply put, warm air holds more water as vapour before it starts to rain. In the early 1960s, data from the first Venus probes suggested that a water-mediated greenhouse effect had overtaken that planet's atmosphere.[23] Since that time, positive feedback between water and greenhouse gases such as CO_2 has been a central element in models of global warming.[21,24-25] More recent experiments from NASA's Aqua satellite have confirmed this link. The observed increase in atmospheric heat absorption per degree rise in temperature is approximately 2.04 $W/m^2/K$.[26]

Predictive models work

It is true that greenhouse gases such as CO_2 and water are but one part of a much larger and complex global system. Climate modellers face a significant technical challenge when they attempt to estimate greenhouse gas-mediated temperature gains in the future. But it is important to note the modellers do not claim to foretell what will happen in the future. Instead, they offer models as a guide to what may happen, based on best efforts to understand causal relations and complexity.

The climate models used in the IPCC AR4 were tested against the conditions of the last 40 years and produced backcasts that fitted closely with observations at global and regional levels.[16] As Held and Soden wrote in 2000,

> "… it is useful to watch an animation of the output of such a model, starting from an isothermal state of rest with no water vapour in the atmosphere and then 'turning on the sun,' seeing the jet stream develop and spin off cyclones and anticyclones with statistics that closely resemble those observed, watching the Southeast Asian monsoon form in the summer, and in more recent models, seeing El Niño events develop spontaneously in the Pacific Ocean."[21]

Doctors are familiar with this kind of uncertainty. We are constantly required to make forecasts, judging risk and prognosis on a daily basis. We regularly use algorithms,[27] imperfect as they may be, to assess risk and individualise clinical decision-making.

Cardiovascular risk is one such example. Quantitative risk models cannot of course predict the date on which an individual patient will suffer a heart attack or stroke. But an algorithm based on age, gender, current blood pressure, lipid profiles, diabetes, and smoking history, expressed as a simple colour chart or computer programme, provides an invaluable guide to decisions about treatment. This has been validated in New Zealand through a back casting exercise, demonstrating how well the model could 'predict'[28] results from previous epidemiological studies.[28-30]

But unsurprisingly, if your starting position is to categorically deny that CO_2 or other greenhouse gases can trap heat in the atmosphere, it is unlikely your models will predict human-induced global warming.

The science demands action

Due scepticism has an important role to play, particularly in fields such as evidence based medicine that are complex and contested. It is essential though to distinguish between appropriate scepticism and counterproductive 'denialism'. Denialism includes the use of rhetorical arguments, at times selective and influenced by economic interests beyond the science, *inter alia*,[15] to give the impression of legitimate argument where there is none. There are common patterns in the tactics employed by the tobacco industry in its beat-up of 'the smoking controversy', those who deny that HIV causes AIDS, and the climate change 'sceptics' (see Diethelm & McKee 2009[15] for more detail). This kind of denial is dangerous, and must be questioned diligently.

Diligent questioning has also been leading scientists to update the latest IPCC assessment, which is now more than two years old. The science in this area is fast-moving. There is mounting evidence the IPCC predictions may have been too *conservative*, where more recent comprehensive reviews[31–33] indicate that climate change is proceeding at or beyond the upper projections of the 2007 IPCC assessment.

This is not a criticism of IPCC models, so much as an ongoing refinement process, similar to updating a medical diagnosis and prognosis as evidence accumulates. The purpose of climate models is not to foretell the future, but to inform and guide present-day decision-making in light of future possibilities.

The climate observations, IPCC models, and physical mechanisms are consistent; the mechanisms mooted are plausible and can be demonstrated experimentally at the correct scale; and the process can be observed in real life and reproduced by models. There is no plausible alternative explanation that passes these basic tests.

In summary, there are more than sufficient grounds to reject the arguments of the 100 Scientists[12] and kindred Climate Change Deniers.[15] Change is not necessarily normal: small changes can matter especially when they are rapid and cumulative, and variation within normal ranges (e.g. variation in either absolute temperature or rates of change of temperature) is not always benign; the context of greenhouse gases makes such variation alarming. There is ample evidence the climate models perform well. CO_2 and other greenhouse gases are causing substantial climate change at current industrial atmospheric concentrations, and will continue to harm unless these concentrations are reduced.

Good medicine recognises risk and urgency and is willing to act on presumptive diagnoses and emerging yet incomplete information. The warnings of the IPCC are stark, and have serious implications for health workers throughout the world.[2]

As Sir Austin Bradford-Hill pointed out,[2] scientific work is inherently incomplete and uncertain, and yet we are required to use such knowledge as we have and to act now in the face of uncertainty. Uncertainty is not in itself a reason to postpone or avoid action.

New Zealand adopted this precautionary principle when we signed up to the Rio Convention after the Earth Summit of 1992. In the health arena, New Zealand has acted on this principle in its response to epidemic Group B meningococcal disease. In the absence of trials of vaccine efficacy, we undertook safety trials and implemented a vaccination programme, as the most ethical option.[34] In contrast, we have watched helplessly while HIV-AIDS deniers seriously retarded work on that illness in Africa, causing much increased mortality and morbidity.[15,35]

The same principles hold true whether the scale of action be clinical or global. As Peter Doherty (the Nobel Prize-winning Australian immunologist) says, paralleling climate science with biomedical research:

> "This experiment, which involves 6.8 billion human beings, as well as every other complex life form on our small planet, can only be done once. Can we afford to explore the extent of its possibilities? I fail to comprehend how any competent scientist could argue that our current strategies are sustainable. Comparable intimations of disaster during for instance the testing of a new drug would lead to the immediate termination of the trial."

As a profession and as global citizens, we need to move beyond dissent and denial. We were able to do this for lead, tobacco and immunisations. As reasonable as it is to verify the evidence on climate change, circumstances now require us all to take action.[1,2,4,6–9,37–47]

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References:

1. Metcalfe S, Woodward A, Macmillan A, et al. Why New Zealand must rapidly halve its greenhouse gas emissions. N Z Med J. 2009;122:U3827. http://www.nzma.org.nz/journal/122-1304/3827/
2. Costello A, Abbas M, Allen A, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. Lancet. 2009;373(9676):1693-733.
3. World Medical Association International Code of Medical Ethics, http://www.wma.net/en/30publications/10policies/c8/index.html, accessed 31/10/09
4. World Medical Association. WMA Declaration of Delhi on Health and Climate Change, http://www.wma.net/en/30publications/10policies/c5/index.html, accessed 31/10/09
5. Confalonieri U et al, 2007: Human health. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry et al , Eds., Cambridge University Press, Cambridge, UK, 391-431.
6. Pencheon D, Montgomery H, Gilmore I, et al. Climate needs to change before Copenhagen. Guardian Oct 21, 2009: 31. http://www.guardian.co.uk/environment/2009/oct/21/climate-change-summit-copenhagen-1010
7. Chan M. Cutting carbon, improving health. Lancet 2009;374:1870-1. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61993-0/fulltext
8. Gill M, Stott R. Health professionals must act to tackle climate change. Lancet 2009. doi:10.1016/S0140-6736(09)61830-4, published online November 25, 2009. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61830-4/fulltext
9. Haines A, Wilkinson P, Tonne C, Roberts I. Aligning climate change and public health policies. Lancet 2009 doi:10.1016/S0140-6736(09)61667-6. published online Nov 25. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61667-6/fulltext
10. Needleman HL. Clamped in a straitjacket: the insertion of lead into gasoline. Environmental Research 1997;74, 95–103.
11. Wilson N, Horrocks J. Lessons from the removal of lead from gasoline for controlling other environmental pollutants: a case study from New Zealand. Environ Health. 2008;7:1 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2263033/
12. Science and Public Policy 2007. Open Letter to the Secretary-General of the United Nations. Written by 100 Prominent Scientists, Friday, 14 December 2007. http://scienceandpublicpolicy.org/reprint/open_letter_to_un.html, accessed 01/11/09

13. Hallam A, Cohen JM. The Case for Sea-Level Change as a Dominant Causal Factor in Mass Extinction of Marine Invertebrates [and Discussion]. Phil. Trans. R. Soc. Lond. B 1989;325:437-455; doi:10.1098/rstb.1989.0098. http://rstb.royalsocietypublishing.org/content/325/1228/437.full.pdf+html
14. Mackowiak PA, Wasserman SS, Levine MM. A critical appraisal of 98.6 degrees F, the upper limit of the normal body temperature, and other legacies of Carl Reinhold August Wunderlich. JAMA 1992;268:1578–1580.
15. Diethelm P, McKee M. Denialism: what is it and how should scientists respond?. Eur J Public Health. 2009;19:2-4. http://eurpub.oxfordjournals.org/cgi/content/full/19/1/2
16. IPCC Fourth Assessment Report (AR4). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri RK, Reisinger A. (Eds.). IPCC, Geneva, Switzerland. pp 104. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm
17. World Meteorological Organization. 2000–2009, the warmest decade. Press release no. 869, December 8, 2009. http://www.wmo.int/pages/mediacentre/press_releases/pr_869_en.html
18. Review at http://www.houghtonmifflinbooks.com/catalog/titledetail.cfm?titleNumber=689664 of Groopman J. 'How Doctors Think', March 19, 2007, Houghton Mifflin.
19. http://www.niwa.co.nz/our-science/climate/common-questions
20. http://en.wikiquote.org/wiki/Paracelsus, accessed 07/12/09
21. Held IM, Soden BJ. Water vapor feedback and global warming. Ann. Rev. Energy Environ. 2000;225:441–75
22. Wahid A, Gelani S, Ashraf M, Foolad MR. Heat tolerance in plants: an overview. Environmental & Experimental Botany 2007; 61:199–223.
23. Sagan C. 1962. Structure of the lower atmosphere of Venus. Icarus 1:151–69a.
24. Kasting JF. Runaway and moist greenhouse atmospheres and the evolution of Earth and Venus. Planetary Sciences: American and Soviet Research/Proceedings from the U.S.-U.S.S.R. Workshop on Planetary Sciences. Commission on Engineering and Technical Systems (CETS), 1991. pp. 234-245.
25. Randall DA et al 2007: Climate Models and Their Evaluation. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon S et al (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
26. Dessler AE, Zhang Z, Yang P. Water-vapor climate feedback inferred from climate fluctuations, 2003-2008. Geophysical Research Letters 2008; 35:L20704.
27. Anderson KM, Odell PM, Wilson PW, Kannel WB. Cardiovascular disease risk profiles. Am Heart J. 1991;121:293-8.
28. Bannink L, Wells S, Broad J, Riddell T, Jackson R. Web-based assessment of cardiovascular disease risk in routine primary care practice in New Zealand: the first 18,000 patients.(PREDICT CVD-1). N Z Med J 2006;119:U2313.
29. Milne R, Gamble G, Whitlock G, Jackson R. Framingham Heart Study risk equation predicts first cardiovascular event rates in New Zealanders at the population level. N Z Med J 2003;116:U662.
30. Wells S. Getting evidence to and from general practice consultations for cardiovascular risk management using computerised decision support. PhD thesis. University of Auckland, 2008.
31. Richardson K, Steffen W, Schellnhuber HJ, Alcamo J, Barker T, et al. Climate Change: global risks, challenges & decisions. Synthesis report from conference at Copenhagen 10-12 March 2009. University of Copenhagen, 2009. http://climatecongress.ku.dk/pdf/synthesisreport/
32. McMullen CP, Jabbour J. Climate change science compendium. Nairobi: United Nations Environment Programme (UNEP), Earthprint, 2009. http://www.unep.org/compendium2009/,

http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=596&ArticleID=6326&l=en

33. Allison I, Bindoff NL, Bindoff RA, Bindschadler RA, Cox PM, et al. The Copenhagen Diagnosis, 2009: updating the world on the latest climate science. The University of New South Wales Climate Change Research Centre (CCRC), Sydney, Australia, 60pp. http://www.copenhagendiagnosis.org/
34. Sexton K, Lennon D, Oster P, et al. The New Zealand Meningococcal Vaccine Strategy: a tailor-made vaccine to combat a devastating epidemic. N Z Med J 2004;117:1015 http://www.nzma.org.nz/journal/117-1200/1015/
35. Gluckman P. Climate change. The Office of the Prime Minister's Science Advisory Committee; 2009 http://www.pmcsa.org.nz/issues/climate_change/
36. Doherty P. Skeptical Thinking. The Monthly, 2009;51 (November):38-40. http://www.themonthly.com.au/monthly-essays-peter-doherty-copenhagen-and-beyond-sceptical-thinking-2112
37. Godlee F. Climate change: permission to act. BMJ 2008;336:0 http://www.bmj.com/cgi/content/full/336/7637/0
38. McMichael AJ, Friel S, Nyong A, Corvalan C. Global environmental change and health: impacts, inequalities, and the health sector. BMJ 2008;336:191-4. http://www.bmj.com/cgi/content/full/336/7637/191
39. Gill M, Godlee F, Horton R, Stott R. Doctors and climate change. BMJ 2007;335:1104-5. http://www.bmj.com/cgi/content/full/335/7630/1104
40. Gill M. Why should doctors be interested in climate change? BMJ 2008;336:1506. http://www.bmj.com/cgi/content/full/336/7659/1506
41. Griffiths J, Hill A, Spilby J, Stott R. Ten practical steps for doctors to fight climate change. BMJ 2008;336:1507. http://www.bmj.com/cgi/content/full/336/7659/1507
42. Roberts I. The economics of tackling climate change. BMJ 2008;336:165-6. http://www.bmj.com/cgi/content/full/336/7637/165
43. Tong S, Mackenzie J, Pitman AJ, FitzGerald G, Nicholls N, Selvey L. Global climate change: time to mainstream health risks and their prevention on the medical research and policy agenda. Intern Med J 2008;38:445-7.
44. A Commission on climate change. Lancet 2009;373:1659. http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)60922-3/fulltext
45. Gray M. Climate change is the cholera of our era. The Times, 25 May 2009. http://www.timesonline.co.uk/tol/comment/columnists/guest_contributors/article6355257.ece
46. Wiley LF, Gostin LO. The international response to climate change: an agenda for global health. JAMA 2009;302:1218-20. http://jama.ama-assn.org/cgi/content/full/302/11/1218
47. Lim V, Stubbs JW, Nahar N, Amarasena N, Chaudry ZU, et al. Politicians must heed health effects of climate change. BMJ 2009;339:b3672; Lancet 2009;374:973. http://www.bmj.com/cgi/content/full/339/sep15_1/b3672; http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61641-X/fulltext
48. IPCC, 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. [Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds)]. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm