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Models: instruments for evidence based policy

Most of us have been taught with models. The easiest examples come from medicine: the anatomy models that helped place the traditional description of the human anatomy in a three dimensional perspective and the models of the human circulation that, in all their crudeness, helped you to understand why a septum defect would have the physiological consequences it has. Both are examples of models that help the understanding of complex systems or dynamics that cannot be observed readily in real life. Both are examples of how the sum of the existing knowledge can be more than the individual bits of evidence.

Epidemiology has been using models for the same purpose for a number of years now, both conceptual models and more quantitative computer simulation models. The need for these stems from the evolution of simple causal models, as still existent in carefully controlled clinical trials, to more complex webs of causality in aetiological research. Here too the bits of evidence from individual studies are often insufficiently understood unless a model is created to visualise the interdependencies.

One of the recent examples of a much used conceptual model, is the model presented by Dahlgren and Whitehead¹ to explain how social inequalities in health are the result of interactions between different levels of causal conditions, from the individual to communities to national health policy levels. In its simplicity it also allows policy makers to understand why action is needed on different levels, if the outcome of a reduction in inequalities in health is to be achieved.

More formal models have been introduced in epidemiology with the increasing computational ability of computers. As we moved from the simple finding of a causal relation between smoking and lung cancer to the more complicated multicausality of, for instance, cardiovascular disease, the population attributable risk, as the translation from the relative risk finding of the epidemiological study to evidence for policy making no longer sufficed. This became even more evident when policy makers demanded more than disease specific outcomes as potential benefits of preventive interventions. The introduction of generic health status measures such as life expectancy and years of life lost or gained, and more recently the addition of composite health measures such as healthy life expectancy and disability adjusted life years, forced epidemiologists to investigate the issue of the interaction between causes of morbidity and mortality and the time lags involved in some of the outcomes. The resulting techniques of computer simulation models, such as Prevent² and POHEM³ added an important instrument to our epidemiological tool kit. Here again a good quantitative model incorporating results of different epidemiological studies can be of more value to policy makers than the sum of the individual epidemiological evidence.

But there are two important conditions to keep in mind when using such instruments. The first has to do with understanding the dynamics that are being modelled. As computers get more sophisticated and models get a more friendly user interface, the complexity or what can be modelled but also the range of potential users of models has greatly increased. It is no longer easy as an outsider to grasp exactly what the underlying assumptions of some of the mathematical functions used in the models, are. Nor can we be sure that those who interpret the results generated by these models fully understand the dynamics that might be generated by these assumptions or the model itself. A good overview of publications considering such dynamics have recently been brought together in the thesis by Barendregt and Bonneux.⁴

It will therefore become increasingly necessary to establish a code of good modelling practice to help readers but also editors to judge the value of the models used in research papers. Additional validation studies such as the one presented in this issue⁵ will undoubtedly help foster such understanding and formal validation. They are therefore of great scientific value, and need to be recognised as such.

Even more important in the years to come may well be the correct understanding of the purpose and the use of models. Just as most doctors, when performing an operation or a necropsy in later life, find that the real body does not always look like the exact replica of the anatomical model they used in their studies and that in real life blood is not red or blue depending on the place in the circulation, policy makers will have to use epidemiological simulation models for what they are. Models do not predict the future, they are instruments to help understand the complex webs of causality and underlying morbidity patterns in the health of populations and to help explore the margins within which the potential for improving that health status lie. If used correctly computer simulation models will have much to add in the years to come to epidemiological research and to evidence based policy making.

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- 2 Gunning-Schepers LJ. The health benefits of prevention, a simulation approach. *Health Policy Special Issue* 1989;12 1-2:1-256.
- 3 Wolfson MC. POHEM - a framework for understanding and modelling the health of human populations. *World Health Stat Q* 1994;47:157-76.
- 4 Barendregt JJM, Bonneux LGA. *Degenerative disease in an aging population. Models and conjectures*. [Phd thesis.] Rotterdam: Febodruk, 1998.
- 5 Brønnum-Hansen H. How good is the Prevent model for estimating the health benefits of prevention? *J Epidemiol Community Health* 1999;53: 300-5.