

Editorials

Economic modelling in public health: a tool of growing relevance

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As their colleagues in clinical medicine, decision makers in public health should require the best available evidence in order to set priorities. Decisions on public health intervention need to take into account questions of how many people are at risk, how these people and care givers will respond to different types of interventions, how effective interventions will be for different subgroups and what the costs are linked to all of this? A public health decision—even one that is not taken—is likely to at least implicitly weigh these issues. When looking for an evidence base, it may be difficult or even impossible to identify results from clinical trials that are suitable to cover all above issues. Data on the epidemiologic situation in the target population, on behaviour as well as on health and cost outcomes may be necessary to assess the decision maker's choices. Models provide an option to synthesize all data within a consistent framework. In order to be relevant, model parameters must be chosen such that the decision context is reflected appropriately. For this purpose, the best available evidence from various sources of data should be integrated. In addition, models can compare several intervention strategies, often at quite low costs for the additional strategy investigated. Accounting for uncertainty in the parameters, models can also identify the main drivers of outcomes.

Economic models inform decision makers on the health consequences of interventions and on their cost-effectiveness. In a nutshell, economic modelling means to mathematically describe the major events over the course of one or more diseases, to assign functional relationships between the health states occurring, to formally integrate interventions and their impact on the progress of disease and to add to each state health outcomes, resource use and costs. A basic type of model, decision trees, describes the consequences of different treatment choices in a single run. In case progression of disease occurs at different points in time, Markov models may be used. Markov models describe health states that are linked with each other, and that can be passed through in various cycles. Markov elements can be embedded in decision trees. Both types of model consider a fixed process of disease for one unit of observation. Mostly, this unit of observation represents the average characteristics of the cohort investigated, but it can also represent a single individual. Micro-simulation models in turn describe developments for many individuals with heterogeneous characteristics. The individual's characteristics are randomly drawn from population distributions. One type of modelling that by this way defines the whole life course of an individual right at the start of the model is discrete event simulation.¹

Surveys show that economic modelling has broadly been used for assessment in public health fields such as screening for cancer, cardiovascular disease and diabetes,² vaccination

programmes³ and physical activity programmes.⁴ There are many further studies: we searched the PubMed data base (24 March 2010) for papers from the last decade that mention in their title or abstract economic evaluation (or cost-effectiveness/-utility/-benefit) and the terms decision model/analysis/analytic, Markov model or discrete event simulation. Compared with the first half of the decade, the number of papers on modelling published 2005–09 has grown by 62%. As a tracer for public health, papers were marked that mentioned the terms prevention, screening or vaccination in their title or abstract. The number of such papers grew slightly less, but reached a total of 668 over the decade and accounted for about 30% of all modelling papers. Economic modelling is thus becoming a tool of growing relevance, not the least in public health issues.

There are, of course, constraints to the evidence derived from economic modelling. Results can only reflect what the structure and the parameter input of the models produce. Accordingly, there is a great need for transparency as well as for quality standards and control. A fairly comprehensive set of standards has been developed,⁵ and has been used by regulators such as the UK National Institute of Health and Clinical Excellence. It remains to be shown how well these standards cover the challenges of complex public health interventions. An example for validation, model parameters can be calibrated such that the model is able to reproduce real situations and trends. There is scattered evidence on the conduct of calibration, and guidance for the calibration of complex public health models is yet lacking.

Finally, new topics for modelling are likely to emerge. Information on health risks by genome sequencing is just beginning to enter health care. New technologies of screening for a wide range of health risks may develop, as well as consecutive interventions such as further diagnostics, early prevention and targeted treatment. For the assessment of health and cost impacts of such complex interventions, economic modelling seems a very likely candidate.

References

- 1 Weinstein MC. Recent developments in decision-analytic modelling for economic evaluation. *Pharmacoeconomics* 2006;24:1043–53.
- 2 Karnon J, Goyder E, Tappenden P, et al. A review and critique of modelling in prioritising and designing screening programmes. *Health Technol Assess* 2007;11:1–145.
- 3 Kim SY, Goldie SJ. Cost-effectiveness analyses of vaccination programmes - a focused review of modelling approaches. *Pharmacoeconomics* 2008;26:191–215.

- 4 Cobiaci LJ, Vos T, Barendregt JJ. Cost-Effectiveness of interventions to promote physical activity: a modelling study. *PLoS Med* 2009;6:e1000110.
- 5 Philips Z, Bojke L, Sculpher M, et al. Good practice guidelines for decision-analytic modelling in health technology assessment - a review

and consolidation of quality assessment. *Pharmacoeconomics* 2006;24:355–71.

doi:10.1093/eurpub/ckq070

From public health to population medicine: the contribution of public health to health care services

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Just as it is impossible for the citizen of today to go out into their garden and dig a well for clean and clear water, so it is impossible for them to create the health service they need when and where they need it. Like water supply, the supply of a health service requires the organized efforts of society and is therefore a public health service. Every European country is committed to ensuring that its citizens receive a health service of assured quality, just as they are committed to ensuring that its citizens receive water or education of assured quality, although the task of providing quality-assured health care is much more challenging than the task of providing quality-assured water.

In the last half century, health services have made fantastic advances due to scientific developments, which have given us resources like chemotherapy and the artificial hip, the investment of large amounts of public money and better education of professionals, all enveloped in a competently managed framework based on good evidence. In the last 50 years, health services have made a contribution to mortality reduction and to the number of years of life spent free of disability, magnitude comparable to the improvements in adult life expectancy and quality created by the public health revolutions of the previous 100 years. There is much to be proud of.

However, at the end of this half century of progress, every health service in Europe still faces five major problems—variation in quality, waste of resources, poor patient experience, health inequalities and failure to prevent the preventable. Furthermore, every health service in Europe faces four additional challenges—increasing need, growing demand, limited financial resources and, increasingly important and relevant, the need to change not only hospital energy use but also to change to a much more sustainable, lower carbon, pattern of clinical practice. These challenges cannot be met simply by more science, more money, more education and more management; they require a new paradigm—the one that uses all the best principles and skills that we have come to associate with public health.

The hospital service, for example, has to be transformed from being a lump of real estate to becoming a node in a network delivering systems of care, with clinicians in hospitals concerned not only about the quality of the service they give to the referred population but also the use of their scarce resources, including their own time, to meet the health care needs of the population that they serve. Similarly, clinicians in all sectors need to understand clinical

epidemiology so that they can offer patients unbiased information, because we know that giving people information in the form of relative risks produces a different result than in the form of absolute risk. The people who manage health care or pay for health care in future need to think of systems, not bureaucracies and of networks, not institutions. They need to manage knowledge as carefully as they manage money, and think about value as well as quality, about allocative efficiency as well as technical efficiency.

Public health professionals could deliver many benefits to health care, but in most European countries public health is semi-detached or detached from health care provision. Furthermore, there is little appetite for getting involved in the health service among some public health professionals who feel that their time and resource is better spent dealing with problems like poverty. That may or may not be the case, because there is still a lack of evidence about the effectiveness of highly paid public health professionals on the problems of poor people. But there is also resistance on the part of clinicians to the brand of public health, which they still see as being associated with a 19th century agenda; the term ‘drains’ is still used by some clinical colleagues. In some countries, it may be possible for public health involvement in health services to be more effective, but another approach is to create new language and to change the paradigm of the clinicians. The introduction of evidence-based medicine principles has helped raise epidemiology in the medical curricula, but only clinical epidemiology, not health care epidemiology. Clinicians also need to understand issues such as the significance of variations in service provision or outcome. One approach, therefore, would be to approach those involved in management, because most of the people who manage health services are clinicians but they never call themselves managers, the skills of population medicine, namely an epidemiological approach to the management of clinical services. This would complement the epidemiological approach to the consultation, which is now generally known as evidence-based medicine.

Public health can make major contributions to health services, but this might better be made as covert operations. Public health professionals need not feel that by transferring skills they are going to lead to their redundancy; as one senior public health officer said many years ago, our aim was always to work for our own redundancy because there would be plenty of new challenges once we had got other people to think the way we do. Clinicians are changing too as a major