EVIDENCE-BASED DECISION-MAKING IN PUBLIC HEALTH

David Mowat

Abstract

The deliberative use of evidence to inform decision is relatively well-developed in clinical medicine, but is only in its early development in the field of public health. Evidence can inform, but not make, public health decisions. Good decision making requires evidence which is both as valid and as relevant as possible, information on the values espoused by citizens, and many other contextual factors such as stakeholders' interests and political priorities. This paper argues that transparency in decision-making is desirable, and is facilitated by clear distinctions between the various inputs into decision-making. Scientists and policy-makers need to appreciate each other's needs.

This paper is concerned with decisions -not with decisions for individual patient care, or decisions about access to, and the distribution of, health care services- but decisions related with public health. In this context, public health means "an organized effort by society, primarily through its public institutions, to improve, promote, protect and restore the health of the population through collective action" (PAHO, 2002: 46). The public health does not direct its activities towards individuals, except insofar as such actions are taken for the benefit of the entire community or a subgroup of the community.

The functions of public health include health status assessment, surveillance, disease prevention, health promotion, health protection, and emergency preparedness and response. These functions are accomplished using a variety of levers: legislation

This paper is not endorsed by and does not necessarily represent the views of, the Public Health Agency of Canada.

(for example public health statutes), which sets out obligations and prohibitions, and provides for penalties; legislation providing for regulatory regimes (e.g. regulation over monitoring, licensing and labelling of drugs, food, the workplace, toxic substances and dangerous products); actions aimed at changing behaviours, and the underlying determinants of health (including environmental and social determinants) through education, the provision of information, community development and others; and direct preventive services such as mass screening programs and immunization. Whether formulating policy, designing programs, making the operating decisions necessary for the practice of public health, or providing information to the public, a variety of individuals, groups and institutions, is likely to be involved. Primary among these in most countries is the State, through its role in establishing health care, often through national schemes of health insurance, and nearly always through such matters as the regulation and licensing of health professionals, hospitals and laboratories, or the training of health care providers.

The role of the State in protecting citizens from threats to health is, however, the earliest and most fundamental role. For example, early as the fourteenth century, legislation in both England and the Republic of Venice attempted to prevent, or contain hazards to health. Although the State is the source of the authority to take decisions to protect and promote the health of the public, that authority is in practice dispersed among various levels of government, such as institutions and agencies created by governments, as well as healthcare providers and non-governmental organizations.

From Evidence-Based Medicine to Evidence-Based Public Health

The varied objectives, programmes and actions taken in the name of public health must be founded on empirical evidence. There is a widespread recognition of the need to use information more effectively to inform policy-making, program development, and operational decisions in public health. The volume of information potentially available for use in public health is very great indeed. Some of it is in the form of observational data -health surveillance data and health status data- and some arises from research activities. Evidence-based decision-making means using this information to inform the making of better decisions. In

clinical medicine the collection and use of empirical evidence (data) is highly developed. The practice of clinical care based on this data is called Evidence Based Medicine (EBM). While EBM has been criticized (Raphael, 2000: 355; Kemm, 2006: 320) for failing to take into account the context of decision-making, and for relying mainly on evidence from highly selective randomized controlled trials, it is widely accepted that EBM has led to more rational and cost-effective clinical care. Can we use EBM in public health -evidence based public health (EBPH)? In both, EBM and EBPH decisions are based upon evidence, with contextual factors taken into account rather than being made by evidence (Woolf, Grol, Hutchinson, Eccles & Grimshaw, 1999: 527; Muir Gray, 2004: 988). It is true, however, that there are important differences between EBM and EBPH.

First, the unit of analysis in public health is often a population rather than an individual. Second, randomized control trials are seldom possible, and a wide range of other evidence, including quasi-experimental and observational studies, must be used. Third, contextual factors may be more important in public health decisions than in decisions related to clinical practice or health services management.

Lastly, decision-making for public health tends to be more complex than decision-making in a clinical setting. It involves assessing the likely impact of policies and other complex interventions, often over the long term (Mowat & Hockin, 2002:19). The model based upon a comprehensive summary of the relevant evidence being presented to the decision-maker at the appropriate point in time, and being fully utilized in arriving at a decision is an oversimplified version of the real world. In reality, decision-making in public health is not a single event, but a diffuse, even haphazard process with many stages spread over time, and with no clear and predictable relationship of the stages (Lomas, 2000: 42). Research studies of efficacy and effectiveness are only one kind of evidence which is required for these complex decisions. Interaction between researchers and policy-makers, and indeed between researchers and stakeholders, may occur at many points: hypotheses may be generated, theories expounded, and findings of greater or lesser degrees of certainty be presented. Policy formation is thus an extended process rather than one occurring at a single point in time.

As an added complication, policies are seldom developed in isolation. In public health, as in health services management, there is a hierarchy of decision-makers, with different decisions being taken at different levels. Decisions taken at one level commonly affect or constrain those taken at the other levels. In the clinical world, a professional association may develop a clinical guideline, but this must be followed by decisions by individual practitioners who will apply them to individual cases. In public health, legislation at the national or state/provincial level may impose duties, such as the provision of services or the inspection of potential hazards to health, on regional health authorities or municipalities; governments may mandate the establishment of regional or local organizations, and set their governance and funding, health care providers may be required to provide reports, etc. This is entirely appropriate as no one party -governments, citizens, health care providers, or the private sector- has the combination of authority and information necessary to make all the decisions which direct the complex systems necessary to protect, promote and restore health. Citizens may expect equal protection wherever they live within the boundaries of the State, and the private sector may expect consistency of public health measures in order to minimise impediments to trade. Both of these will require policy decisions at the national, or at least at the state/provincial level. Tailoring programs to local needs, or enforcing legislation, will demand that decisions be taken lower down the hierarchy. Each level of the hierarchy relates to a different universe within which choices are made. Thus providers are concerned, usually, with the interactions with individual patients without regard to its impact on others. Regional authorities must make decisions balancing the provision of different types of care, but only within the region, and they are usually concerned with health services only. Governments, however, need to provide not only health services but all other services in the public sector: health care needs as a whole must be balanced against the need for other services, such as education or social services. In any case, it is obvious that the decisions that may be made by any policymaker will be constrained by relevant policy decisions which are taken higher in the hierarchy.

Evidence

Decision making in public health involves the collection and analysis of evidence concerning the likely effects of various interventions or courses of action. But evidence of this type is a necessary, not a sufficient, condition for good decision making. Evidence informs, but does not dictate, policy. Decisions are made within a context. Each of these issues: evidence, and context have received some attention from researchers and commentators.

Guyatt, Haynes, Joeske, Cook, Green, Naylor, Wilson & Richardson (2000: 1292) have described evidence as "any empirical observation about the apparent relationships between events; Culyer (2006: 5) refers to "anything that claims to be an empirical fact which gives a reason for believing that thing, or something to which it relates, like a consequence that might reasonably be expected to flow from it". But, evidence of what? And how reliable is it? Dobrow, Goel & Upshur (2004: 211) describe a model showing an inverse relationship between the evidentiary quality of data and its relevance. Thus, the types of evidence preferred in clinical medicine may demonstrate relationships with a high degree of certainty, but, even if available, would not be fully relevant to policy making in public health. This observation is helpful, but one should note that, for a given degree of relevance, rational behaviour would still require the use of the best evidence available. One way to increase the relevance of research findings is to involve decision-makers in the process from the beginning. Some granting bodies now require this approach when funding highly-applied research. Moving beyond the classic hierarchy of evidence used in evidence-based medicine does not mean that we have to believe that all evidence is equally valuable. High-quality evidence which is irrelevant to the decision being considered is obviously useless, but so is evidence which is apparently relevant but nevertheless wrong or misleading.

Different types of evidence are to a greater or lesser degree supportive of different types of decision. For example, well-controlled, quantitative and quasi-experimental studies are best able, if available, to assess efficacy; whereas qualitative studies may be more relevant to understanding how an intervention works, or its feasibility and acceptability (Petticrew, 2003: 528; Culyer, 2006: 10). The central issue of evidence thus becomes, not a single hierarchy, but the appropriateness of each type of evidence to its intended use. Raphael (2000: 363) advocates the use of

multiple sources of evidence. There is thus a possible middle ground between a futile attempt to force-fit the hierarchy of evidence of EBM into public health on one hand, and the denial or neglect of the place of evidence in public health decisions on the other. Some (Smith, Ebrahim & Frankel, 2001: 185) believe that there are circumstances in which evidence is not needed because the solution is obvious. Whilst a strict reliance on good evidence for every decision that has to be made in a day's work is obviously not possible, one should bear in mind, that those beliefs once thought "obvious" have since been proven to be erroneous. Thus, although the methods of the evidence-based medicine movement may not always apply to policy making, there are indeed issues concerning the quality of evidence in EBPH, and this requires to be assessed just as much as its relevance.

Another helpful observation about evidence concerns certainty. Thus the values for type 1 (inferring a difference when in truth there is none) and type 2 (inferring that no difference exists when in truth it does) demanded in clinical medicine may be inappropriate in public health. Kemm (2006: 322) points out that in the policy world few decision-makers expect to be correct 19 times out of 20 and a higher risk of type 2 errors may therefore be acceptable.

Decision Making in Context

The term "context" is used to describe all of the factors within an environment where a decision is made, which might influence that decision and its outcomes. The analysis of context in the public health literature is inconsistent. It may be helpful to recognize context as being of two types: the relevance of the evidence -the applicability of evidence generated in one set of circumstances to decisions regarding other circumstances-, and the totality of all considerations other than the evidence which must be taken into account at arriving at a decision. One might term the first type the "internal" context i.e. it relates to the nature of the evidence itself. Here the question is whether the evidence provides the answers to the questions that one might ask in practice. Beyond whether the proposed action can work (efficacy), one might ask whether it does work in the real world (effectiveness), at what cost (efficiency), how the benefits and risks are distributed (equity) whether it is acceptable (acceptability and compliance), whether it is worth doing, whether the capacity is

available, whether the findings are applicable in the external context, etc. It is obvious that obtaining evidence on all of these points is a challenge, and that not all of this evidence, at a high degree of certainty, would necessarily be available at the time of a decision, especially if it concerns a novel intervention. Often the applicability of the evidence to a particular set of circumstances is an issue for decision-makers. Is evidence obtained by studying a population of a particular socio-economic status, or ethnic origin, in a particular country, truly helpful in deciding what to do in circumstances which differ in one or more of these respects? In this respect health evidence forms an interesting contrast to legal evidence. As Eisenberg (2001: 375) points out "the law relies on evidence of the instance: health care relies on evidence of the generalizable". Unfortunately, if one finds evidence with which one disagrees (or, more accurately, with the implications of which one disagrees), it is all too easy to argue that it does not apply to the particular circumstances in question. It would be wise, rather, to search for the available evidence which is most relevant and to extrapolate wisely from one set of circumstances to another. Also part of the internal context are disease-specific factors, derived from epidemiological data, concerning the incidence and/or prevalence of diseases, risk factors or determinants, and their distribution within the population. This can provide information on the magnitude of the problem, and thus on the potential impact of the policy.

The "external" context is more far-ranging and complex. It encompasses all those factors which are necessarily taken into account when arriving at a decision about policy. These include social, economic, legal and ethical factors, as well as the opinions and interests of the public, professional, industry, labour and other stakeholders. Decision-makers also often want to know what is being done in other jurisdictions. Competing priorities within a constrained budget are, in practice, one of the most important factors. The government or other decision-makers may also have political priorities, including those laid out in one form or another of published plans or priorities. Other contextual factors include the history of the issue, i.e. what has been done before, and its severity.

Values

Empirical evidence is concerned with reality. But in practice decisions are often simultaneously about the real and the normative, about what is, and what we would like to be. Values -things that society would like to achieve- therefore have an important place in decision-making in health. At this point, we have moved beyond the dispassionate observation of reality. Good clinical practice recognizes that the patients' preferences and values are an important consideration in decision-making. Similarly, in the management of health services, and in public health, the values of the community must be taken into account. Whilst evidence of effectiveness is the most important input into clinical decisions, at the population level efficiency and equity become important. Resources are limited, and must be used with some attention to their distribution to support a full range of services and to produce the greatest benefit possible. Decision-makers must also consider not only the objective of improving overall health status, but also its distribution: policy-makers must use judgement in deciding on how much to focus on overall improvement, and how much on reducing inequalities. There are many possible outcomes of public health interventions, including effects upon morbidity, mortality, disability, pain and suffering, and many others. In order to compare the effects of different interventions, and thus to be able to make decisions, for example about the allocation of resources, one must have a means of quantifying and aggregating these multiple effects. There is not one accepted method of aggregating these effects into a single index. Although indices such as Quality-Adjusted Life Years (QALYs), Disability-Adjusted Life Years (DALYs), Health-Adjusted Life Expectancy (HALEs), Potential Years of Life Lost (PYLLs) and others are useful, they cannot address all issues simultaneously and are only applicable to a limited range of issues. There are also challenges in understanding and handling the values which are inherent in the production of these indices. The challenge still remains the assessment of the relative value of different types of outcome. At present, these indices are more used in health services management than in public health.

The values of individuals and communities are thus an important contextual factor which must be taken into account when making decisions in public health. Muir Gray (2004: 988) comments that clinical decision making requires taking into

account the values which patients place upon benefits and harms, and that the same approach is applicable at the population level. However, at the population level, the preferences of individuals may impact on other members of society, and decisions must be made which will concern the distribution of benefit, and potentially also harm, amongst various subgroups of the population. A typical issue in health services management is how to distribute scarce resources, e.g. between the young and the aged. In public health one must often balance the rights of individuals against the welfare of the whole population.

Ethical issues of relevance to clinical practice are well known examples and include: codes of professional ethics, research ethics, and clinical ethics. In all of these cases the emphasis is upon the autonomy of the individual, as well as beneficence and non-maleficence. In public health, ethical issues tend to involve the balance between the rights of the individual and the protection of the health of the population and involve concepts such as equity, equality, protection of the vulnerable and marginalised, avoidance of stigmatization, the precautionary principle, privacy, confidentiality, liberty and respect for autonomy (Joint Centre for Bioethics, 2005: 6). However, it is clear that ethics for public health has not received the attention afforded to clinical ethics or distributional ethics and that more work is necessary to produce a widely-accepted and widely-applicable framework for public health ethics. In both cases, there are expectations and values concerning the processes which institutions use to arrive at decisions: these procedural and institutional values include fairness, accountability, transparency, trust and stewardship.

In clinical practice it is relatively easy to ascertain the values of individuals. In public health this is much more of a challenge, and only recently has attention been paid to the determination of the values held by the public. Some level of public participation is usual in arriving at decisions affecting health at the population level. This can range from public communication in which the flow of information is from decision-maker to public and includes advertisement, publication of reports, websites, etc.; public consultation which allows for information to flow from the public to decision-makers, including public meetings, opinion polls, etc.; and public participation, meaning the exchange of information between public and decision-makers and an interactive process of deliberation involving both parties (Abelson, 2006: 3). In public consultation there is the potential, for example, to select only those

of known, and possibly sympathetic views for advisory committees, or to place little value upon findings. In public participation, the agenda is brought on less under the control of the decision-makers, and the process is more open and transparent. In none of these, however, are citizens actually making policy decisions: they are providing advice and an insight into the views of the general public. Care must be taken in assessing the validity and generalisability of findings concerning public views on ethical questions. The answers received may depend upon the form of the question and the nature of information provided to the respondents (Ham, 1990: 436).

One challenge in public involvement is distinguishing between stakeholders and the general public. Public consultation through meetings frequently results in participation on the part of stakeholders, but fails to identify the more general public interest. In the U.K. (Culyer, 2006: 16), The National Institute for Health and Clinical Excellence (NICE) uses a system of citizen panels to provide advice on matters involving values. These panels are chosen to be roughly representative of the entire community, meet in public, and direct their own process. In Australia, this has been taken one step further with the use of citizens' juries, with members randomly selected from the electoral roll (Mooney & Blackwell, 2004: 76). These juries are presented with balanced evidence and given time to discuss and deliberate, and are able to identify debate issues of broad principle, such as equity. They might, for example, be called upon to comment on the effect of the age of the target population on the relative value to be placed on the outcome, or on the balance between restriction of freedoms and the need to protect the public from hazards to health.

Scientists and Policy-Makers

There is a large body of literature on how information is processed during decision-making, and a larger one on how policies are made. It is not my purpose here to discuss either of these, but to point out some of the factors affecting the interface between scientific evidence and decision-making in the health field.

It is perhaps taken for granted today that a decision reached with the assistance of a thoughtful review of the evidence will necessarily be a better decision than one lacking that assistance. This has not always been the case. Eisenberg (2001) speaks of

"eminence-based decisions", in which the influence upon decision-making is not evidence, but reliance upon the fame or credibility of the informant. For centuries the reliance was not upon expertise, but on authority: those in power said what was to be done and that was the sum total of the process.

Moving beyond the issues of relevance and context noted above, other characteristics of evidence have been noted. Decision-makers prefer certainty: evidence presented as probabilities, or with a long list of qualifications, may be less influential than other simpler and more certain information. Decision-makers may be confused by studies with conflicting results. Evidence is not the only form of knowledge: Nonaka and Takeuchi (1999: 56) describe how several types of tacit knowledge "the way we do things around here" supplement explicit knowledge. EBM is a maturing science about which much is known; yet we know that evidence is poorly used in practice (Davis, Thomson, Oxman, and Haynes, 1995: 700) and that systematic reviews of evidence or guidelines infrequently influence clinical decisions.

If this is true for EBM, then surely it must be even more the case for public health with all of the complexities mentioned above. This can be the cause of disappointment on the part of both researchers and decision-makers. Researchers want to know why the evidence which they have produced does not have more influence upon policy decisions, and policy-makers want to make decisions more influenced by evidence, but are frustrated by the low relevance of the available evidence, its uncertainty, and a lack of timely access to it.

We have seen how good decision-making in public health must take into account not the scientific evidence, but also all of the contextual factors. Two questions that arise from this are: how is the evidence to be chosen and assembled, and how does the evidence interact with contextual factors?

Scientists need to understand that public health research ultimately deals with the levers of public health policy and their impact on populations, and is of interest only if translated into policies. These policies may be "sensible", rather than (in the view of the scientist) "rational" (Lomas, 2000: 143). Scientists cannot expect to have their findings automatically translated into policy. They should understand that policymaking is not a simple process, and should be prepared to provide a variety of different types of information over an extended period. Lomas (2000: 142)

speaks of the difficulty, sometimes impossibility, of changing beliefs. Whilst this is true, it should be borne in mind that many decisions do not involve firmly-held beliefs: public health professionals may be seeking guidance in how best to address a health issue, or policy-makers may be seeking advice on a new problem about which they have an open mind.

It is the responsibility of policy-makers to specify exactly the question which they expect to be answered. They need to be realistic about how much of the evidence that they seek will be available, and about the length of time necessary to acquire additional information. Policy-makers need to gain some understanding of the different types of evidence and their value. Although policy-makers will seldom be experts in science, it is an advantage for them to have some understanding of the scientific process, and appreciate the significance of different types of study. For example, hypotheses generated by "dredging" existing large databases, single studies, and systematic reviews differ in their significance. There should be an appreciation that different studies can reach different conclusions, and that this is not an indication of poor science. There should also be some appreciation of the limitations of studies, and the hazards of extrapolating from the context of the study to another, very different context, the difference between association and causation, and between absence of evidence and evidence of absence. However, scientists must always be prepared to explain the implications and limitations of their work.

Transparency

Scientists and policy-makers have different roles. Scientists are concerned with the search for truth, deal with uncertainty, pursue their quest through comprehensive, unbiased and stringent methods of observation and analysis, and expect their results to be refuted or validated by their peers.

Science may provide valuable information to aid decision-making: it might also be used either to influence decisions in favour of certain interests or ideologies, or to provide post-hoc justification for a decision already taken. The goal must be to ensure that relevant, high quality evidence is first produced, and then used in the decision-making process. Scientists are accountable for the quality of the evidence, policy-makers for the outcome of the chosen policy.

Recently there have been concerns (Nature, 2006, Rosenstock & Lee, 2002) that the integrity of science is being affected by efforts by governments, industry and professional groups to favour particular interests or ideologies. Among the possibilities are the conscious directions of research funds away from ideologically-sensitive areas of enquiry, pressure to change findings, subtle or informal constraints on controversial work, or even suppression of findings. Garrett (2000) provides insight into how one totalitarian regime corrupted science for decades. There is no reason to believe that these influences are widespread in most countries, but vigilance is necessary.

Scientific publications are the way in which scientists communicate their findings among themselves, contribute to the body of knowledge, expose themselves to open criticism by their peers, and build a career; and is a key step in the validation process for scientific knowledge. Publication is also the basis for effective knowledge translation. The integrity of the published knowledge base must be preserved. Measures are being taken, for example, to limit the potential influence of the pharmaceutical industry through the movement to register all clinical trials, thus ensuring that those with adverse results are not withheld (De Angelis et al., 2004), and there is an increasingly common requirement of medical journals for authors and editors to declare sources of funding and competing interests (Lexchin & Light, 2006). Other measures include policies prohibiting the pre-publication review of scientific papers by employers or donors. Some scientists, for example those working for government, have an obligation to demonstrate a wise use of resources and the achievement of objectives. In these cases, assignment of tasks and review of work for quality by a suitably-qualified supervisor is appropriate. The true test of transparency in science is whether the results of scientific enquiry are made freely available to everyone.

Public health science is characterized by a relatively large proportion of gray literature, that is, documents not published in the international scientific literature and therefore not accessible by searching the well-known databases. This is an important part of the evidence-base, and should be made accessible to those wishing to summarize all of the available evidence. Investment in cataloguing and providing access to the gray literature is important. Beyond ensuring that evidence is produced and made accessible, one must ensure that decision-making makes the best possible use of all of the evidence. This is, of course, more

complex than merely using all of the studies on a particular issue, as they will inevitably vary in their quality and relevance. However, there is a developing science which provides guidance on how to best summarise the evidence in a way which maximises its usefulness to knowledge translation by decision-makers.

Knowledge Translation

Knowledge translation is the process of supporting the uptake of health research and facilitating its influence upon health policy. Briefly, it involves summarizing the available evidence (e.g. through a systematic review or meta-analysis), providing access to the summary to decision-makers, and working with decision-makers to bridge the gap between knowledge and action. It also involves identifying gaps in knowledge and conveying this information to the research community. Its potential beneficiaries include any person or institution seeking to make a well-informed decision about public health, and this includes governments, other policy-makers, industry, professionals, and non-governmental organizations.

Techniques of knowledge translation are not limited to formalized processes based on synthesis of the literature, but include the transfer of tacit and implicit knowledge and socialization and communities of practice (Keifer, 2005: 6). This process is more involved, and more effective, than merely "pushing" research findings at decision-makers. If individual scientists were to establish relationships with policy-makers and promote their own findings, the evidence could become distorted. Face to face interaction between the scientist and the policy-maker will be more effective than a written summary, but is more likely to be biased. Individual scientists will naturally have a positive opinion of their own work.

Investments in research should be supplemented by investments in knowledge translation if knowledge is to be put into use. There is a need to provide the means to synthesize evidence, bring together researchers and policymakers to exchange knowledge, develop and utilize electronic methods of accessing the knowledge base, to develop new and more appropriate methodologies for synthesizing public health evidence, and continue to learn about the process of using evidence in public health decisions. The users of public health evidence seek structures and processes for knowledge translation for public

health which are responsive, produce results rapidly, and which are autonomous and credible (Keifer, 2005: 10).

A properly functioning infrastructure for knowledge translation in public health would greatly increase the choices of being able to respond to the needs of decision-makers within the time they have available before the decision must be made, evidence or no evidence. Once a systematic review has been completed, it may be updated as new evidence becomes available. It is also potentially cost-saving, as reviews of evidence are frequently repeated: because there is no currently single place to find systematic reviews, guidelines, etc. Optimally, this infrastructure would also have an international element. At present, knowledge translation in public health is proceeding slowly, mainly because there is not yet a sufficiently large cadre of scientists and professionals with the appropriate skills.

Some countries have established programs to undertake knowledge translation. These include Canada's National Collaborating Centres for Public Health, the Canadian Population Health Initiative, the United States Task Force on Community Preventive Services, the International Campbell Collaboration, and the UK's National Institute for Health and Clinical Excellence. Placing these in arm's-length organizations facilitates the development of the necessary infrastructure (which is different from research infrastructure), and also demonstrates transparency. Other institutions may also perform primary research and undertake knowledge translation as well as develop guidelines, investigate outbreaks, and provide expert technical advice, and may also provide laboratory services or other direct services (Naylor, 2003: 78). These are increasingly set up as arm's length organizations. They have a high proportion of scientific and professional staff.

An Effective Relationship

Too often decisions are made without using evidence optimally: evidence is lacking, or decision-makers cannot make sense of complicated or irrelevant evidence, or summaries of the evidence have been done but are inaccessible, or there is a reliance on information from interested parties on expert opinion, or the selection of evidence is biased perhaps unconsciously, by preconceived notions.

Better decisions require distinct roles for scientists and policy-makers. Each has a question to answer. For scientists it is a realist question; what does the sum of the entire available, dispassionate, objective, disciplined enquiry say about relationships between an action and its consequences, or some similar empirical question? For policy-makers it is a normative question; taking into account both the evidence and all other relevant factors, what should be done?

There are differing views on the most effective and appropriate relationship between scientists and decision-makers. Some (Lomas, 2000: 142) advocate a close relationship and involvement by scientists in developing policy. Others (Muir Gray, 2004: 988) distinguish between decision-making –by setting out all of the evidence before the decision-maker-, and decision-taking- the job of the policymaker. The risk of being very close to the policy making process is that the scientist will unconsciously select and interpret the evidence in favour of a preferred course of action.

Evidence based decision-making in public health presents opportunities to develop a strong knowledge base, and one more relevant to the needs of policy-makers and practitioners; to strengthen public confidence in both science and in decision-makers and, most importantly, to make decisions which are more likely to produce the intended result.

REFERENCES

Abelson, J. 2006. Primer on Public Involvement. Prepared for the Health Council of Canada. Ottawa.

Culyer, A. 2006. Deliberative Processes and Evidence-Informed Decision-making in health care. Toronto: Institute of Work and Health. http://www.irpp.org/events/archive/nov05JDI/culyer.pdf Downloaded on June 13th 2006.

Daniels, N. 2000. "Accountability for Reasonableness". *British Medical Journal* 321:1300–1301.

Davis, D.A., Thomson, M.A., Oxman A.D. and Haynes, R.B. 1995. "Changing physician performance: a systematic review of the effect of continuing medical education strategies". *JAMA*. 274:700-705.

De Angelis, C., Drayen, J.M., Frizelle, F.A., et al. 2004. "Clinical trail registration: a statement from the International Committee of Medical Journal Editions". *Canadian Medical Journal*, 171 (6) 606-607.

Dobrow, M.F., Goel, V. and Upshur, R.E.G. 2004. "Evidence-based health policy: context and utilization". *Social Science and Medicine* 58:207-217.

Eisenberg, J.M. 2001. "What does evidence mean? Can the law and medicine be reconciled? " *Journal of Health Politics, Policy and Law*, 26 (2) 369-

382.

Garrett, L. 2000. *Betrayal of trust: The collapse of global public health*. New York: Hyperion.

Guyatt, G., Haynes, R.B., Joeske, R.Z., Cook, D.J., Green, L., Naylor, C.D., Wilson, M.C., Richardson, W.S. 2000. User's guides to the medical literature. XXV. "Evidence-based medicine: principles for applying the users guides to patient care". *JAMA* 284 (10): 1290-1296.

Ham, C. 1990. "Priority setting in the NHS: reports from six districts". *British Medical Journal* 307: 435 - 445.

Keifer, L., Frank, J., Mowat, D., et al. 2005. Fostering Evidence-based Decision-making in Canada: Examining the Need for a Canadian Population and Public Health Evidence Centre and Research Network. 96 (3) I 1-20.

Kemm, J. 2006. "The limitations of 'evidence-based' public health". *Journal of Evaluation in Clinical Practice,* 12 (3):319-324.

Lexchin, J. and Light, O.W. 2006. "Commercial influence and the content of medical journals". *British Medical Journal* 332: 1444-1446.

Lomas, J. 2000. "Connecting Research and Policy". *Canadian Journal of Policy Research* ,1:140-144.

Mooney, G.H.and Blackwell, S.H. 2004. "Whose health service is it anyway? Community values in healthcare". *Medical Journal of Australia*, 180 (2): 76-78.

Mowat, D. and Hockin, J. 2002. "Building Capacity in Evidence-based Public Health Practice". *Canadian Journal of Public Health*. 93: 19-20.

Muir, J.A. 2004. "Evidence based policy making". *British Medical Journal* 329:988-989.

Nature. 2006. Science under attack. Nature 439, 891.

Naylor, C.D. 2003. National Advisory Committee on SARS and Public Health. Learning from SARS. *Renewal of Public Health in Canada*. Ottawa: Health Canada Publications.

Nonaka, I. and Takeuchi, M. 1995. *The knowledge-creating company*. New York: Oxford University Press.

Petticrew, M. and Roberts, H. 2003. "Evidence, hierarchies, and typologies: horses for courses". *Journal of Epidemiology and Community Health* 57:527-529.

Raphael, D. 2000. "The question of evidence in health promotion". *Health Promotion International* 15 (4) 355-367.

Rosenstock, L. and Lee, L.J. 2002. "Attacks on science: the risks to evidence-based policy". *American Journal of Public Health*. 92 (1): 14-18.

Smith, G.D., Ebrahim, S. and Frankel, S. 2001. "How policy informs the evidence". *British Medical Journal* 322:184-185.

University of Toronto Joint Centre for Bioethics Pandemic Influenza Working Group 2005. Stand on Guard for Thee. Ethical Consideration in Preparedness Planning for Pandemic Influenza. http://www.utoronto.ca/jcb/home/documents/pandemic.pdf. Downloaded on June 13th 2006.

Woolf, S.H., Grol, R., Hutchinson, A., Eccles, M. and Grimshaw, J. 1999. "Clinical guidelines: potential benefits, limitations and harms of clinical guidelines". *British Medical Journal* 318: 527-530.

ABOUT THE AUTHOR

David Mowat graduated in medicine at the University of Edinburgh, and in public health at Berkeley, California, and is a fellow in community medicine of the Royal Colleges of Physicians and Surgeons of Canada. After several different appointments as a public health physician at local, provincial and national levels, he is currently Deputy Chief Public Health Officer at the Public Health Agency of Canada, where his interests include public health human resources and knowledge translation. He holds appointments at Queen's University and the University of Ottawa.