# What should public health research focus on? Comments from a decision analytic perspective

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Scientific articles often end with 'further research is needed...'. However, further research in one specific area consumes resources that could have been needed to address other research questions, or could have been used for public health interventions—and improve health—instead of filling journals. How can the desirability of further applied research be substantiated in the face of scarce resources?

While the tools of statistical inference can establish when evidence is insufficient they cannot address whether it is worthwhile to invest scarce resources into an improvement of the evidence base. A methodological alternative is Bayesian cost-effectiveness and value of information (VOI) analysis, which can address decisions on both technology adoption and research priorities in a coherent manner.[1]

Cost-effectiveness analysis compares the ratio of additional costs and effects of an intervention like a screening program, expressed in the form of an incremental cost-effectiveness ratio (ICER = $\Delta C/\Delta E$), to a threshold value. This threshold value, often referred to as $\lambda$, represents the incremental value forgone by not using the scarce resources elsewhere. In the context of a controlled budget increase, it represents the willingness to pay for a health gain, e.g. determined by a public decision maker who compares the value of investments in health to investments in other fields like education. In the context of a fixed budget, it represents the incremental cost per health gain of the programme(s) that would have to be displaced in order to fund the intervention under investigation. The UK National Institute for Health and Clinical Excellence currently uses an administrative rule of thumb as an estimate of $\lambda$ of approximately £20–30 000 per quality-adjusted life year.[2] Equivalently to using ICERs, the funding decision can be based on whether or not the net monetary benefit ($\lambda \times \Delta C - \Delta E$) or the net health benefit ($\Delta E - \Delta C/\lambda$) exceed zero.[1]

Bayesian decision-analytic models reflect the uncertainty of the costs and effects associated with alternative interventions by assigning distributions to input parameters. As an example, among other factors, the cost-effectiveness of screening for hereditary hemochromatosis depends on the mortality associated with the condition, test uptake in a screening program and the cost of testing and counselling in a routine setting.[3] Instead of point estimates, a Bayesian decision-analytic model incorporates probability distributions for these variables, e.g. derived from a quantitative synthesis of published studies.[3] Further information is valuable for the decision maker if there is any possibility that a wrong decision might be made. This is the case if the mean net benefit is positive, yet the distribution of outcomes includes negative values. Alternatively, a negative mean net benefit may suggest rejecting the alternative although there is some probability that the net benefit is positive.[1]

The expected value of perfect information (EVPI) is the difference between the net benefit that could be achieved if all uncertainty was resolved and the expected net benefit achieved if the decision is based on the current evidence. It can be computed from the results of a Monte-Carlo simulation.[4] To assess which parameters or groups of parameters are of highest priority for further research, the EVPI can also be calculated for a single parameter or a group of selected parameters (termed expected value of partial perfect information, EVPPI). Typically, parameters are grouped according to policy relevant research designs necessary to gain further information. This allows comparisons of the potential value of alternative study designs. In the example above, the EVPPI of variables which could be informed by a pilot study (e.g. test uptake and costs) could be compared with the value of an observational study to increase knowledge about the long-term mortality associated with hereditary hemochromatosis.

Generally, the concepts of Bayesian cost-effectiveness and VOI analysis provide lessons for the prioritization of public health research: research is likely to be most valuable if it addresses interventions with high budget or health impact; for which the expected cost-effectiveness is close to the payer's threshold value; which target large populations; and for which high decision uncertainty remains.[4] Also, research should focus on those areas within decision problems for which new information is most likely to influence whether or not to recommend a given intervention. Additionally, the potential knowledge gains and costs of different study designs as well as practical issues need to be considered.[5]

There is value from research which cannot easily be captured by decision-analytic methods. For example, VOI analyses only demonstrate the value related to a single decision problem—not spillovers to other areas where the knowledge also can be applied. More generally, benefits from research comprise development of scientific methodologies, networks, skilled graduates and impact on innovation and growth.[6] And, there may be a justified political will to fund research in fields without any quantifiable benefit, e.g. in some fields of philosophy or arts.

Nevertheless, the reference of what public health research adds to solving decision problems in promoting public health can help prioritize research to areas where it is most likely to make a difference. Given that wrong decisions direct scarce public health resources away from cost-effective interventions and thus decrease the health benefit that can be

attained, such valuable research pays off not only in journal articles but also in health improvements.

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