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PRIORITIZING INVESTMENTS IN HEALTH TECHNOLOGY ASSESSMENT

Can We Assess Potential Value for Money?

Linda Davies
Michael Drummond
University of York

Panos Papanikolaou
University of Wales

Abstract

Objective: The objective was to develop an economic prioritization model to assist those involved in the selection and prioritization of health technology assessment topics and commissioning of HTA projects.
Methods: The model used decision analytic techniques to estimate the expected costs and benefits of the health care interventions that were the focus of the HTA question(s) considered by the NHS Health Technology Assessment Programme in England. Initial estimation of the value for money of HTA was conducted for several topics considered in 1997 and 1998.
Results: The results indicate that, using information routinely available in the literature and from the vignettes, it was not possible to estimate the absolute value of HTA with any certainty for this stage of the prioritization process. Overall, the results were uncertain for 65% of the HTA questions or topics analyzed. The relative costs of the interventions or technologies compared to existing costs of care and likely levels of utilization were critical factors in most of the analyses. The probability that the technology was effective with the HTA and the impact of the HTA on utilization rates were also key determinants of expected costs and benefits.
Conclusions: The main conclusion was that it is feasible to conduct *ex ante* assessments of the value for money of HTA for specific topics. However, substantial work is required to ensure that the methods used are valid, reliable, consistent, and an efficient use of valuable research time.

Keywords: Health technology assessment, Priority setting

Given the large number of health technologies that could potentially be evaluated, no country has the resources available to undertake all the assessments it would

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ideally require. Some technologies, such as heart transplantation or breast cancer screening, have been assessed in a number of countries and settings. In contrast, the majority of technologies used in health care have not been the focus of broad evaluations to determine the policy and practice implications associated with them (1). Some economies of effort can be realized through the closer collaboration of national health technology agencies, e.g., through the International Association of Health Technology Agencies (INAHTA). However, there is still a need to set priorities among the assessments that could be carried out (1;11;16;22;28).

Priorities can be set according to a range of criteria, using various methods to systematically weight or score each topic (2;3;8;11;18;19;23;24;26). An important criterion relates to the *value,* in improved information for decision making, from undertaking a given assessment (2;3;11). Some authors have referred to this as "payback" (2). Several authors have discussed the issue of payback from health technology assessments (HTAs) or approaches to prioritizing the HTA effort. In a seminal paper, Eddy (11) outlined a model for determining priorities. Detsky (6) and Drummond et al. (9) undertook *ex post* assessments of particular research studies. For example, Drummond et al. estimated the costs and benefits of conducting the Diabetic Retinopathy Study (DRS), a large randomized controlled trial of laser photocoagulation treatment for diabetic retinopathy. They considered two states of the world, one with the study and one without, and estimated the likely impact of the trial results on the costs and effects of treatment.

Buxton and Hanney (2) defined payback in a broader sense, to encompass not only the impact of research on health and health care, but also on knowledge more generally. They also suggested that research could meet a range of political and administrative needs, and illustrated their approach by conducting *ex post* assessments of a range of research projects undertaken in the United Kingdom.

Several authors have recognized the need for *ex ante* analysis of the value of research and the additional challenges this raises. Attempts by Buxton and Hanney to assess the payback from four proposed projects were not very successful. In addition, preliminary papers from the PATHS project (15) outlined a number of difficulties. However, if HTA agencies are to consider value for money or payback in making decisions about priorities for assessments, *ex ante* analyses are required and more exploration of the problems are needed (16;20). This paper addresses these issues in the context of the support given by the National Coordinating Centre for Health Technology Assessment (NCCHTA) for decisions about priorities made by the Standing Group for Health Technology Assessment (SGHT), as part of the NHS Research and Development Programme in the United Kingdom.

THE NCCHTA AND PRIORITIZATION

The National Coordinating Centre for Health Technology Assessment (NCCHTA) was established in 1996 to manage and develop the NHS Health Technology Assessment Programme. The principal tasks of the NCCHTA are: a) identification of important (to the NHS) underevaluated health technologies; b) supporting the SGHT and its advisory panels in the clarification and prioritization of these, through the provision of relevant information; c) commissioning research; d) monitoring and assessing commissioned research and; e) communicating openly about the processes and products of the HTA program.

Each year approximately 1,000 potential topics are identified by the NCCHTA, excluding topics where there is finished or ongoing research elsewhere. These are

subdivided into six broad areas, for discussion by six expert panels. The panels meet biannually to prioritize topics in acute sector care, primary and community care, diagnostic and imaging, screening, and pharmaceuticals and methodology. For the first meeting, the panels are given brief information about the technology area, the reason for evaluation, the source of demand for evaluation, and the patient group. At this stage the information given to the panels can be very nonspecific. The panels select approximately 100 topics, for which vignettes/expert papers are prepared.

The vignettes summarize available clinical, epidemiological, and cost information about the topic and broad research questions to be addressed. At the second round of panel meetings the 100 topics are discussed in detail. The technologies, target groups, and initial research questions are refined and approximately two-thirds of the topics are selected for consideration by the SGHT. The SGHT finally selects over 40 topics to be commissioned each year.

The decision-making criteria at each of these stages include consideration of economic factors and potential value for money in terms of the importance of the question (economic burden of disease), the degree of current uncertainty, trajectory of diffusion of the technology, and the cost of research. However, paucity of data make it difficult to quantify all of these variables and relate them in an explicit economic framework to assess the potential value for money of research. Thus, there are potential benefits from the development of an economic model to provide structured economic information for the prioritization process.

METHODS

A pilot study was conducted to assess the feasibility of providing broad cost and outcome information for the first round of the prioritization process. Three criteria were set to judge the quality and potential value of the data. First, there is complete incidence, cost, and outcome data on each of the topics considered by a panel. Second, the data could be collected and estimated in a consistent fashion. Third, the topic is sufficiently defined to identify relevant patient groups and interventions. Although a wide range of data were collected, the criteria specified above were not met. Subsequent development work was conducted to develop a model for the *ex ante* analysis of the value for money of commissioning assessments in specific topic areas. To date, this has been constrained to the provision of information to the second stage of the prioritization process.

The approach and economic prioritization model (EPM) to support the NCCHTA and SGHT at the second stage were based on previous methodological expositions (11) and empirical work to evaluate the costs and benefits of a clinical trial *ex post* (9). This section outlines the key features of the approach. A technical description of the model is given in Appendix 1.

Objectives

The overall purpose of the model was to provide additional information to the SGHT and its advisory panels. Specific uses of the information were to assist those involved in the selection and prioritization of HTA topics and the commissioning of HTA projects. The objectives for the development of an economic prioritization model were to: a) collect, structure, and analyze comparative information to assess the relative value-for-money of potential HTA questions/topics, in terms of the costs and benefits of HTA to society; b) provide relevant and useable information

to those involved in the decision-making process, to improve the allocation of resources between potential HTA areas; and c) identify critical factors that determined the value for money of specific assessments, which should be considered in the process of commissioning, disseminating, and implementing HTA evidence.

Perspective

The EPM was constrained to consideration of HTA funded by the NHS research and development (R&D) program. It was assumed that the principal objective of HTA is to provide information and evidence to influence healthcare practice and improve the efficiency of its provision. The perspective of the model included consideration of the costs and benefits to the research funding body, the providers of health and social care services, and the patients who are likely to receive the healthcare interventions targeted.

The broader costs and benefits of HTA to society (such as value of knowledge *per se,* the development of research skills, political and administrative benefits, or the costs and benefits to other research funding agencies) were excluded. The main logic for exclusion of these items was that, first, the aim of HTA is the production of information to support change in healthcare policy and practice, rather than the production of knowledge *per se* (1). Second, they are difficult to assess differentially between competing HTAs. For example, benefits to the research infrastructure from HTAs would accrue irrespective of the particular technology evaluated. In addition, inclusion of political benefits among the criteria for investment leads to the question of whether these should also be considered in economic evaluation of specific health technologies. Traditionally, these evaluations focus on the benefits in improved health, not the broader political gains (10;12).

Time Frame

The period covered by the model was the estimated time from commissioning of the research (year 1) and initial dissemination of the research findings, to substitution of the health care intervention of interest by other new technologies. A maximum time frame of 20 years for the lifetime of the healthcare intervention in question was also imposed, on the grounds that the impact of costs and benefits beyond this were likely to be negligible because of discounting.

Approach

The model used decision analytic techniques to estimate the expected costs and benefits and relative efficiency of the healthcare interventions that were the focus of the HTA question(s). It compared the health technology of interest with relevant comparators from standard or usual care. The expected costs and benefits were estimated for 1-year incidence or prevalence cohorts of treated patients. Average or best-guess expected costs and benefits were estimated. Where possible, minimum and maximum estimates were also defined to incorporate uncertainty about the level of efficiency that will occur in routine practice rather than in controlled clinical trial settings. These data were then combined with available information about the:

- Likely utilization rates of the new technologies;
- Probability that the new intervention will be proven effective or ineffective by the HTA;
- Maximum lifetime for the new technology;
- Probability of additional new technologies and utilization rates;

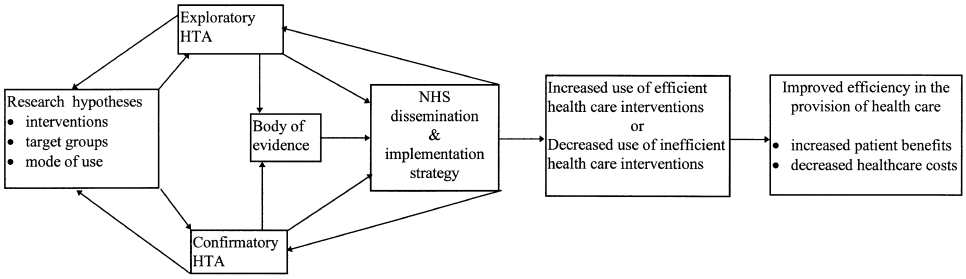

Figure 1. Process of HTA impact on healthcare provision.

- Transition costs of adopting the new intervention; and
- Cost of the HTA.

The model was used to determine the level of uncertainty about clinical and economic evidence and the critical factors that would affect the potential value for money of the HTA for each topic.

Value of HTA and the EPM

The final value of HTA was limited to the potential impact of the results on the efficiency of healthcare provision (11). Furthermore, HTA was only deemed to be of value if it was instrumental in bringing about changes in healthcare policy and practice that improved the efficiency of healthcare provision (1;28). Figure 1 illustrates the processes through which HTA can change the efficiency of healthcare provision. Figure 2 illustrates the range of factors that may modify the impact of HTA on the provision of health care. The flow diagram in Figure 3 illustrates the conceptual structure of the EPM.

Process of HTA Impact on Healthcare Provision. Figure 1 starts at the point where there is a set of HTA questions or hypotheses to be addressed. These can be evaluated by exploratory HTA or confirmatory HTA. Exploratory HTA is defined as primary HTA to tackle questions or hypotheses that have not previously been subjected to rigorous or systematic evaluation. Confirmatory HTA is defined as primary HTA or synthesis of available evidence, which adds to the existing body of rigorous or systematic evaluations for specific questions. These questions may have been the subject of previous evaluation. Confirmatory HTA may be required

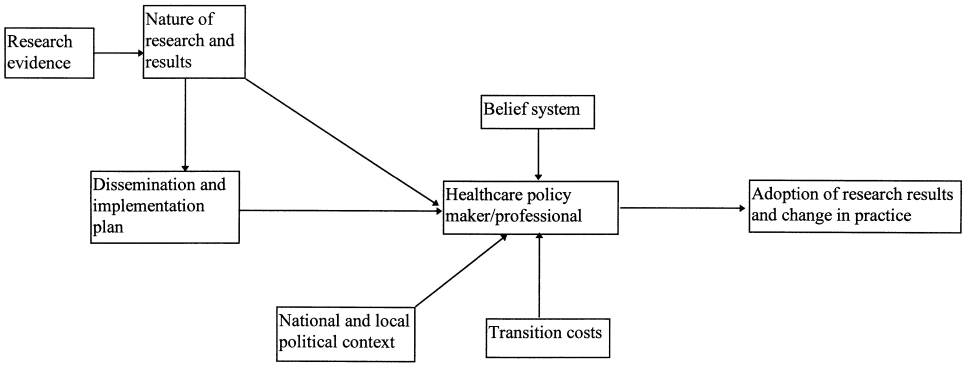

Figure 2. Adoption and utilization of HTA results.

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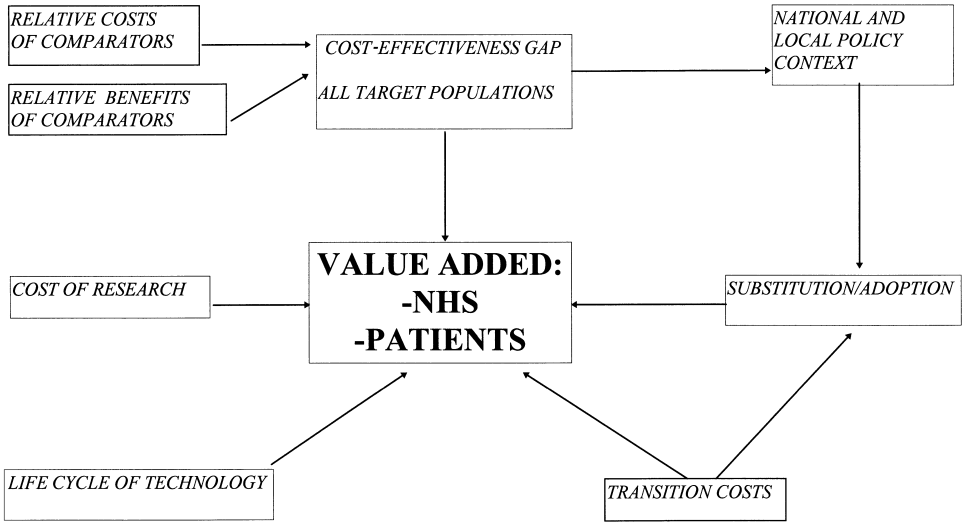

Figure 3. Economic prioritization model.

if the results of earlier evaluations were thought to be uncertain due to perceived flaws in study design, such as inadequate sample size or use of inappropriate endpoints, or there are two or more studies where the results are contradictory (5).

The intermediate outputs of either exploratory or confirmatory HTA at this stage are the generation of new HTA questions or hypotheses and additions to the existing body of evidence. This intermediate set of outputs are highly uncertain and remote from the final outcome of efficiency of healthcare provision. In addition, the impact of these factors is likely to be low and not amenable to reliable quantification or valuation. For these reasons the generation of additional questions or hypotheses were not included as a variable in the economic prioritization model.

Adoption of HTA Information. A prerequisite for HTA results to be translated into action to improve efficiency is that the results are disseminated and recognized as relevant and useable evidence by healthcare policy makers and healthcare professionals. However, this is not sufficient to ensure that the results will be translated into appropriate action. Various factors were assumed to affect the adoption of HTA results and the provision of health care (Figure 2).

First, it was assumed in the EPM that the nature of the existing body of evidence and the HTA results will affect the process of adoption. Changes in the practice of healthcare policy makers and professionals are positively, if weakly, related to the quantity and quality of available evidence (4;14;19;21;29;30). If the HTA is exploratory rather than confirmatory and existing evidence is low or contradictory, the impact of a specific HTA on practice may also be low. Even if the design of the exploratory HTA is sufficient to address the evaluation question with a high degree of certainty, there may still be uncertainty about the quality/validity of the evidence. In this case healthcare decision makers may prefer to wait for additional confirmatory HTA before implementing the results. In contrast, HTA to confirm the existing body of evidence may have a relatively higher impact on practice and the efficiency of healthcare provision. Results that are positive and conclusive are more likely to have an impact on the provision of health care than results that are negative or equivocal.

Second, it was assumed that the methods of dissemination and implementation will affect the extent to which HTA results are known and accepted by healthcare policy makers and professionals. If healthcare professionals are to practice evidence-based medicine, they must access and interpret a wide range of HTA-based information. It is also well documented that healthcare professionals (for a variety of reasons) do not review all relevant published evidence relating to their practice. For HTA results to be accepted and have an impact on practice, they need to be interpreted and presented in a systematic and accessible manner. It was assumed that HTA that incorporates a coherent and broad-ranging dissemination or implementation plan is more likely to change practice than HTA that does not.

Third, it was assumed that the adoption of HTA results is affected by factors outside the HTA process. These include: the advent of new interventions and HTA information; the transitional costs of implementing the results of HTA, in terms of investment in new skills or facilities or dis-investment in existing skills and facilities; the national and local political and organizational context; and the belief systems of healthcare professionals. However, the relationship between some of these factors and the strength of their influence on the adoption of HTA evidence is highly uncertain. The impact of new interventions and HTA information was directly quantified in the model as an independent variable. It was assumed that future technologies would be substituted for the least effective interventions available.

The impact of transitional costs, the national and local political context, and belief systems on the adoption of HTA evidence were indirectly captured in the estimated minimum and maximum rates of annual utilization.

In particular, it was assumed that these factors would ensure that all new and standard technologies would have a minimum level of use above zero, regardless of whether the technology was effective or otherwise, and the conclusions of any associated evidence base. In addition, it was assumed that these factors would mean that the rate of utilization of each available technology would be less than one.

Analysis of Data

The principal analysis of data was estimation of the expected net costs and benefits of HTA, and the level of uncertainty surrounding these estimates. The model calculated point estimates of the expected value for money of a specified piece of HTA. To address uncertainty in the data, a minimum and maximum range of estimates of expected value for money were also derived. These were based on a number of sensitivity analyses to vary each of the parameters from across a range of plausible values. In addition, threshold analyses were conducted to find the minimum (maximum) value at which a variable would need to be set for the net expected costs and benefits of the HTA to be zero or equivalent to the expected costs and benefits of not undertaking the HTA.

PRELIMINARY RESULTS

Initial estimation of the value for money of HTA was conducted for the topics considered by the pharmaceutical panel in the second stage of prioritization in 1997 and 1998. The panel members were asked to complete a short questionnaire to assess the value of the model and results to the second round of the prioritization process.

Tables 1 and 2 present the data and results for three of the topics in detail. These were new disease-modifying drugs for rheumatoid arthritis, new drugs for

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Table 1. Estimated Values of Variables for Four Case Studies

Variable	Disease-modifying drugs for rheumatoid arthritis Best guess (range)	New drugs for osteoporosis Best guess (range)	Pneumococcal vaccine Best guess (range)
Treated cohort (no./yr)	600,000	2.5 million (1.65–3.3 million)	8 million
Cost per person treated			
Standard therapy	160 (30–240)	93 (54–134)	0
New therapy	360 (240–480)	134 (67–201)	10
Associated health care	473 (236–710)	13,602 (6,801–20,403)	1,528
Additional benefit per person treated			
% increase in benefit new therapy	2.5 (0–5)	2.5 (0–5)	50 (25–75)
Cost of HTA	100,000–1 million	100,000–1 million	100,000–1 million
Transition costs of adopting new therapy	0	0	0
Probability new therapy effective	0.67	0.67	0.67
Probability HTA accurate	1.00	1.00	1.00
Probability dissemination effective	1.00	1.00	1.00
Current utilization rate			
Standard therapy	0.97	0.97	0.60
New therapy			
Effective	0.03	0.03	0.40
Ineffective	0.02	0.02	0.40
Annual adoption rate, new therapy			
With HTA			
Effective	0.16 (0.05–0.97)	0.16 (0.05–0.97)	0.16 (0.05–0.97)
Ineffective	0.02 (0.02–0.16)	0.02 (0.02–0.16)	0.02 (0.02–0.16)
Without HTA			
Effective	0.05 (0.05–0.97)	0.05 (0.05–0.97)	0.05 (0.05–0.97)
Ineffective	0.03 (0.02–0.16)	0.03 (0.02–0.16)	0.03 (0.02–0.16)
Utilization rate of future therapies			
Effective	0.16 (0.02–0.97)	0.16 (0.02–0.97)	0.16 (0.02–0.97)
Ineffective	0.02 (0.02–0.16)	0.02 (0.02–0.16)	0.02 (0.02–0.16)

Table 2. Expected Costs and Benefits of HTA for Four Case Studies

	Disease-modifying drugs for rheumatoid arthritis		New drugs for osteoporosis		Pneumococcal vaccine	
Analysis	NEC	NEB	NEC	NEB	NEC	NEB
Principal analysis	434 million	58,097	364 million	4,378	333 million	3,414
Analysis of uncertainty (threshold values for NEC/NEB = 0)						
Cost of new therapy/person	163	N/A	94	N/A	1.46	N/A
Cost of standard therapy/person	358	N/A	133	N/A	No threshold	N/A
Cost of associated therapy/person						
New therapy	276	N/A	10,906	N/A	No threshold	N/A
Standard therapy	671	N/A	16,314	N/A	7,991	N/A
Additional benefit of new therapy/person	N/A	0	N/A	0	N/A	0
Cost of HTA	No threshold	N/A	No threshold	N/A	No threshold	N/A
Transition costs	No threshold	N/A	No threshold	N/A	No threshold	N/A
Probability new therapy effective	0.39	0.21	0.49	0.21	No threshold	No threshold
Probability HTA accurate	0.18	0.17	0.20	0.17	0.22	0.50
Probability dissemination effective	0.25	0.20	0.31	0.20	0.21	No threshold
Use of effective new therapy						
With trial	0.02	0.02	0.02	0.02	No threshold	No threshold
Without trial	0.23	0.23	0.22	0.23	No threshold	No threshold
Use of ineffective new therapy						
With trial	No threshold	No threshold	No threshold	No threshold	No threshold	No threshold
Without trial	No threshold	0.01	0.51	0.01	No threshold	No threshold
Use of future therapies						
Effective	No threshold	No threshold	No threshold	No threshold	No threshold	No threshold
Ineffective	No threshold	No threshold	No threshold	No threshold	No threshold	No threshold

Abbreviation: NEC = net expected cost; NEB = net expected benefit.

osteoporosis, and pneumococcal vaccination for elderly people at risk of pneumococcal infection. The cost data for each topic were estimated from the vignettes prepared for the pharmaceutical panel and national statistics. For rheumatoid arthritis and osteoporosis there was insufficient information about the potential benefits or use of the new technologies. Default estimates (see below) were used for these variables. In contrast, it was possible to replace the default values for the level of use and potential benefit associated with pneumococcal vaccination.

Table 3 summarizes the results of the analyses. In the preliminary analysis the data estimates were derived in a short time scale. Because of the time constraints, default values or assumptions were used for several of the variables used in the model. These were:

1. The likely rates of utilization of new technologies were assumed to vary according to the true effectiveness of the technologies and the evidence of effectiveness. It was assumed that the level of existing evidence about new technologies will be relatively low or uncertain, leading to low utilization rates (a minimum of 5% of healthcare provision for effective technologies and 3% for ineffective technologies). The addition of evidence about effectiveness from new HTA will increase the annual utilization rate of effective technologies (to 16% per annum) and decrease the annual utilization rate of ineffective technologies (to a minimum of 2% per annum) (13;17;26;30). The current utilization rate of the technology in question was based on information from the vignettes or was assumed to be 5% for effective technologies and 3% for ineffective technologies if no data were available.
2. It was assumed that a proportion of the technologies in question were ineffective. The chance of the technology being effective was assumed to be equal to the rate of new pharmaceutical compounds which are successful in phase III clinical trials. This has been estimated at 67% (7).
3. A maximum lifetime for the new technology was given at 20 years. During this time the technology will be gradually replaced by additional new technologies that will enter healthcare practice and be utilized at the rates given in number 1 above.
4. The transition costs of adopting the HTA results and implementing the new intervention were assumed to be zero unless it was clear that utilization of the healthcare intervention would require significant (dis)investment in staff, equipment, or facilities.

Overall, it was possible to conduct analyses for 80% of the topics considered by the pharmaceutical panel in 1997 and 60% in 1998. It was not possible to conduct analyses for some of the topics due to uncertainty about the topic, the interventions, or the patient groups to be targeted. For all of the topics analyzed, there were sufficient data to generate base-case or best-guess estimates of costs and to generate a range of costs for sensitivity analysis. In all the analyses the outcome data available were not sufficient to generate one consistent measure of patient benefit (such as the quality-adjusted life-year [QALY]) for all the topics. This meant that the outcomes or benefits reported ranged from measures such as case averted to deaths averted or life-years gained for the 1997 panel topics, and people with improved symptom control to cases averted in the 1998 panel topics. In addition, there was insufficient information about possible ranges in levels of effectiveness on which to base a sensitivity analysis. The approach taken was to use threshold analysis to determine critical levels of effectiveness at which the net benefits of the analysis would be zero.

The results from both years' analyses indicate that, using information routinely available in the literature and from the vignettes, it was not possible to estimate the absolute value of HTA with any certainty for this stage of the prioritization

process. Of the topics analyzed in 1997, the results for 58% were considered uncertain (i.e., switched from net saving to net cost or vice versa) compared with the results for 73% in 1998. Overall, the results were uncertain for 65% of the HTA questions or topics analyzed.

As might be predicted, the relative costs of the interventions or technologies compared with existing costs of care and likely levels of utilization were critical factors in most of the analyses in two respects. First, the level of costs extend into the model for the new technology and standard or existing care determined whether the analysis switched from net saving to net cost in the majority of cases (69%, 1998, and 58%, 1997). Second, a threshold level for one or more cost variables was found in 68% of topics (93%, 1998, and 50%, 1997).

The probability that the technology would be found to be effective with the HTA was a critical factor in determining the expected costs and/or benefits for 47% (1998) to 92% (1997) of topics. Threshold analysis also indicated that the impact of HTA on the rates of utilization of the new technology and existing care was a critical factor in 75% to 80% of the analyses.

Overall, the results of the survey of the panel members in 1998 suggested that they found the additional information generated by the model was of value. All of the members stated that the data were helpful in defining and understanding the topics and in their initial prioritization of the topics. However, 70% recognized that further development was required. A particular area of development highlighted was the range of uncertainty inherent in the assumptions and estimates, and how this should be interpreted.

DISCUSSION

The preliminary results suggest that it is feasible to conduct *ex ante* assessments of the potential value for money of HTA for some topic areas and that this is a useful addition to the information presented to the panels in the prioritization process. However, the work to date raises several issues for further consideration. An underlying set of questions relate to whether continued development of the approach, the model, and data inputs is a worthwhile activity compared with the methods of prioritization currently used by the NHS R&D program or alternative approaches. These questions require consideration of a number of factors directly relating to the approach taken and development of the model and the relative efficiency of alternative approaches and models.

Validation of the Model and Analyses

The first issue is whether the approach and subsequent economic prioritization model presented here are valid in terms of the methodological framework and attributes. There are several components to be addressed. First, is it legitimate to restrict the scope of the model to the impact of HTA on the provision and outcomes of health care, given the likely cost of undertaking the research? As mentioned above, this excludes the broader economic benefits of HTA to other sectors of society (15). Some of these broader consequences may already be taken into account in the decision-making process. It is not clear whether quantification and inclusion of these factors in the analysis would have a significant impact on the overall results, such that the prioritization or choice of topics to be commissioned would change.

Table 3. Expected Costs and Benefits of HTA: Results of Payback Analyses, Pharmaceutical Panel, 1997–98

Patient condition	Net expected cost (range) of HTA (£, million)		Net expected benefit of HTA (improved symptom control)		ICER	Key determinants of cost/benefits of HTA		
						Cost/benefit of therapies	Effectiveness of therapies	Use of therapies
1998								
Erectile dysfunction	+307	(−695, +1,678)	0.6 m	people with ISC	494–3,020	Yes	No	Yes
Rheumatoid arthritis	+434	(−88, +956)	58,000	people with ISC	2,917–16,457	Yes	Yes	No
Stable angina	−315	(−823, +844)	0		N/A	Yes	No	Yes
Chronic pain (opioids)	+2	(−45, +50)	0	years with ISC	0–746	Yes	Yes	Yes
Kidney transplant	+104	(−118, +339)	2,518	cases averted	41,000–224,133	Yes	Yes	Yes
Multiple sclerosis	−9	(−409, +652)	7,030	people with ISC	0–92,745	Yes	No	Yes
1° open-angle glaucoma	+1,122	(+357, +1,887)	13,432	people with ISC	26,600–140,500	Yes	No	Yes
Chronic pain (cannabinoids)	+136	(−775, +600)	1,819	people with ISC	74,858–0.3 m	Yes	Yes	Yes
Asthma	+27,309	(+10,769, +43,849)	290,484	people with ISC	37,072–150,954	Yes	Yes	No
Breast cancer	−59	(−28, −117)	0		N/A	No	No	No
Osteoporosis	+364	(−549, +15,079)	4,378	cases averted	83,082–3.4 m	Yes	No	Yes
Chronic constipation	−860	(−239, −1,238)	0		0	No	No	No
Unstable angina	+181	(−647, +1,005)	5,781	cases averted	27,568–173,804	Yes	Yes	Yes
1997								
Alzheimer's disease	−1,005	(−1,947, +223)	0		N/A	Yes	Yes	Yes
Breast cancer	+42	(+11, +50)	1,160	life-years gained	9,353–53,323	Yes	Yes	Yes
Benign prostatic hyperplasia	+55	(−41, +84)	448	deaths averted	0–187,500	Yes	Yes	Yes
Influenza immunization	+182	(+2, +337)	13,019	deaths averted	1,313–25,892	Yes	Yes	Yes
Migraine	−167	(−167, +118)	0		N/A	No	Yes	No
Pneumococcal vaccination	+333	(+318, 358)	3,414	deaths averted	48,990–104,730	No	Yes	Yes

(*continued*)

Table 3. (*Continued*)

Patient condition	Net expected cost (range) of HTA, £, million		Net expected benefit of HTA (improved symptom control)		ICER	Key determinants of cost/benefits of HTA		
						Cost/benefit of therapies	Effectiveness of therapies	Use of therapies
Thromboembolic disease	+9	(+8, +10)	81	deaths averted	94,174–117,949	Yes	Yes	No
Tardive dyskinesia	−0.2	(−2, +3.8)	0	cases averted	0–4,445	Yes	Yes	Yes
Motor neurone disease	+68	(−51, +70)	1,252	life-years gained	0–55,910	No	Yes	Yes
Hemophilia A	+1,924	(−75, +1,924)	3,380	life-years gained	0–569,183	No	Yes	Yes
HIV/AIDS	+200	(+19, +259)	8,740	life-years gained	0–29,558	No	No	No
Asthma & COPD	+15	(−203, +15)	0		N/A	No	Yes	Yes

Abbreviations: ISC = improved symptom control; ICER = incremental cost-effectiveness ratio.

Model Specification

The model currently uses a deterministic framework for the analyses with the results determined by specified inputs and relationships, rather than a Bayesian or stochastic approach to determine the value of information (3;20). This means that the complex process of HTA, dissemination, and utilization can be analyzed in a relatively simple model. The advantages are that deterministic models require relatively fewer data than stochastic models and require fewer resources to run each analysis. The disadvantages are that for problems where there are complex relationships and distributions of data, it is difficult to assess the robustness of the results. In particular, a deterministic formulation restricts analysis of the extent to which the results are uncertain, due to a real lack of evidence rather than inaccuracy in the model inputs or relationships. However, the work to date has indicated that in the U.K. setting, there is a lack of data with which to populate a deterministic model. This problem would be intensified if a stochastic model were to be implemented. In particular, use of an incorrect distribution incurs a risk that the results of a stochastic analysis may be even less reliable than a deterministic one. The extent of the risk of inaccuracy of the results of the analyses and the subsequent impact on the efficiency of the prioritization process is unclear.

Decision Rules

The data in Table 1 indicate that the results of most analyses were uncertain. In addition, for most cases the input values for the effectiveness and utilization rates and the costs and benefits of interventions were critical factors. Changes within a plausible range for these variables can switch the results from net saving to net cost (or vice versa). Even if the input data were accurate and a consistent outcome measure could be generated, it is not clear how these results should be interpreted and whether they add value to the prioritization process. In particular, decision rules need to be developed to determine which topics should be prioritized for further consideration. The results for the majority of topics indicate a range from net saving to net cost, with a correspondingly large spread of expected cost/outcome estimates. This makes the application of standard economic criteria of expected value difficult to apply.

One approach would be to categorize the results on the basis of uncertainty; for example, clearly worthwhile funding, uncertain, or obviously not worthwhile. The worthwhile category might include those projects where there are always net savings with positive benefits, or cost/QALY ratios that are all within a predefined range. The uncertain category would include those topics where the results are sensitive to changes in input parameters or for which thresholds can be determined for the critical factors. The obviously not worthwhile range would include those topics where there were always net costs with zero or negative benefits, or where the cost/QALY ratios were all outside the predefined range. Within the uncertain category, projects could then be ranked by level of uncertainty. For example, those projects where no threshold values for some of the variables, such as utilization rates, were defined could be given a lower priority than those where thresholds could be defined. This would require the assumption that HTA should be targeted at topics where there is a greater level of uncertainty about current evidence and/or the impact of HTA on healthcare provisions.

Data Availability and Quality

Epidemiological and economic data were not available for the formal quantification of some topics, using routine information sources in the United Kingdom. Furthermore, the data were uncertain for one or more parameters for each topic. The time constraints imposed by the current prioritization process employed by the NCCHTA mean that the value of HTA cannot be formally quantified for all the topics. The need for rapid estimation of the value for money of HTA for a number of topics and the available research resources imposed constraints on the quantity and quality of data collected. Information about the likely impact of new technologies had to be constrained to symptom control or improvement, cases cured or prevented, or life-years lost/deaths averted for some diseases. The problems in estimating a consistent outcome measure and plausible ranges of values have a number of major implications for the analyses. First, it was not possible to compare incremental cost-effectiveness ratios across topics, in isolation from detailed information about the disease group and impact of therapy. Second, the sensitivity analysis of incremental ratios was driven mainly by changes in cost rather than variations in both costs and benefits. These difficulties were compounded by the use of default values for parameters such as annual utilization rates and probabilities of actual and proven (in)effectiveness. The information for the default values were derived from a limited number of published sources dealing with the utilization and success rates associated with pharmaceutical interventions.

A literature review is currently under way to collect additional information with which to refine these estimates and, if possible, generate default values that are at least specific to the general themes of the individual panels, if not disease or broad therapeutic groups. However, this still leads to the question of whether the use of default values is plausible and valid for some or all of the topics considered. The analyses to date indicate that the results were sensitive to these values. Inaccurate specification of the default values could bias both the point estimates and the analysis of uncertainty. Refinement of the values for specific topics may reduce the uncertainty in the inputs to the model and the interpretation of the results. However, it is clear that uncertainty in the values of all the variables in the model is an inherent factor that determines the need for HTA and thus methods of prioritizing the HTA agenda.

In conclusion, it is feasible to conduct *ex ante* assessments of the value for money of HTA for specific topics. However, substantial work is required to ensure that the methods used are valid, reliable, consistent, and are an efficient use of valuable research time (16). In particular, the relative value of alternative analytic techniques such as option pricing (25), data envelopment analysis, and stochastic simulations to determine the efficient allocation of research resources needs to explored. In addition, the value of providing decision makers with quantitative estimates of the "payback" of health technology assessments needs to be compared with softer qualitative approaches to prioritization of research portfolios (16;20;22).

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APPENDIX 1
DETAILS OF THE PRIORITIZATION MODEL

Expected Costs and Outcomes of Treated Disease

The model is built in blocks, starting with estimation of the expected costs and outcomes of the new intervention and one or more forms of existing treatment. The model uses either lifetime costs of treatment for 1-year incidence cohorts (acute diseases of less than 1-year duration) or the annual costs for 1-year prevalence cohorts (chronic diseases of greater than 1-year duration).

Transition Costs

The adoption of HTA results and the utilization of specific healthcare interventions could incur (dis)investment costs not directly included in the expected costs of treatment. If incurred, these need to be added to the expected costs of the technology assessed. In addition, transition costs may affect the rate of adoption and utilization of interventions. This is included in the model indirectly, by weighting standard utilization rates for healthcare interventions or through the estimation of rates specific to the interventions studied.

Lifetime of New and Future Interventions

The model estimates the expected value of HTA over the lifetime of the healthcare intervention in question. This is either a maximum of 20 years or based on estimates specific to the intervention. The maximum of 20 years reflects the effects of discounting the costs and outcomes over the life of the intervention. Year 1 of the lifetime for the technologies assessed starts when the results of the HTA project are reported.

Utilization Rates of Interventions

To calculate the expected costs and outcomes of treatment for each year, the costs and outcomes of each intervention considered are multiplied by the estimated net rate of utilization for that year. The model can use either standard estimates of utilization rates or specific estimates of utilization. Utilization rates are estimated for the intervention to be compared to existing treatment with and without HTA. Each of these categories are subdivided into the rates that would apply if the intervention was effective or not effective. The utilization rate for each year is estimated from the annual rate of utilization, the probability of the intervention

being proven (in)effective by HTA, or being (in)effective in the case where HTA is not undertaken, the probability that the dissemination and implementation plan for the HTA results is effective, and the probability of substitution by future interventions not yet evaluated.

Equations A–E illustrate the calculation of net utilization rates for the case where the proposed HTA will be undertaken, and equations F–H where the proposed HTA is not undertaken. It is assumed that the HTA design will be adequate to deliver results that are unequivocal. For the purposes of this model, effectiveness of new technology or treatment is defined as equivalence to, or superiority over, standard or existing care.

Case With HTA

A. The annual utilization rate of an effective new technology, when HTA indicates it is effective

$$= Ae_{t-1} + (ARe_t * PEe * IR) - Z,\ 0<A<1;$$

B. The annual utilization rate of an effective new technology, when HTA indicates it is ineffective

$$= Ae_{t-1} + (ARi_t * PIe * IR) - Z,\ 0<B<1;$$

C. The annual utilization rate of an ineffective new technology, when HTA indicates it is ineffective

$$= Ai_{t-1} + (ARi_t * PIi * IR) - Z,\ 0<C<1;$$

D. The annual utilization rate of an ineffective new technology, when HTA indicates it is effective

$$= Ai_{t-1} + (ARe_t * PIe * IR) - Z,\ 0<D<1;$$

E. The annual utilization rate of standard or existing technology, with HTA

$$= (1 - A - B - C - D - Z),\ 0<E<1.$$

Case Without HTA

F. The annual utilization rate of an effective new technology, with no HTA

$$= (Ae * Pe) - Z,\ 0<F<1;$$

G. The annual utilization rate of an ineffective new technology with no HTA

$$= (Ai * Pi) - Z,\ 0<G<1;$$

H. The utilization rate of standard or existing technology, with no HTA

$$= (1 - F - G - Z),\ 0<H<1;$$

where:

Ae = the annual probability of utilization of an effective technology, given existing evidence;

Ai = the annual probability of utilization of an ineffective technology, given existing evidence;

ARe = the maximum incremental probability of utilization of an effective technology, new evidence;

ARi = the maximum incremental probability of utilization of an ineffective technology, new evidence;

PEe = the probability the new HTA indicates an effective new technology is effective;

PEi = the probability the new HTA indicates an ineffective new technology is effective;

PIi = the probability the new HTA indicates an ineffective new technology is ineffective;

PIe = the probability the new HTA indicates an effective new technology is ineffective;

Pe = the probability the new technology is effective;

Pi = the probability the new technology is ineffective;

IR = the probability that dissemination and implementation of new HTA results changes practice;

t = time, 1–20 years; and

Z = the substitution of health care technologies by future developments.

Costs of HTA

For the purposes of this model it is assumed that there is no HTA ongoing that could address the questions of interest. The net expected costs (NEC) and benefits (NEB) of conducting the HTA are calculated as:

$$NEC = [CR + (Dt*((ECnt*A) + (ECnt*B) + (ECMAXnt*C) + (ECMAXnt*D) + (ECst*E))] - [(Dt*((ECnt*F) + (ECMAXnt*G) + (ECst*H))],$$

$$NEB = [(Dt*((EBnt*A) + (EBnt*B) + (EBMINnt*C) + (EBMINnt*D) + (EBst*E))] - [(Dt*((EBnt*F) + (EBMINnt*G) + (EBst*H))]$$

where:

CR = cost of HTA;

Dt = discount rate, time t;

ECnt = expected treatment cost of an effective new intervention at time t;

ECMAXnt = expected maximum cost of an ineffective new technology at time t;

ECst = expected cost of standard or existing treatment at time t;

EBnt = expected benefit of an effective new intervention at time t;

EBMINnt = expected benefit of an ineffective new technology at time t;

EBst = expected benefit of standard or existing treatment at time t.

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