AMEE Guide 122 - An Educational Decision-Makers Guide to Reading Studies of Educational Costs

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ABSTRACT

Healthcare and health professions education share many of the same problems in decision making. In both cases, there is a finite amount of resources, and so choices need to be made between alternatives. To navigate the options available requires effective decision making. Choosing one option requires consideration of its opportunity cost - the benefit forgone of the other competing options.

The purpose of this guide is to introduce educational decision-makers to the economic concept of cost, and how to read studies about educational costs to inform effective cost-conscious decision-making.

This guide leads with a brief review of study designs commonly utilised in this field of research, followed by an overview of how study findings are commonly presented. The tutorial will then offer a four-step model for appraising and considering the results of an economic evaluation. It asks the questions: 1) Can I trust the results? 2) What are the results telling me? 3) Could the results be transferred to my context? 4) Should I change my practice?

Educational decision-makers are uniquely positioned to create change in teaching and learning practices. Data published from economic evaluations can be a powerful decision-making aide. As the number of studies that examine the cost and value of health professions education grows, education decision-makers will require increasing skill in understanding, appraising, and considering the study findings, to ensure that educational activities achieve optimal value for a given spend.

PRACTICE POINTS

1. The main reason to consider cost and value in health professions education is to ensure that teaching and assessment deliver optional educational value for a given spend.

2. A more expensive option may represent greater value if it provides better educational outcomes than lower-cost alternatives; or conversely, a less-effective option may be judged of greater value because it is substantially less expensive.

3. A partial-economic evaluation reports on what had to be spent for an activity to occur (i.e. the educational inputs). A full-economic evaluation considers not only what was spent, but also considers what value was obtained in return – both the educational costs and the outcome.

4. Economic analyses are designed to help the person making decisions today, thus, they should include present day (start-up) and future (ongoing) costs, and typically ignore past (sunk) costs that cannot be recovered.

5. Appraising a study's reporting of costs can be assisted by asking 1) How were the interventions cost-items identified? 2) how were the cost items measured? And 3) how were the cost items priced?

6. Uncertainty around point estimates of cost and value is evaluated through the sensitivity analysis, which considers the impact of varying assumptions and conditions. Decision-makers should consider the sensitivity scenario which best aligns with their own context, to better interpret study transferability.

7. Value is highly context dependent, and decisions concerning the uptake or rejection of an educational innovation are ultimately affected by factors and forces beyond effectiveness and costs.

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INTRODUCTION

The purpose of this guide is to introduce the economic concept of cost, and how to read research about educational costs in health professions education to inform cost-conscious decision-making.

Our target audience is educational decision-makers, including teachers, administrators, deans, hospital financial officers, and leaders in government and professional organizations who share the responsibility of shaping the health workforce – those who use educational research to guide their decisions about education.

In considering how to read studies of educational cost, we will focus in on the interpretation and application of research findings (economic evaluations) that may be encountered, rather than the creation of quality research in this field which is found in other publications. We will introduce different types of economic evaluation (e.g., Box 1) and illustrate how these are important to educational decision making.

Box 1: *A partial-economic evaluation reports on what had to be spent for an activity to occur (i.e. the educational inputs). A full-economic evaluation considers not only what was spent, but also considers what value was obtained in return – both the educational costs and the outcomes (Higgins and Green 2011).*

The pressing need to consider cost and value

Healthcare and health professions education share many of the same problems in decision making. In both cases, there is a finite amount of resources, and so choices need to be made between alternatives. To navigate the options available requires effective decision making. Choosing one option requires consideration of its opportunity cost - the benefit forgone of the other competing options. Ultimately, the decisions that educators and administrators make are likely to have impact on the training and development of the future health workforce and thereby on the quality of health care (Brydges et al. 2015, Reeves et al. 2013, Tolsgaard et al. 2015, Walsh 2010).

Although there has been relatively little scrutiny of the costs or efficiency of health professions education (Zendejas et al. 2013), that is likely to change as demand for transparency and efficiency of spending increases.

The goal of accessing and interpreting economic evaluations in health professions education

Analyses of cost and value are tools to assist evidence-based decision making. Education decision-makers are generally not advocating for low cost education; rather, they are usually trying to optimise educational value (Tolsgaard and Cook 2017). Educational value is context dependent, influenced by the financial costs, in conjunction with the real and perceived benefits obtained. The main reason to consider cost and value in health professions education is to ensure that teaching and learning delivers maximum educational value for a given spend – favored toward education that is sustainable, accessible and able to meet future health care requirements (Maloney et al. 2017). A more expensive option may represent greater value if it provides better educational outcomes than lower-cost alternatives; or conversely, a less-effective option may be judged of greater value because it is substantially less expensive.

To fully appreciate how to select wisely among the myriad of possible interventions in health professions education, we need to understand their costs (Maloney S. and Haines T. 2016).

Figure 1: 'The Educator's choice'

The guide structure

This guide leads with a brief review of study designs commonly utilised in this field of research, followed by an overview of how study findings are commonly presented. The tutorial will then offer a four-step model for appraising and considering the results of an economic evaluation to inform decisions about change in practice. It asks the questions: 1) Can I trust the results? 2) What are the results telling me? 3) Could the results be transferred to my context? 4) Should I change my practice? In creating this model, we drew upon the Users' Guides to the Medical Literature on Economic Analysis (Drummond, Richardson, et al. 1997) as well as established practices and standards from the fields of general economics, health economics and educational economics (Husereau et al. 2013, Sanders et al. 2016).

ECONOMIC EVALUATION DESIGNS AND OUTCOMES: A QUICK REVIEW

Study designs

The most common economic evaluation designs relevant to decision-makers in health professions education are cost-analyses, cost minimisation analyses, cost effectiveness analyses, cost-benefit analyses and break-even analyses (Walsh et al. 2013). Each design addresses a different question related our understanding of costs and rewards, and thus offers a distinct contribution to the decision-making process.

The educational decision-maker's question	Evaluation Design	Education outcomes
How much does the intervention cost?	Cost Analyses	Not considered
Which will be the cheaper of the options, assuming the outcome is equivalent?	Cost Minimisation Analysis (CMA)	Assumed equal
Does this approach represent 'good value' when considering both costs and educational outcomes (with outcomes expressed in natural educational units)?	Cost Effectiveness Analysis (CEA)	Natural units (e.g., measures of learning)
Does this approach represent 'good value' when considering both costs and educational outcomes (with outcomes expressed in monetary units)?	Cost Benefit Analysis (CBA)	Monetary units
Based on the cost to implement and operate a new educational approach, can I expect to make my money back, and if so, when?	Break-Even Analyses (BEA)	Sometimes

Table 1. Aligning value-related questions with specific types of economic evaluations.

Cost analysis

A cost-analysis (also known as a partial economic analysis) describes the costs associated with a single event or intervention. It does not measure the outcome or effect of that event (Higgins and Green 2011). A cost-analysis paper is useful when seeking information on which to base priority setting and resource allocation, without necessarily trying to prioritize one educational intervention over another. For example, Brown et al. (2015) conducted a retrospective cost-analysis of their final year Objective Structured Clinical Examination (OSCE) assessments for a medical program (Brown et al. 2015). Costs were included from all phases - from development, production, administration and post-examination phases - of their 15 station OSCE delivered to 185 students. This OSCE cost a total of £65,328 to operate, with individual stations ranging from £3,108 to £6,577. The cost per student was £355. Since there is no comparator, readers are left to judge for themselves whether the costs are reasonable or excessive - i.e. whether it provides value. However, it does provide a starting point for discussion of costs. For these educators, the results prompted the consideration of alternative assessment approaches, ultimately leading them to explore the sequential OSCEs (Currie et al. 2016), in which the learner' progression through the OSCE varies based on their performance at particular screening stations.

Cost-minimisation analysis

A cost-minimisation analysis (CMA) provides a cost-comparison, assuming that the outcome or effect is the same for each compared strategy (Rojas and Gagnon 2008). A cost minimisation analysis is useful when seeking the cheapest pathway to a specific defined goal. Corelli et al. (2015) contrasted the cost involved in the development and administration of differing types of admission interviews used as a screening tool for a Doctor of Pharmacy program

(Corelli et al. 2015). Their analysis revealed that the multiple mini-interviews ($75.30 USD per candidate) were less expensive than the standard interview format ($136.34 USD per candidate), but did not evaluate how the interviews themselves influenced the admissions process.

Cost-effectiveness analysis

A cost-effectiveness analysis (CEA) compares the cost of a program or intervention with its outcomes or effects (where the effects are expressed in non-monetary terms) (Walsh, et al. 2013). It calculates the amount spent to create a unit of change in outcomes. Therefore, a cost-effectiveness analysis is useful to decision-makers interested in comparing two or more options that may have different costs and different educational outcomes. The educational outcomes are measured in natural units (e.g., measures of learning, clinical performance, or number of students taught) rather than monetary terms. For example, Tolsgaard et al. (2015) used a cost-effectiveness model to examine the costs and the impact on patient waiting times in a study that trained midwives to measure cervical length (Tolsgaard, et al. 2015), compared with the conventional approach of relying on an obstetrician to perform these measurements.

Box 2: Worked Example – Cost-Effectiveness

Background

An academic program has been using a peer-assisted review activity for improving the communication skills of their learners. A new approach is now being compared - one that replaces the peer-assisted review activity with video-based self-reflection.

A study has been conducted, where equal number of students were randomized to either receive the training using the incumbent peer-assisted review approach, or the new video-based review approach. The students' communication skills were assessed within a clinical scenario both before and after the training with an Objective Structured Clinical Examination (OSCE). The results are presented below.

	Cost per student per year	Pre-training score (OSCE)	Post-training Score (OSCE)	Incremental Cost-Effectiveness Ratio (ICER)*
A) Peer-assisted review	£20	40%	70%	-
B) Video-based reflection	£50	40%	80%	£3*

*ICER $= \frac{Cost\ A - Cost\ B}{Effect\ A - Effect\ B} = \frac{20 - 50}{70 - 80} = \frac{-30}{-10}$ = £3

Interpretation:

The video-based reflection was more effective at increasing OSCE score than the incumbent peer-assisted review process, however it was also more expensive.

The incremental cost effective ratio, provides a comparison of change in costs in conjunction with the change in effects, and was calculated to be £3 per 1% gain in test score. This means that the video-based approach requires an additional £3 to be spent per student to create an additional unit of effect. I.e. to increase student OSCE score by 1% above that of the original peer-assisted review approach.

No incremental cost effective ratio is recorded within the row for the peer-assisted review approach, as it is the existing education approach or reference point. Our interest is in the incremental differences in both cost and effect of the 'challenger'.

Whether these additional educational benefits are worth the additional cost is unable to be determined from the analysis alone. Whether change is a smart investment is explored within 'should I change my practice' later in this guide.

Cost-benefit analysis

Cost-benefit analysis (CBA) also calculates the relationship between costs and outcomes. The difference between a cost-benefit analysis and cost-effectiveness analysis is that in a cost-benefit analysis the outcome is expressed in monetary units e.g. dollars (Walsh, et al. 2013). For example, Williams et al, (2016) are conducting a cluster-randomised controlled trial evaluating the impact of an inter-professional simulation-based education program, targeting clinical education students, on the prevention of falls among hospitalised inpatients (Williams et al. 2016). The measure of effect is the number of patient falls on the intervention and control hospital wards, which at first would sound like a cost-effectiveness analysis. However, their study goes on to assign a monetary value to those falls and so becomes a cost-benefit analysis.

Break-even analysis

Break-even analysis (BEA) guides decision-makers on how long it would take to see an economic benefit from their undertaking – i.e., the point where outgoing costs are equalled by enhanced savings or revenues. This type of analysis may take into account the start-up costs of an educational intervention, innovation or practice and the subsequent positive gains as the intervention continues over time. Maloney et al. (2012) conducted a series of economic analyses focused on contrasting face-to-face delivery of medical student training in evidence based medicine against a blended learning approach (Maloney et al. 2012). Their break-even analysis looked at the cost involved in transitioning to the newer, blended learning approach (i.e. the start-up costs and the ongoing maintenance costs of the online materials and web-based tutors) against the savings achieved in the blended learning approach through decreased demand on physical space costs. Their analysis revealed that savings exceeded costs after three-years.

Measurement and representation of costs

Cost ingredients

Each of the economic evaluations described above must quantify costs. One model for this considers each cost as an "ingredient" in the overall educational intervention (Levin et al. 2017). Zendelas et al. (2013) identified potential cost ingredients relevant to health professions education. An adaptation of their list is provided in Table 1 to illustrate the breadth of costs taken into consideration (Zendejas, et al. 2013). We will discuss how to formally apply the ingredients method later in this Guide.

Cost Categories	**Cost Ingredients**	**Description/Examples**
Equipment and Materials	Equipment Purchase	Market price of specialized equipment, such as computers, simulators, projectors, if not already accounted for in facility costs.
	Equipment Maintenance	Annual fee, upgrades, tech support
	Equipment Depreciation	Percentage of the annual price drop in the value of the equipment.
	Lifespan of Materials	Length of time or number of attempts before materials need to be replaced
	Donations	Donated equipment
	Furnishing	Furniture or appliances needed to support the learning.
Personnel Cost	Academic Staff	Academic staff required in preparation, delivery of training and any after-training support of learners.
	Volunteers	Time that teachers and other staff may be expected to contribute beyond their paid workday
	Administrative Staff	Staff requirements to run the administrative components of the program.
Facility Costs	Facility Rental Fee	For rented facilities: Fee per hour or day of use
	Facility cost	For facilities that have been constructed or purchased: the depreciation of the building and interest on the remaining undepreciated original value.
	Facility maintenance	Building upkeep, lighting, air conditioning, heating, electricity.
Required Client Inputs	Learner costs	Expenses incurred by the learner (transportation, meals, course registration, books, information technology software and hardware requirements etc.)

Other Program Inputs	Information Technology	Information technology hardware and software requirements, such as learning platform access and support, video recording and viewing equipment, servers for storage and retrieval of information.

Table 1. Potential cost ingredients in health professions education - adapted from (Zendejas, et al. 2013) and (Levin, et al. 2017)

Start-up costs and sunk costs

Economic analyses are designed to help the person making decisions today. Thus, they always include present day (start-up) and future (ongoing) costs. However, since investments that have already been made cannot be recovered ("sunk costs"), economic analyses ignore past costs (Mogyorosy and Smith 2005). Start-up costs are new costs incurred through shifting to a new educational approach. For example, adopting a new high fidelity simulation education programme may have start-up costs of purchasing a high-fidelity mannequin, training staff, producing scenarios and tailoring the existing learning materials, perhaps even building new spaces (Zendejas, et al. 2013). However, costs which are sunk for one decision-maker are not necessarily sunk for another, as this depends on the individual setting. Using the previous example, if an educational programme had previously purchased a high fidelity mannequin for another purpose, then this simulator is no longer a start-up cost, but rather a sunk cost, and is excluded from the analysis.

Willingness to pay

Willingness to pay (WTP) is a method for converting a sentiment or perception into financial terms. For example, how much someone with low back pain would be willing to pay in order not to have the back pain, might give some insights into their level of pain and ability to cope with that pain. Willingness to pay can be asked directly (e.g., "How much would you be willing to pay to obtain complete relief of your back pain for three months?"), or indirectly, through methods such as discrete choice experiments that help reduce the impact of bias. Nicklen et al (2016), provide an example of applying a willingness to pay measure to health professions education in their study that focused on the students' perceived benefit from experiencing the same training in two different formats (Nicklen, Rivers, et al. 2016). To ascertain the students' perceptions of which approach was more valuable to them, the authors asked the participants who had experienced both formats to indicate which they preferred, and how much they would be willing to pay for their preferred format if they encountered the learning again. An alternative use of the willingness to pay metric for monetising less tangible options can be found in the paper by Cleland et al (2017) who investigated the strength of UK medical students' preferences for the characteristics of training posts within their discrete choice experiment (Cleland et al. 2017). The main outcome measure was the monetary value based on willingness to forgo and willingness to accept extra income for a change in each job characteristic calculated from regression coefficients. It was found that medical students value good working conditions significantly more than they value desirable geographical location, indicating that as new graduate doctors, they would require compensation of an additional 44% above average earnings to move from a post with excellent working conditions to one with poor working conditions.

Modelled costs

Sometimes costs are difficult or impossible to measure. In this situation, investigators can estimate costs if there is a defensible approach explained, or by using the costs previously reported by another source. For example, in a study examining the cost-effectiveness of mobile app-based ultrasound training, Nilsson et al (2017) estimated development costs based on hourly rates for the developers based on how many hour they spent on the project (Nilsson et al. 2017).

Although this was not the price that the authors had to pay themselves because the developers were part of the research team, the cost estimate was needed to communicate the actual costs associated with the intervention.

Net Present Value

Net present value (NPV) adjusts both costs and outcomes to account for how the perceived value of expenditures and benefits changes over time. It is human nature to want to achieve an outcome sooner rather than later. The sooner returns are realised, the more control we have over the use of those rewards, and the less risk that future events may disrupt the return of the rewards. Thus, we value immediate benefits more than those that might be realised in the future. Net present value addresses the time sensitive value of money by discounting or devaluing future costs and outcomes relative to immediate costs and outcomes (Drummond, O'Brien, et al. 1997), distilling all of the economic costs and benefits – both immediate and future – down to a single value. It does this using a discount rate. The discount rate is like a currency exchange rate, but instead of being an exchange rate between countries' currencies, it is essentially an exchange rate between the present and the future (Claxton et al. 2011). The further into the future, the poorer the exchange. A positive net present value indicates that more is 'gained' than 'lost' once converted to today's values. The opposite is true for an option with negative net present value, which would represent a poor educational investment. Rivers at al. (2015) applied the net present value approach to their exploration of the economic value of an investment in physiotherapy education in Australia (Rivers et al. 2015). In this case, the net present value calculation represented future earnings as a physiotherapist minus the costs associated with obtaining the degree. Even after assuming an expected discount rate of almost 10%, investment in education by domestic students yields an estimated net present value of $784,000 Australian dollars over the lifetime career of one public sector physiotherapist. In other words, the up-front payment of educational fees yields financial rewards that far outweigh the costs – making the education a profitable long-term investment.

A FOUR-STEP MODEL FOR APPRAISING AND CONSIDERING ECONOMIC EVALUATIONS (Box 3)

Box 3: An Educational Decision-Makers Guide to Appraising and Considering Findings from Economic Evaluations

1. Can I trust the results?
   a. Were the costs and outcomes properly measured and valued?
   b. Was appropriate allowance made for uncertainties in the analysis?

2. What are the results telling me?
   a. What were the incremental costs and learning outcomes of each strategy?
   b. Do incremental costs and outcomes differ between subgroups?
   c. How much does allowance for uncertainty change the results?

3. Could these results be transferred to my context?
   a. Could I expect similar learning outcomes in my situation?
   b. Could I expect similar costs in my situation?

4. Should I change my practice?
   a. Are the educational benefits worth the costs?
   b. Does the change align with my educational context?

Can I trust the results?

A study focusing on cost and value in health professions education is going to be useful for decision making only if it transparently describes how economic costs are defined and measured, and how the educational intervention was delivered and its outcomes measured(Levin, et al. 2017). Educational decision-makers may already be familiar with the requirements for critically appraising the methodological quality and rigor of studies that focus simply on the field of education (e.g., considerations regarding group assignment, sample size, outcome measurement validity, and loss to follow-up). A number of tools exist for appraising the methods of quantitative studies (e.g., the Medical Education Research Study Quality Instrument and the Newcastle-Ottawa Scale-Education (Cook and Reed 2015)), validation studies (Whiting et al. 2011, Cook et al. 2014,) and qualitative research for quantitative research, and qualitative research. These attributes of rigor are no different when applied to an economic evaluation in health professions education, and we refer readers to previous publications for further suggestions in such appraisals. In this section, we will review a four-step approach to appraising the economic elements of an economic evaluation.

Were the costs and outcomes properly measured and valued?

Box 4: Questions to target the appraisal of reported costs

1. How were the cost items identified?
2. How were the costs items measured?
3. How were the cost items valued/priced?

Earlier in the guide the concept of cost ingredients for determining what costs are relevant to an intervention was explored adapted from (Zendejas, et al. 2013). Educational decision-makers need to apply an approach to critically appraising whether these identified costs applied by the researchers within the study were appropriately measured and valued. This task can be guided by asking three key question of the studies reporting which will be explored below; 1) How were the interventions cost-items identified? 2) how were the cost items measured? And 3) how were the cost items priced? (Box 4).

How were cost items identified? The true economic cost is the accumulation of all resources that need to be expended to achieve the education result. Educational decision-makers should look for a reporting of the study's approach for determining what costs items were identified as relevant for inclusion within their analysis. For example, one common approach utilised by researchers is the use of a reference group of stakeholders to assist in identifying all possible hidden costs. Perhaps they are replicating or extending another study, in which case they may only be using costs reported from the other study. Although no gold standard exists, the approach taken should be explicit and replicable.

A commonly overlooked cost is that of faculty time and donated inputs (Maloney et al. 2016, Maloney 2017). Although it could be argued that educational activities are part of the staff member's role, there is an opportunity cost involved; that is, the opportunity has been lost to use that staff member's time in another productive way (Maloney 2017). For example, Sherman et al. (2016) proposed a model for the effective training of physicians in low-income countries (Sherman et al. 2016). Within their study, the evaluation of costs included the time of visiting physicians from high-income countries, as many of those involved graciously donated their time, with flights supported by charity organisations. However, if this training were to be reproduced, educational decision-makers would need to be aware that these costs were excluded, to avoid the risk of adopting this model and then discovering hidden costs too late (Maloney, et al. 2016).

All relevant resources need to be accounted for regardless of whether they were paid for. However, it is an accepted convention within economic evaluations that costs are not considered relevant if they contribute little to the overall result, or if they are considered equal and unchanging for both interventions being considered. Regardless, any such decisions leading to the exclusion of costs should be made transparent and justified accordingly.

How were the cost items measured? Once the educational decision-maker is satisfied with the approach used by the study's authors in determining relevant cost-items, attention should be turned to the process of how each cost ingredient was quantified? For example, was the cost-item measured using prospective logs, or a method that exposes the data to greater risk of recall bias (e.g., a retrospective survey)? Another feature of economic analyses is that not all items are easily measured – so sometimes costs are modelled, meaning that those costs are estimated, or taken from similar measures reported in other studies.

How were cost items valued? The final stage of appraising costs via the Ingredients Method is to look for how the authors determined the price of the cost-item. For example, if the cost item identified was administrative assistance, then how was the salary level for that assistance determined? Similar to the concept of costs being either measured or modelled, prices are commonly determined using what was actually paid within the study or assigned the closest estimate from existing literature or sources.

Was appropriate allowance made for uncertainties in the analysis?

Educational decision-makers should look for how the investigators considered the uncertainties inherent in their study, including the uncertainty of the estimates utilised within the analysis (i.e. estimates of cost, or measurements of educational outcomes), and the uncertainty in the processes and models they used (i.e. the possibility that important costs might have been omitted).

The reporting and discussion of uncertainty can impact on the educational decision-maker's interpretation of the trustworthiness of the results. One way to examine and transparently acknowledge uncertainty is through sensitivity analysis (Sculpher et al. 2004). A sensitivity analysis repeats the study's calculations, but does so using different assumptions or hypothetical conditions. In an economic analysis, this might involve using a range of potential cost estimates instead of a single estimate (Sculpher, et al. 2004). For example, to explore the impact of uncertainty surrounding the cost-item of faculty time, a sensitivity analysis may repeat the analysis first inflating and then decreasing the estimate of how much staff time was required, or considering different pricings for that staff time (Box 5). Educational decision-makers should also consider whether an appropriate array of parameters that have a significant impact on the total costs have been varied within the sensitivity analysis, and whether they have done so by an appropriate magnitude.

Box 5: Sensitivity Analysis

Background:
An educational decision-maker reads a study which compares 'routine delivery' of a faculty led workshop for assessing cognitive impairments in elderly patients, against an innovative approach that utilises 'near-peer' educators. The near-peer educators are final year students who have recently experienced the skill in practice during their clinical placements, and are returning to assist in the training of their pre-clinical student colleagues.

The educational decision-maker has a similar workshop within their own program, and is considering whether the approach would also be cost-effective for their learners. In doing so, they consider the sensitivity analysis of the study's results as pictured below:

Scenario No.	Description	Preparation costs (£)	Delivery costs (£)	Total cost (£)	Clinical competence	ICER
1	Faculty led workshop	50	200	250	+8	-
2a	Near-peer led workshop (Primary scenario)	100	100	200	+6	-£25
2b	Near-Peer (Primary scenario + preparation costs increased 30%)	130	100	230	+6	-£10
2c	Near-Peer (Primary scenario + preparation costs increased 60%)	160	100	260	+6	£5

Interpretation:
The study's principle result, taken from the analysis of their primary scenarios (scenario 1 and 2a), suggests that the greater increase in clinical competence seen in the faculty lead workshop above the near-peer lead workshop comes at an increased cost of £25 per unit of clinical competence.

However, if the educational decision-maker felt strongly about the quality of the preparation provided to the near-peer educators, believing they would be more comfortable with increased near-peer preparatory time than scenario 2a currently had allocated, they might be interested in the incremental cost effectiveness ratio for scenarios 2b and 2c. They would therefore observe that when preparatory time was increased by 60% compared to the primary scenario, that the direction of the result switches – the near-peer led workshop becomes more costly and less effective, and is therefore an inferior option.

Economic evaluations are likely to contain a number of assumptions that will impact on the structural uncertainty, and the external validity of the results. Whereas study limitations are more related to possible sources of error, assumptions in economic analyses relate to active choices made by the researcher, based on the context of their own

institution, and public culture at the time the study was conducted. For example, in the past it may have been assumed that computers would be supplied on campus for learners to engage in online activities, which may have led to the cost being owned by the institution. With the current prevalence of personal web-enabled devices, the cost of IT hardware is now more likely to be borne by the learner (Nicklen, Keating, et al. 2016). Thus, whether to include or exclude hardware costs, and whether to attribute these to the institution or the learner, represent critical and debateable assumptions with potentially high impact on the overall cost estimates. Thus, sensitivity analyses examining the costs from both perspectives would present the most complete and transparent picture. Extending this example to look at internet access as compared to computer hardware, who bears the cost of the internet access is likely to be determined by whether the learner engages in the online learning on campus or off-campus. As with any study, the assumptions and limitations should be included in the paper's discussion, making the choices transparent to the reader.

What are the results telling me?

What were the incremental costs and learning outcomes of each strategy?

When we compare the outcome measures of two or more interventions in health professions education, we are most interested in the incremental differences between the two options. This provides guidance toward answering how much additional gain can be obtained from what additional cost. Or taking this one step further, breaking the differences down to single units, one might ask: What is the cost of one additional unit of benefit?

Do incremental costs and outcomes differ between subgroups?

As with any empirical research, educational decision-makers should consider whether outcomes have been explored for relevant subgroups, and whether the results differ for any subgroup explored. When applied to economic evaluations, the reader should consider that subgroups may experience either significant differences in cost or outcome measures. What constitutes a relevant subgroup will depend on the context of the evaluation, and may include features relating to cost, such as those who may be subsidized or fully paying for the education, or features relating to factors that may predispose to different experiences of the benefits, such as cultural differences between international and domestic learners. Hints as to which subgroups are relevant to consider may be found in the demographic data of the participants shared within the study results.

How much does allowance for uncertainty change the results?

The concept of the sensitivity analysis for assessing the impact of uncertainty of the results also applies here. Namely, the educational decision-makers should examine whether the direction of the study's results is consistent across different scenarios and assumptions. If a favourable cost benefit holds true only under a very narrow band of situations, this might decrease confidence in the overall decision. For example, Maloney et al. (2015) conducted an analysis comparing the cost effectiveness of blended versus face-to-face teaching of evidence based medicine to medical students. Their sensitivity analysis explored multiple permutations of the key variable of staffing costs, revealing robust results favouring the blended learning format – remaining a positive overall value even when staffing levels were 20% higher than the face-to-face alternative (Maloney et al. 2015).

Could these results be transferred to my context?

After assessing whether the results can be trusted, and what the results indicate, the next consideration before the educational decision-makers is how transferrable the results are to a local context (Drummond et al. 2005): can educational decision-makers expect learning outcomes and costs similar to those experienced by the study authors?

Figure 2: The 'road map' of transferability'

Could I expect similar learning outcomes in my situation?

Measurement of educational outcomes is a science unto itself, and even a brief summary of current best practice lies outside the scope of this particular guide. However, decision-makers must ask themselves whether, if they replicated the exact same educational delivery, they would be likely to obtain the same educational outcome as the study. The transferability of these educational benefits relies on many factors, including the quality of the study itself, whether the reporting was sufficient for the approach to be replicated, and the degree of similarity of the learners. In making such judgments, educators may find support in guides or appraisal tools designed for this purpose (Koufogiannakis et al. 2006).

Could I expect similar costs in my situation?

The generalisability or transferability of study findings is a limitation of nearly all research, yet perceptions and estimations of value are particularly context dependent. As such, consideration of whether the findings of one economic evaluation will translate to similar results in a new application and context requires careful scrutiny (Drummond, et al. 2005, Maloney S. and Haines T. 2016, Walsh 2014).

Drummond et al (2005) outlined recommendations for increasing the transferability of the results of economic evaluations of clinical practice, touching upon the design, analysis, and reporting of studies of economic evaluations for clinical practice (Drummond, et al. 2005). The practical implications for educational decision-makers looking to assess the transferability of the study findings are to look for clarity from the papers concerning their description of the study centre(s), enrolment of participants, alternative options, perspectives of stakeholders, resources used and their costs, instruments used, variability, and any problems with the analyses such as incomplete data (Walsh 2014) (Table 2). The educational decision-makers should then look for alignment between the study's original context, and their own proposed new context.

Reporting domain	**Example of recommendation for this domain**
Study centre(s)	Description of the characteristics of the participating centres. If from different countries, then including relevant features of various educational systems.
Enrolment of participants	The types of the learners included or excluded.

Alternative options	Description of the alternatives in detail, such as the required contact time, and pre and post learning activities and learner support.
Perspectives of stakeholders	Report costs and benefits by each relevant perspective e.g. the student or the institutional perspective.
Resources used and their costs	Reporting the ingredients and their measurement and pricing separately.
Instruments Used	Report the sourcing of any values used.
Variability	Quantitative analysis of variability, such as the inclusion of a sensitivity analysis.
Problems with analyses	Detail on the extent of missing or censored data, and the methods used to address the problem.

Table 2: Practical implications for educational decision-makers concerning a studies reporting, adapted from (Drummond, et al. 2005).

Sensitivity analyses can be very helpful in informing the transferability of study results. When these are available, educational decision-makers should look for the described scenario or conditions within the sensitivity analysis that most closely reflect the context and costs within their own institution.

Should I change my practice?

Are the educational benefits worth the costs?

Sometimes the results are easy to interpret and utilise. Since a cost-minimisation analysis compares only the cost (assuming the educational outcomes are equal), the lower-cost alternative is considered superior. In analyses that examine educational outcomes, if one option costs less and provides better outcomes then again this would be considered superior (this is referred to as a "dominant" result). Conversely, a more expensive and less effective option would be decisively inferior.

However, if one option is slightly more effective but is also slightly more costly (i.e., neither option is dominant, as in the example provided in Box 2); or if both outcomes and costs are similar for both options, the superior option is unclear (a "non-dominant" result). In these situations, neither the study investigators nor the education decision-makers seeking to apply the study findings can conclusively identify one option as superior. Rather, that judgment depends on local values, priorities, and assumptions. However, if transparently reported and thoughtfully applied, the information will be useful in making an informed decision.

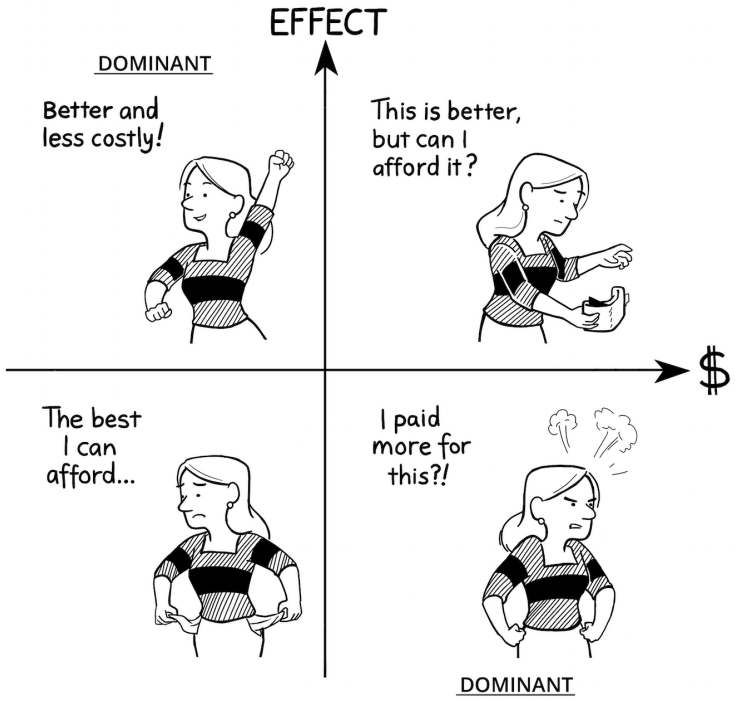


Figure 3: 'Learning outcomes' from the Cartesian plane.

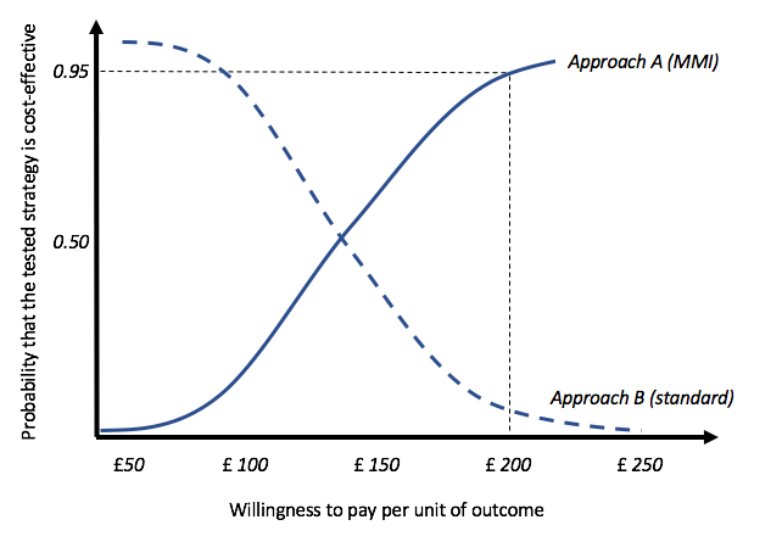
In the case of a non-dominant result, decision-makers might ask questions such as: Is the added effect is worth the added cost? Is a reduced benefit acceptable given the reduced cost? Are there other consideration (beyond effectiveness and cost) that might lead toward one approach over another?

It can also be helpful to consider the question of "Is the benefit worth the cost?" through the lens of willingness to pay. A visual representation of the relationship between a stakeholder's willingness to pay and the probability that an intervention is cost-effective is known as the Cost-Effectiveness Acceptability Curve (CEAC) (Box 6) (Hoch JS et al. 2006, Tolsgaard, et al. 2015). The cost-effectiveness acceptability curve is created by the authors using empirical data, with the range of values presented within the curve being representative of the uncertainty within studies point estimates. Educational decision-makers can consider the maximum amount they would be willing to pay to achieve or avoid a unit of the outcome of interest. They can then check this against the model's prediction of cost-effectiveness, and thereby gain some assurance as to whether the intervention would be considered cost-effective by local standards.

Box 6: Cost-Effectiveness Acceptability Curve (CEAC)

Background:
The study being considered is a cost-effectiveness analyses of a traditional interview compared to the Multiple Mini-Interview (MMI) for accessing the undergraduate learner's aptitude for a health professional program, with the aim of reducing program attrition i.e. student drop-out.

The authors have created a cost-effectiveness acceptability curve to help present the uncertainty of their results, and assist the educational decision-maker in assessing the acceptability of the cost-effectiveness outcomes against their own institutional context. The educational decision-maker has met with their own team and concluded their budget can only afford for them to investing £200 per student drop-out avoided, and is now viewing the cost-effectiveness acceptability curve below to determine the probability of the Multiple Mini Interview being cost-effective for that price



Interpretation:
The finding is mapped on the above graph with the dotted line extending up from the £200, to meet the cost-effectiveness acceptability curve for the Situation Judgement Test (approach A), and then aligned across to the corresponding probability on the vertical axis. The educational decision-maker can be 95% confident that the Multiple Mini Interview approach will be cost-effective.

Does the change align with my educational context?

As noted above, value is highly context dependent, and decisions concerning the uptake or rejection of an educational innovation are affected by numerous factors and forces beyond effectiveness and costs. A greater understanding of the factors and forces influencing such decisions can lead to more effective decision-making.

At a simple level, an analysis of the decision-making environment might include reflecting upon the institution's current educational capabilities, capacity for change, and strategic goals. For example, a program operating within an emerging nation (where low-cost options are likely to be required for sustainability) may find greater utility from a study evaluating low-cost alternatives as a means of minimising costs (Maloney, et al. 2016). A more comprehensive analysis of the decision-making environment may go beyond one institution's internal environment to also examine the competitive educational market and other external factors. Such factors might include the political climate,

opportunities for scholarly activity, or key features of market differentiation. Tools developed for decision-making in business may be helpful in such analyses, such as Porter's Five Forces framework (Porter 1979), or the Political, Economic, Sociological, Technological, Legal, and Environmental (PESTLE) framework (Law 2009). Use of these tools frequently culminates in an analysis of Strengths, Weaknesses, Opportunities, and Threats (SWOT), summarising the overall context to allow strategic decision-making to occur (Christensen and Raynor 2003).

Educational decision-makers will benefit from appreciating that we live in an ever-changing system, and that decision-making is a cyclical and iterative process. Circumstances change, evidence changes, as do learner behaviours and society's expectations.

CONCLUSION

Educational decision-makers are uniquely positioned to create change in teaching and learning practices. Data published from economic evaluations can be a powerful decision-making aide. As the number of studies that examine the cost and value of health professions education grows, education decision-makers will require increasing skill in understanding, appraising, and considering study findings if they are to ensure that educational activities achieve optimal value for a given spend.

GLOSSARY

Term	Relevance for the educational decision-maker
Break-Even Analysis (BEA)	An analysis approach that considers if and when return on investment may be expected, mapping outgoing costs (including start-up costs) against incoming savings.
Break-even point	The time-point at which incoming savings have balanced out the outgoing costs (including start-up costs) - i.e. when return on investment has been achieved.
Cost-Analysis	An analysis approach that investigates costs alone, and not the subsequent returns or outcomes; often referred to as a partial economic analysis.
Cost Benefit Analysis (CBA)	An analysis approach that compares costs and benefits i.e. effects of a proposal/intervention, expressed in monetary units – e.g. dollars.
Cost Effectiveness Analysis (CEA)	An anaylsis approach that compares both costs and benefits, with (i.e. learning outcomes) in natural units i.e. knowledge change, or clinical competence.
Cost-Effectiveness Acceptability Curve (CEAC)	A method of representing uncertainty in a study's findings regarding willingness to pay.
Cost Minimisation Analyses (CMA)	An analysis approach that provides information on which intervention or process has the least costs, assuming the outcomes of the interventions are equivalent.
Discounting	An analysis approach that gives greater weight to returns realised today relative to future returns, because of advantage of immediate use, as well as uncertainty and inflation.

Discount Rate	The numeric term used to discount future costs (see "Discounting"). The higher the discount rate the lower the value (weighting) of future dollars.
Dominance	A pattern of results showing that one intervention is both more effective and less costly than its alternative.
Economic Cost	The true cost of the intervention or process, including financial costs, as well as those of time and resources consumed.
Educational Decision-Maker	Anyone whose decisions can impact on learners, or teaching practices.
Incremental Costs	The additional cost in producing one additional unit of measure.
Modelled Costs	Cost estimates based on indirect approaches or external sources (as contrasted with actual costs, which have been specifically measured).
Net Present Value	An estimate of the financial value of all future benefits realised over a defined time period.
Opportunity Cost	The value of 'something', whether tangible or intangible, given up or sacrificed in order to obtain goods, services or inputs (i.e., the worth of this "something" if applied to its next best use).
Quality Assessed Students Educated (QASE)	This is a measure of effect that takes into account the degree of change, and the quantity of students who experienced the change (QASE = number of students educated × the group's average grade)(Maloney, et al. 2015).
Perspective	The stakeholder viewpoint from which costs are being calculated i.e. are costs being considered from the perspective of the student, or perspective of the educational institution?
Sensitivity Analysis	An approach for representing uncertainty or variability in study findings, accomplished by repeating key analyses using alternative assumptions, conditions, or estimates.
Stakeholder Perspective	The stakeholder viewpoint of interest (e.g., the student, the health service, or the educational institution).
Start-up Costs	Costs incurred in initiating the activity, as distinct from ongoing or running costs e.g. infrastructure costs.
Sunk Costs	Costs that have been incurred prior to initiating an intervention/activity and that cannot be recovered.
Willingness to Pay (WTP)	A measure of the stakeholders' perceived value of the item, intervention or experience.

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