Title: The Prato Method: A guide to the application of economic evaluations in health professions education research.

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BACKGROUND

A sustainable expansion and reform of the education and training of health professionals is necessary to strengthen health systems and improve population health outcomes (1). Central to such change is not only discerning the efficacy and effectiveness of education strategies, but also understanding the ongoing economic analyses of viable programs and their innovations. The economic literacy of educational researchers is a significant barrier to targeting education that returns the greatest value at a given cost, and is able to meet future health workforce training requirements. Although there are a number of quality resources targeted for evaluations in the health economics area, such as the Drummond's checklist (3) and the Cheers Statement (4), there remains a lack of any resources tailored to applying cost-analyses to continuing health professions education. In the absence of such guidance, educational researchers are applying economic evaluations haphazardly, often using methods and terminology incorrectly (5).

Simulation, as an example, has rapidly developed as a method of enhancing, and in some case substituting, aspects of clinical education (35). As the number of simulation interventions has increased in use, so too has the number of studies evaluating its effectiveness (36) Whilst studies have focused on the quality of research, cost reporting in simulation education research is infrequent and incomplete (30). A recent review identified 967 comparative studies examining the effects of simulation, of which only 1.6% provided any comparative reporting of costs (30). Moreover, there are several studies (31, 32 and 33) which evaluate costs in eLearning where costs were collected inconsistently or on the basis of a wide variety of factors making it difficult to assert conclusively that eLearning is more cost-effective than face-to-face instruction. Finally, the World Health Organisation (WHO) has highlighted a call for harmonized metrics and methodologies, to strengthen, evidence, accountability and action (34).

The aim of this paper is to describe the terminology and methodology for economic evaluations of continuing health professions education programs It is based on the *Prato Statement* comprising the consolidated discussions around cost and value in education, across the domains of knowledge, policy, and culture – as held by the organising delegates of the inaugural Symposium of the Society for Cost and Value of Health Professions Education (SCVHPE), held in Prato, Italy, October 2015 (28). This paper is intended as a basic guide to those undertaking economic evaluations of continuing education programs for the health professions to ensure a more consistent and standard approach.

This paper is organized around the major steps in planning and implementing an economic study [adapted from Polinder et al (37)]:

1. Designing the study
2. Estimating effects/assigning value
3. Estimating costs
4. Calculating the incremental cost–effectiveness ratio
5. Adjusting for timing and uncertainty
6. Reporting results

An ongoing hypothetical case study of a continuing health professions education intervention is illustrated and highlighted throughout this paper to demonstrate application of the concepts and approaches.. The hypothetical continuing health professions education intervention chosen is training or for learners using a virtual environment as opposed to a traditional face-to-face environment.

1. Designing the study.

This section provides an overview of the case scenario used throughout this basic guide. The hypothetical case study of an intervention relates to continuing professional development of medical learners using a simulated environment. The idea of using simulation is to fully engage the learner's attention to improve their clinical competence with access to increase training capacity at lower cost in a virtual training environment.

Define the intervention, target population and clinical and/or educational context

Running Case example

Defining the intervention is critical for evaluation purposes and should be clearly specified in including its role in solving/addressing an identified problem/opportunity. In this case the intervention provides an emersion into a simulated clinical experience by creating a tool that enables them to access a virtual environment and virtual instructor (hereto referred to as 'the tool'), 24 hours a day, 7 days a week. This tool would operate simultaneously with other face-to-face elements of the training program. Through the tool, the learner would make observations and clinical decisions through the assessment of virtual patient.

For the purpose of the hypothetical case scenario it is assumed that the funding provided for the tool is equal to $500,000 of which $100,000 has been designated for content creation and $400,000 for software and hardware. There are also ongoing operational costs of maintaining the server and technical support of $120,000 per annum. The target population designated for exposure to the tool is assumed to be 50 medical learners with the other 50 learners used as 'control group' and who do not have access to the tool.

Choose the form of economic evaluation.

There are a variety of evaluation approaches available for estimating the cost and value of health professions continuing education interventions including those that involve broader social costs and benefits, such as cost-benefit analysis (CBA) as summarised in Figure 1. These methods are discussed in greater detail in the following sections.

Cost-benefit analysis.

Cost–benefit analysis represents a systematic approach to evaluating alternative health professions education programs by assigning monetary values to benefits and costs of such proposals, thereby allowing a comparison to be made between different proposals (5). Cost-benefit analysis is the fullest form of evaluation, which considers not only private costs and returns from educational investment, but also the broader social costs and returns from such investments (5). From a public benefits perspective in continuing health professions education in particular, there are implications for society in terms of productivity gains and positive third party effects to those who are not directly involved in the educational investment - such as the community at large (12).

The other advantage of cost-benefit analysis is that it can explicitly compare costs and benefits occurring at different points in time. This advantage is useful where investments and returns are ongoing in nature and occur over time. As a rule in the cost-benefit analysis method, interventions with the greatest positive net benefit are generally taken to be attractive, notwithstanding distributional and other considerations, and should be selected as preferred. That is to say, where efficiency objectives are the single objective, and where available data allow costs and benefits to be monetised, continuing education programs with the greatest net benefit should be selected and implemented. Notwithstanding the difficulty in providing quantitative monetary estimates for benefits, the validity of results relies on being able to identify or isolate benefits provided by the intervention and not by other factors (5).

Where data gaps prevent the monetisation of costs and benefits, other methods should be considered to determine a preferred alternative such as break-even analysis or multi-criteria analysis (MCA), as discussed in the next sections of this paper.

Break-even analysis (BEA).

This divides the costs of an intervention by the minimum amount of benefits required for the intervention to generate incremental benefits which just equal incremental costs, that is to say a cost-benefit ratio (CBR) of 1. Estimating the minimum additional benefits required to achieve a cost-benefit ratio of 1 involves a judgment about the likelihood of the required level of benefits actually being achieved.

Multi-criteria analysis (MCA).

Multiple criteria decision analysis or multi-criteria analysis can be used to rank alternatives and determine the most preferred proposal. Multi-criteria analysis establishes preferences between alternative proposals to meet a specific set of objectives, and which are assessed against measurable criteria. Multi-criteria analysis ranks proposals by assessing the ability of alternatives to meet the objectives through the application of numerical analysis (16) to a performance matrix.

Private Rate of Return on Education (PRORE).

Rates of return to education (RORE) can be considered as the stream of goods and services (private and social returns) that flow over time in response to an educational investment (private and social investment). The challenge of estimating rates of return to education is unpacking the contributions towards future earnings from the education program itself versus other factors such as general aptitude, motivation, and socio-economic class, which may also contribute to future earnings (12). Private rates of return on education involve the measurement of private pecuniary benefits such as additional earnings as compared to base-line earnings as well as non-pecuniary benefits such as status, better quality of life or better or more interesting work, and expresses incremental benefits as a proportion of the initial private outlay (cost) in continuing health professions education (12).

Social Rates of Return on Education (SRORE).

Social rates of return on education encompass both private pecuniary benefits and broader social benefits to society from health professions education - including productivity and improved health outcomes as well as intangible benefits such as improvements to culture and the arts (12). Social return expresses incremental private and social benefits as a proportion of private and social outlays utilising public resources such as subsidies (12).

Cost-effectiveness analysis (CEA).

As another popular evaluation method, cost-effectiveness analysis can be used to assess the lowest-cost way of achieving a predetermined common objective around health professions education policy, which either cannot be monetised (22) and/or has been determined by the political process. A comparison is made of alternatives to determine which one delivers a given outcome (value) at the lowest cost per unit of outcome (the least cost per unit alternative). However, cost-effectiveness analysis is limited as it compares program alternatives against a 'pre-determined education outcome' (5) and does not promote the option with the greatest amount of net benefit.

Base line.

The choice of the correct 'base line' or 'control situation' is critical to identifying the appropriate level of costs and benefit outcomes when evaluating health professions education. It establishes as a point of reference what stakeholders (e.g. learners, teachers, or the health service) would be doing in the absence of the intervention and allows us to isolate the net impact of a program over time. In the ongoing case example, the base line is what would exist in the absence of the intervention, specifically traditional face-to-face delivery of training for learners.

The choice of which form of valuation is undertaken will depend on the scope of the problem or opportunity (primary objective) which the intervention is trying to deal with in the first instance. An evaluation can focus the problem or opportunity from a single point of view, or include multiple viewpoints to provide a more 360 degree perspective on an issue. It is important to identify the scope of the evaluation and stakeholders affected before deciding on the form of evaluation.

The potential range stakeholders identified with this intervention including their priorities include:

- *The provider* – improvement in the quality/reducing the cost of training as well as the ability to generate additional revenue streams;
- *The learner* – earnings and non-pecuniary returns to education including reduced cost of travel;
- *The employer* – greater accessibility to health professionals through reduced time to acquire clinical competence; and
- *The patient and community more broadly* – broader benefits attained by the community in terms of improved health outcomes generated per learner in terms of improved competency (reduced risk) by allowing them to obtain a greater understanding of consequences from bad practices without harming any 'real' patients through the virtual learning environment)

If the evaluation was concerned with the learner only then it would be appropriate to choose the Private Rate of Return on Education (PRORE) which focuses only on earnings and non-pecuniary returns to education. However, this would be a very narrow scope for the evaluation and from a single point of view.

Choose the perspective

The perspective of an evaluation is important because it provides a guide for *which* costs and benefits (outcomes to be achieved) to include in the evaluation. With regards to the case scenario the *primary objectives*, as determined by the (educational) provider funding the intervention, for example, might be to improve the quality and reduce the cost of training, as well as improve health outcomes by reducing the risk to 'real' patients. Therefore, the evaluation is broader and taken from the perspective of the health education provider and the patient.

Define the implementation period and time horizon

The implementation period and time horizon is important for determining the *magnitude* of costs and benefits captured by the evaluation. For example, with respect to the case scenario, there is a one-off cost of $500,000 however there are ongoing operational costs of $120,000 per annum and it will be important to define how long the intervention is to be assessed. This will be important not only from the perspective of cost but also benefits to be attained by the intervention. The implementation period and time horizon therefore serves to guide the scope of the evaluation.

Choose primary or secondary data

The effort that goes into collecting data to undertaking an evaluation should reflect and be commensurate with the social/health/economic impact of an intervention. In turn, the impact will be determined by the scope of the study, including the time horizon and perspective from which the evaluation is being undertaken. In our ongoing case scenario, a high impact of the virtual simulation intervention with respect to minimising risks to physiotherapy patients, for example, would warrant primary data. This would include randomised controlled trials, such as giving access to the virtual simulation to a random 50 learners, whilst giving the remaining 50 students access to online materials only. It might also be useful to fill in data gaps by performing secondary analysis on research reports or existing databases of statistics for economic or health indicators such as time required to achieve clinical competence, learner assessments, and/or health outcomes of physiotherapy patients. Secondary data can be used to complement primary data or substitute for primary data, particularly where interventions have a low social/health/economic impact.

<u>Choose primary data sources</u>

Finding primary data might typically involve learner surveys, database information or patient surveys. In the case scenario, data on learners in terms of quality might be in the form of a comparison of time to completion and marks achieved between the two cohorts. Health outcomes for physiotherapy patients might be determined through surveys or rate of recovery statistics, for example.

2. Estimating effects

2.1 Cost–effectiveness analysis

Cost–effectiveness analysis relies on using a natural unit of measurement (37) such as the *time taken* to attain a level of competency or *injuries prevented* with regards to physiotherapy patients - through the virtual simulation intervention. Costs on the other hand are expressed in monetary units. In this way an intervention can be assessed in terms of its ability to achieve particular outcomes at a cost and compared against the status quo or base line.

2.2 Cost–benefit analysis

With respect to cost-benefit analysis, both benefits and costs are expressed in term of monetary values. This type of evaluation would require the estimation of the monetary value of both costs and outcomes to be achieved. In other words, it requires natural units of measurement such *time to achieve competency* in the ongoing case scenario to be converted to monetary units. This evaluation method therefore raises the issue of how best to convert natural units such as time into monetary units with a number of *revealed preference* or *stated preference* techniques available. With regards to stated preference techniques it might be possible to ascertain what people are prepared to pay for faster completion through willingness to pay surveys. On the other hand, with regards to revealed preference techniques, hedonic pricing might be taken into consideration where education is visualised as a set of attributes including prestige or social standing and ability to earn income to name a few. For learners who achieve competency faster immediate earning capacity might be compared against those who achieve competency later where other attributes are held constant. The differential then measures the dollar worth of a quicker achievement of competency. Another revealed preference technique includes 'defensive expenditure' and this might be used where it is possible to identify whether or not learners spend additional resources to avoid delays in attaining competency. Expenditures to avoid undesirable outcomes can then be used to put a dollar value on achieving competency in a timelier way.

2.3 Break-even analysis

Problems around the conversion of natural units into monetary units can be avoided with break-even analysis because it takes outcomes as represented by dollar amounts required for the intervention to generate incremental benefits which just equal incremental costs. In this case the evaluation would be asking the question - does the virtual simulation provide benefits in terms of improving the quality of training, as well as improving health outcomes by reducing the risk to 'real' patients for around 50 learners equal to an amount of $500,000 on-off and ongoing operational costs of $120,000 per annum? A value judgement would have to be made regarding the number of learners/patients affected that would be required to break-even.

2.4 Multi-criteria analysis

Multi-criteria analysis ranks proposals by assessing the ability of alternatives to meet the objectives through the application of a weighted score (16) for key criteria. This approach is useful where one or more of the criteria cannot be monetised. In our ongoing case scenario, the main objectives are to improve the quality; reduce the cost of training, as well as improve health outcomes by reducing the risk to 'real' patients. Each of these three would form a criterion under MCA and judgement would have to be made as to the importance (weighting) of these in terms of the overall set of objectives.

2.5 Private Rate of Return on Education (PRORE) and Social Rate of Return on Education (SRORE)

Measuring private pecuniary benefits (narrow benefits) including reduced costs of travel with the PRORE approach and expressing them as a proportion of the initial private outlay (cost) would not be relevant for an intervention whose objectives include the quality of education, provider cost and reducing 'real' patient risk. However, with the SRORE approach, might be considered as a better candidate for the case scenario presented above, especially for example, where there are broader community benefits and broader social costs (e.g. government funding via an ICT grant/subsidy) being considered.

3. Estimating costs

The possible major categories of costs relating to a continuing health professions education intervention include direct costs, namely: substantive and administrative (generally time) costs to learners, costs to the education provider - and indirect costs.

Under the case scenario one of the main direct costs identified are those which are incurred by the education provider through the implementation of the virtual simulation tool including upfront capital investment in software and hardware and content creation of $500,000 and operational costs of $120,000 per annum to the education provider. As discussed earlier minimising the cost of providing education is a key objective of the provider and therefore this might be the entire scope for a cost consideration - again depending on the perspective of the evaluation.

However, there are direct costs involved in the adoption of the simulation tool by learners. These costs include the substantive cost to users of computer equipment and private subscriptions to high speed internet (assuming that the intervention is intended for 24/7 access), as well as, more administrative type costs involved in time spent learning to use and navigate the virtual simulation tool. Apart from the cost of private subscriptions to high speed internet, the latter costs to the medical learner are likely to be one-off.

The general formula for annual substantive costs involves the population affected; the frequency with which the costs would have to occur; the rate of adherence; and per unit cost of the activity. This is illustrated as follows:

Substantive cost = Population affected x frequency x adherence rate x per unit cost

In the case scenario example provided above, for example, the annual cost would be estimated for 50 students with a frequency of 12 months per annum of high speed broadband x 100% x $120 per month. This would provide an estimated annual cost of $72,000.

Direct administrative costs are defined as the costs incurred by users to demonstrate adherence with the intervention and generally relate to the opportunity cost of time. Under the case scenario this would relate to learners familiarising themselves with the virtual tool and involves a one-off cost of around 16 hours of training. The components of administrative cost include *Price* and *Quantity*:

Administrative cost = Price x quantity

Where:

- Price = (internal tariff x time)
- Quantity = (population x frequency x adherence rate)

The internal tariff represents an individual medical learner's own cost of time and can be estimated using average hourly earnings with a mark-up to capture salary on costs. Taking these estimates and assuming a mark-up of 25% the administrative cost for learners becomes:

$25/hr x 16hrs x 50 learners x frequency of 1 x 100% adherence = $20,000

With respect to indirect costs - there is a consideration of unintended consequence of the intervention on other stakeholders. For example, the adoption a virtual learning environment with a virtual instructor might result in the replacement of real instructors and loss of employment opportunities in the economy. If the evaluation had a broader social perspective and adopted a SRORE or cost-benefit approach, then such an unintended consequence might be factored into the cost estimation of the intervention.

4. Calculating the incremental cost–effectiveness ratio

When comparing face-to-face learning (F2F) with the intervention of a virtual simulated environment using the cost–effectiveness analysis where the costs and effects of these learning environments are compared by calculating an incremental cost–effectiveness ratio (ICER) defined as:

$$\frac{Cost_{intervention} - Cost_{F2F}}{Effect_{intervention} - Effect_{F2F}}$$

The case scenario might establish the effect of the intervention of interest is the competency of the learner using the validated Berlin Questionnaire (39) where the quality of learners' education with each method is calculated as the product of the number of learners and the group's average rating on the Berlin Questionnaire. Costs for the intervention and face-to-face control include both investment costs and operation costs but do not cover user or administrative costs for learners as the perspective of the evaluation is taken to be from the education provider only.

ICER can be used to compare F2F (the control) with the intervention discussed under the case scenario by establishing the hierarchy of cost-effectiveness with four possibilities as shown in Figure 2.

An ICER comparing F2F to the intervention of with a negative sign on the numerator and a positive sign on the denominator, indicates that the intervention is less costly and more effective than the F2F approach (38).

5. Adjusting for timing and uncertainty

5.1. Discount costs and health effects

Discounting refers to a method of converting future currency (whenever they occur) to ‘present values’ in order to compare costs and benefits in today’s terms. There are three reasons why future currency is valued less than today’s currency. Firstly, individuals prefer to consumption today over consumption in future and will require compensation by way of a rate of return for postponing their consumption. Secondly, the value of money falls over time as a result of inflation - whereby more money is needed to buy the same products and services in the future as compared to today. Thirdly, discounting makes sense because of uncertainty - in that people have a fear of not being alive in the future to collect any benefits and therefore have a higher preference for their benefits in the present.

An inter-temporal weighting known as a discount rate (r) is used to convert future currency into present day currency. In the case of continuing health professions education this is particularly relevant as the benefits of education investment such as additional earnings are usually obtained in future periods and have diminished value over time despite the fact that costs may be incurred today. Transparency and accuracy of the evaluation process would require that future diminishing currency values such as future earnings be appropriately discounted when making comparisons to present day less diminished values such as investment costs. The higher the discount rate the lower the present value of future currency. To convert future currency into present value currency the following calculation is used:

$$Present\ Value\ (PV) = \sum \frac{V_t}{(1+r)^t}$$

Where:

t = year in which the benefit or cost outcome occurs;

V_t = value of benefit or cost at time period *t*; and

r = discount rate.

The interest of decision makers around benefits and costs (V_t) is focused exclusively on ‘operational cash flows’ arising from an investment. Depreciation and interest are instead captured in the discount rate reflecting the ‘opportunity cost of capital’ or, alternatively, the minimum return required to prevent capital from being diverted to its next best alternative use. Therefore, any inclusion of capital costs in V_t is considered as double counting.

Worked example of discounting:

The following case example takes a learner receiving training using a virtual learning environment such that more timely and effective competency translates into additional future earnings received as compared to face-to-face delivery. These additional hypothetical earnings are assumed to equal $10K per annum over the next 5 years. Summing the value of those additional earnings would provide a value of $50K and, assuming a current year one investment of $48K by the learner, would imply a surplus to the learner of $2K making their decision to invest in a training program with a virtual learning component a prudent one.

However, this result over-emphasises the true value of future earnings, which diminishes over time, and would result in errors when comparing against present day costs. This is illustrated in the following example. Taking the time period t to be years 1 to 5 and the value of the benefit (additional earnings) in a particular time period V_t, to be $10K and taking the discount rate, r, to be equal to the foregone interest on a savings account of 2% per annum (a discount factor of 1.02) – the discounted present value of future earnings would actually be:

$$Present\ Value\ = \sum \frac{V_t}{(1+r)^t}$$

$$= \frac{\$10{,}000}{(1.02)^1} + \frac{\$10{,}000}{(1.02)^2} + \frac{\$10{,}000}{(1.02)^3} + \frac{\$10{,}000}{(1.02)^4} + \frac{\$10{,}000}{(1.02)^5} = \$47{,}135$$

In this example, a decision to undertake training in a programme with a virtual environment, would provide a negative result of -$865 to the learner in today's present value dollars – i.e. the $48K investment less the discounted benefit of $47,135, which takes into consideration 'time value of money'. If the evaluation was undertaken from the perspective of the individual beneficiary only, this intervention would not be considered economically viable.

There are a number of discount rates available for discounting future currency - however, unfortunately, there is no consensus on which one should be used (10). Determining the appropriate discount rate over the long term is difficult but can make a difference to an intervention's value. It is worth considering on a case-by-case basis, accounting for the concerns and characteristics of the proposal (11). Where the concern of the education program is future consumption streams only, the discount rate will reflect the consumer or private time preference rate (PTPR) or social time preference rate (STPR) of discount. If only private benefits of health professions education services to the individual are being discounted, then the private time preference rate is appropriate. Social time preference rate is more appropriate where an intervention reflects future consumption streams for future generations or *intergenerational preferences* (10). On the other hand, a risk-free social opportunity cost of capital (SOC) is recommended by most governments when discounting future currency where a program is seen as diverting resources in the economy from private to public investments and involves public funding (11). Calculation methods for discount rates are illustrated in Table 1. The discount rate chosen will have an effect on the final present value estimate and should be clearly indicated as part of the evaluation for transparency.

Implicit time preference may also be used with regards to the consideration of discounting of future benefits for health professions learners where preference rates are determined using psychometric studies. In such studies individuals are asked to choose between smaller more immediate versus longer term/larger monetary and non-monetary rewards, such as job satisfaction (27). In this way, utility function may be broadened to a discussion of multiple objectives where preferences might be expressed in terms of more than just future earnings, such as more or less satisfying jobs at different times in different geographic location or with different health care specialisations.

Worked example of applying different discount rates:

Applying different discount rates to our virtual learning intervention case study, with additional hypothetical earnings of $10K per annum per learner for 5 years, yields different present value results for total earnings under the following three scenarios. In scenario one, the evaluation is taken purely from the perspective of the individual learner where the learner is only concerned with their own private consumption patterns (i.e. they only save for their own future benefit) and, therefore, *private time preference rate is used providing a result of $47,175* (assuming: marginal tax rate t =

30%; risk-free bond rate *i* = 5%; and expected inflation rate *ρ* of 1.5% - with a *discount rate of 1.97 %*):

$$PTPR = \left[\frac{[1 + i(1 - t)]}{(1 + \rho)}\right] - 1 = \left[\frac{[1 + 0.05(1 - 0.3)]}{(1 + 0.015)}\right] - 1 = 1.97\%$$

$$Present\ Value\ = \sum_{t=1}^{5} \frac{\$10{,}000_t}{(1 + 0.0197)^t} = \$47{,}135$$

In scenario two the evaluation is again taken solely with the return to the learner in mind, however the learner has a broader (social) view on the value of consumption patterns - in that they are concerned with preferences of future household generations (including their own children) and, therefore, *social time preference rate is used providing a result of = $44,493* (assuming: 'pure' rate of time preference *r* of 1.5%; elasticity of marginal utility of consumption *e* of 1.4 (2); and expected growth in per capita consumption *g* of 1.8% - with a *discount rate of 4.02%*):

$$STPR = r + (e\ x\ g) = 0.015 + (1.4\ x\ 0.018) = 4.02\%$$

$$Present\ Value\ = \sum_{t=1}^{5} \frac{\$10{,}000_t}{(1 + 0.0402)^t} = \$44{,}493$$

In the final scenario, the evaluation might be concerned with both the return to the individual learner, as well as the community from a publicly funded initiative and the evaluator is concerned about diverting funds from private to public hands to finance the programme; and therefore *a social opportunity cost of capital is used - providing a* *result of $45,217* (assuming: risk-free bond rate *i* = 5%; inflation rate *ρ* = 0.5% - with a *discount rate of 3.45%*):

$$SOC = \left[\frac{(1+i)}{(1+\rho)}\right] - 1 = \left[\frac{(1+0.05)}{(1+0.005)}\right] - 1 = 3.45\%$$

$$Present\ Value\ = \sum_{t=1}^{5} \frac{\$10{,}000_t}{(1+0.0345)^t} = \$45{,}217$$

5.2. Perform sensitivity analysis

Sensitivity analysis involves determining which values are critical to the evaluation and substituting them with plausible yet pessimistic values. If a cost-effectiveness evaluation still results in a more cost effective intervention - then no more tests are required to investigate the riskiness of that intervention in terms of costs and effects reported. On the other hand, when such pessimistic values result in a less cost-effective intervention, then further work is needed, namely replacing the 'critical values' with 'switching values' or values which take the evaluation from a more cost-effective to a less cost-effective outcome. An evaluation must then be made regarding the likelihood of the switching value occurring to get a better idea of the riskiness of an intervention.

5.3. Perform (probabilistic) uncertainty analysis

Investments in health professions education by both individual learners, providers and society are contingent on the ability to generate a return on that investment in future. For the learner, the investment translates into the opportunity to obtain additional earnings, not ignoring any non-pecuniary benefits. For the provider, the delivery of an education program reflects an additional revenue stream. For society, the investment provides the potential for improved health outcomes as the quality of health professionals is further enhanced. However, the outcomes on which investment decisions are predicated on today, are subject to risk or uncertainty which relate to the possibility of different values occurring based on a known probability or unknown probabilities, respectively. Where probabilities of an outcome occurring are known then cost and benefit estimates should take into consideration these probabilities through weighting. Where probabilities of outcomes occurring are unknown, then either a full sensitivity analysis can be undertaken using Monte Carlo type computer simulations and assigning probabilities (26). Alternatively, future costs and benefits which are uncertain should be subjected to a sensitivity test where pessimistic estimates are used to determine whether the present value of a future stream of cash flows remains positive. Finally, sensitivity analysis can also conducted using variations to discount rates to see how higher or lower discounting of future estimates might affect present values.

6. Reporting results

Reporting of results has two important implications. Firstly, it allows for the independent verification of costs and effects being reported in the evaluation (37). Secondly, it allows the reader to determine whether or not the values being presented can be generalised for use in other interventions (37). Assumptions, inputs, methods and sources of primary or secondary data should be clearly indicated to ensure transparency and accountability with respect to cost and effectiveness information being presented. For example, costs should be reported in disaggregated form before reporting as a total amount. The likelihood of costs and effects occurring overtime should be clearly identified by highlighting any uncertainty or sensitivity results including critical and switching values. Finally, cost-effectiveness ratios should be compared with the base case (the null) for all interventions and presented in clear tabular and graphical form.

CONCLUSION

There are a variety of concepts, methodologies and decision tools available for the estimation of cost and value of continuing health professions education interventions. Evaluations of cost and value are critical to the creation and uptake of sustainable educational innovations in the training of our health workforce and to making explicit the societal benefit obtained through a quality healthcare workforce. Having a clear understanding of key evaluation concepts that sit behind these methodologies and decision tools is critical to avoiding contextual errors during the evaluation process. Addressing the economic literacy of health professions education researchers, through providing guidance on tailoring cost-analysis to educational interventions, is the first step in ensuring a consistent and standard approach to meaningful cost-analysis and supporting this important and emerging field of research.

The Society for Cost and Value in Health Professions Education (SCVHPE) is dedicated to the community of educators, researchers and administrators interested in the cost and value of health professions education (see https://www.monash.edu/medicine/sphpm/depts-centres-units/scvhpe). The SCVHPE encourages researchers engaged in the empirical studies of health professions education programs to begin to incorporate evaluations of cost and value, using the approaches outlined in this paper in order to develop an understanding of the economic impact of such programs. This work would begin to generate some much needed evidence for the field of health professions education.

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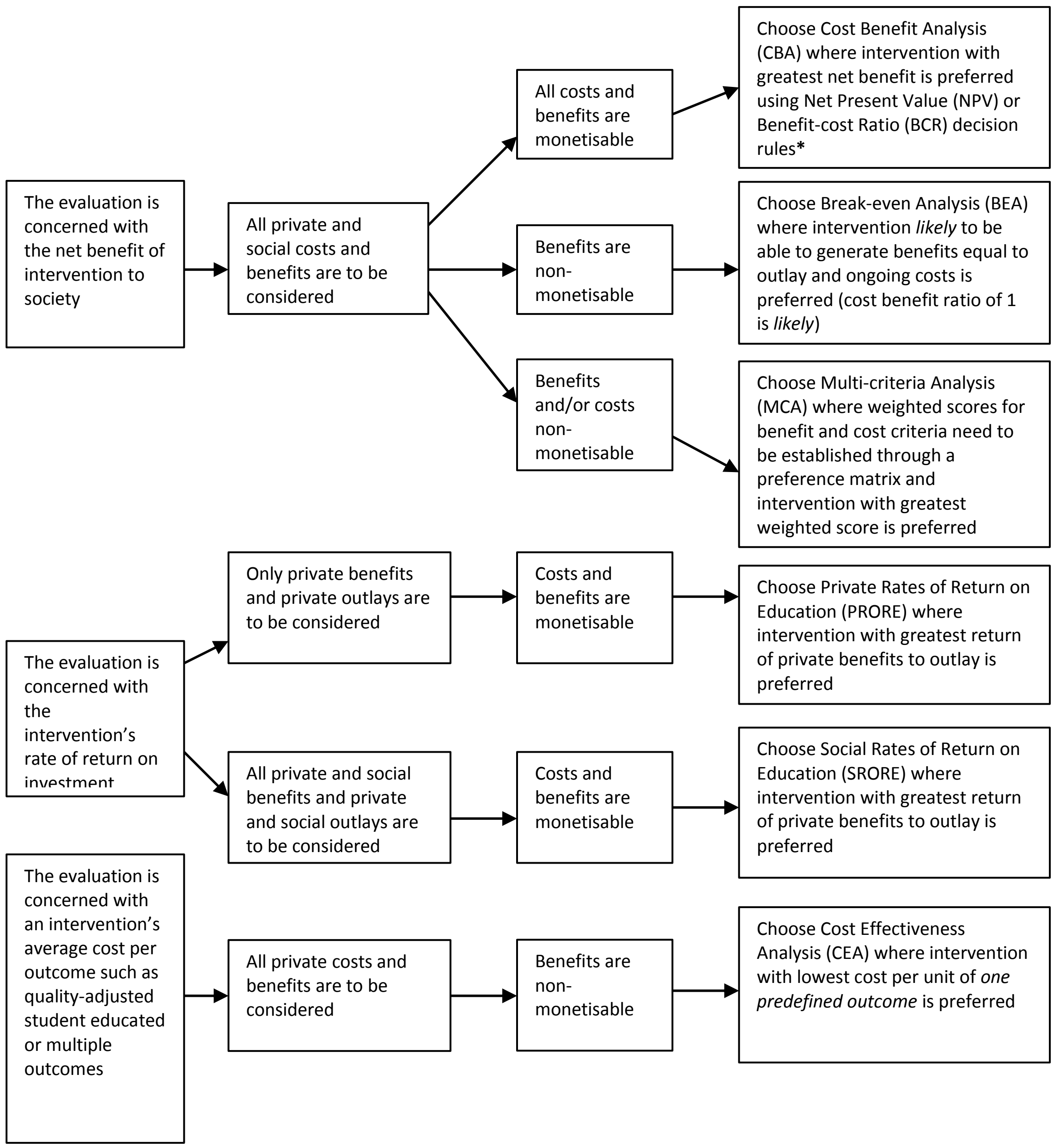
Figure 1: Determining the appropriate evaluation method for continuing health professions education interventions



* These decision rules should act as guides only. For example, in Cost-benefit analysis (CBA), alternatives with greatest net benefit are usually preferred but there may be reasons why other alternatives might sometimes be chosen.

Figure 2: Incremental cost-effectiveness plane

Intervention is more costly and less effective than the control	Intervention is more costly and more effective than the control
Intervention is less costly and less effective than the control	Intervention is less costly and more effective than the control

Table 1: Suggested discount rates and calculation methods

Discount rate	Concern	Calculation method	Variables
Private time preference rate (PTPR)	Value a private individual attaches to present consumption after tax	$PTPR = \left[\frac{[1 + i(1 - t)]}{(1 + \rho)}\right] - 1$	*i* = nominal risk-free interest rate (e.g. government bond rate); *t* = marginal tax rate; and ρ = expected inflation rate.
Social time preference rate (STPR)	Value society attaches to present consumption with a consideration of future generations	$STPR = r + (e\ x\ g)$	*r* = 'pure' time preference rate; *e* = elasticity of the marginal utility of consumption (an increase for society's utility from a one unit increase in consumption) (2); and *g* = expected growth in per capita consumption.
Risk-free social cost of capital (SOC)	Public funding has been diverted from private projects to public projects.	$SOC = \left[\frac{(1 + i)}{(1 + \rho)}\right] - 1$	*i* = nominal risk-free interest rate; (e.g. government bond rate) and ρ = expected inflation rate.