Introduction to Cost-Effectiveness Analysis for Clinicians

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Abstract

As health care expenditures in Canada continue to increase annually, pressure rises to contain spending. Clinicians are partially responsible for cost containment and can help optimize spending by utilizing more cost-effective interventions. An understanding of economic evaluations, particularly cost-effectiveness analysis, will help physicians make well-informed decisions when choosing between different treatments for their patients. This paper describes different types of economic evaluations with a focus on cost-effectiveness analysis. A hypothetical study is included to illustrate how a cost-effectiveness analysis evaluation is performed. By understanding and considering the economic value of appropriate interventions, clinicians can aim to provide evidence-based care for their patients and the population as a whole.

Introduction

Total health expenditures in Canada continue to rise annually. In 2009, expenditures totaled $182.1 billion and increased to an estimated $192.9 billion and $200.5 billion in 2010 and 2011 respectively. This spending represents 11.9%, 11.9% and 11.6% of the nation's gross domestic product (GDP) in 2009, 2010, and 2011 respectively.[1] As the nation continues to contribute significant portions of its GDP to the health care system, it becomes increasingly important to ensure such money is spent efficiently. Physicians play an important role in determining the allocation of health care resources and, as such, bear some responsibility in relation to health expenditures. Many clinicians believe that considering costs when determining priority-setting in medicine is largely unethical.[2] In order to resolve this apparent conflict, it is important to consider the economist's definition of cost. While the traditional accounting cost is understood as the price of the resources consumed, the economist views cost as the benefits sacrificed that could have been gained from using those resources for the next best alternative (also known as opportunity cost).[3] Utilizing a resource for one patient can affect the availability of resources for another patient. Economists argue that by ignoring the opportunity cost, one ignores the sacrifices that are imposed on others.[2] In this regard, it would certainly seem ethical to consider the impact of each decision made at the patient level on the population as a whole. Clinicians are therefore faced with the difficult task of providing good care for their patients while responsibly allocating scarce health care resources.[4] Economic evaluation methods, such as cost-effectiveness analysis (CEA), can be utilized to estimate the most efficient distribution of these resources. A basic understanding of CEA is essential to achieve an appropriate balance between good patient care and reasonable cost containment.

What is Cost-Effectiveness Analysis?

Economic evaluations in health care aim to determine the value for money associated with new interventions. CEA is one of many different types of economic evaluations such as cost-minimization analysis, cost-benefit analysis, and cost-utility analysis.[5] The differences between these methods become clear when considering the number of patient outcomes evaluated and the unit of measure (Table 1).

Table 1. Types of Economic Evaluations

Types	Number of Health Outcomes	Unit of Health Outcome
Cost-minimization analysis	None	None
Cost-benefit analysis	Many	Dollars
Cost-effectiveness analysis	One	Clinical
Cost-utility analysis	One	QALYs

Cost-minimization analysis considers the economic burden of the options when the patient outcomes are equivalent, which leaves only the costs to be compared. In cost-benefit analysis, many different health outcomes can be considered and all outcomes are measured in dollars. In order to assign a monetary value to a health outcome, judgments are often made based on the productive value of the individual to the

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economy. Given the challenge of valuing health in monetary terms, this method is not commonly used in health care.[6] The most commonly used method of economic evaluation in health care is CEA. CEA considers only one outcome and the outcome is typically measured in clinical units, such as symptom-free days or life years gained. Cost-utility analysis is a type of CEA that measures patient outcomes in quality-adjusted life years (QALYs). QALYs are a unit of measurement that considers the number of life years remaining multiplied by a factor representing quality of life. This weighting factor can range from 0 (death) to 1 (perfect health). Using QALYs as a unified outcome measure provides a common unit to facilitate comparisons of the cost-effectiveness of different interventions across disease sites or treatments.[7]

In order to assess the cost-effectiveness of a new intervention, it must be compared to at least one other intervention. Typically, the new intervention under study is compared to the commonly accepted intervention and two estimations must be made: the extra cost (ΔC) and the extra effect (ΔE) of the new treatment. When comparing two treatments, four possibilities exist for the intervention under study: the treatment can be more expensive and more effective, more expensive and less effective, less expensive and less effective, and finally less expensive and more effective (Figure 1).[8] Treatments that fall into the second category are said to be dominated by the other alternatives because one would not be willing to pay more for less benefit. Treatments that fall into the last category are considered dominant and offer health gains at a lower cost. Where CEA is most useful, however, is when considering the treatments that fall into the other two categories: more expensive but more effective and less expensive but less effective. CEA helps with this decision by estimating the additional cost per one unit of additional gain. The extra cost per extra unit of effectiveness (ΔC/ΔE) represents the incremental cost-effectiveness ratio (ICER) for strategy A compared to B.[9]

$$ICER = \frac{Cost\ (A) - Cost\ (B)}{Effect\ (A) - Effect\ (B)} = \frac{\Delta C}{\Delta E}$$

ICERs can be compared with those of other interventions or with a threshold value representing what is considered cost-effective. A threshold range of $20,000 to $100,000 per QALY gained has been proposed in Canada.[10] According to this threshold, treatments with ICERs less than $20,000 per QALY are considered excellent value whereas treatments with ICERs greater than $100,000 are typically viewed as a poor use of resources. An intervention with an ICER falling within the $20,000 to $100,000 range could be considered appropriate use of resources depending on other factors such as patient characteristics and the availability of other treatment options. Threshold values are frequently debated and do not represent widely accepted standards. The decision to label a treatment as cost-effective depends on the amount the payer is willing to pay for an extra unit of outcome. In other words, "willingness to pay is in the wallet of the beholder."[3] Additional information can be generated through sensitivity analysis, where the inputs for the analysis are changed to assess their impact on the final estimate. Sensitivity analysis is used to demonstrate the confidence that can be placed in the calculated ICER.[11]

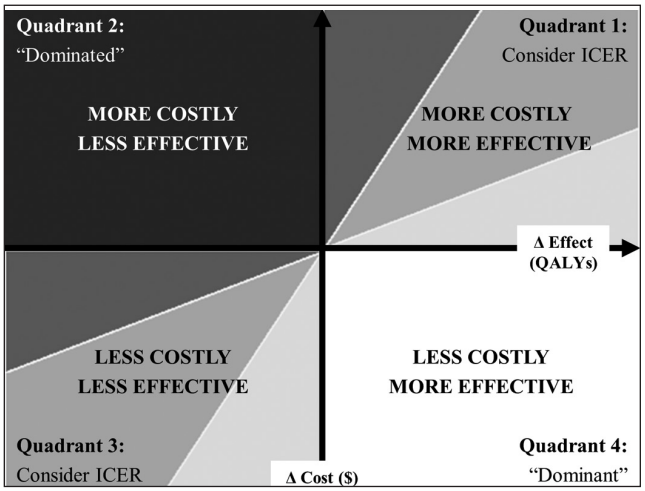

Figure 1. The Potential Results of a Cost-Effectiveness Analysis (CEA) Illustrated on a Cost-Effectiveness Plane.[10]
The quadrants are shaded to reflect the value of the new intervention compared to the alternative. Darker areas represent relatively weaker evidence for adoption. CEA comparisons in quadrant 2 and 4 represent interventions that are easy to reject or accept, respectively. Incremental cost-effectiveness ratios (ICERs) for CEA comparisons that fall in quadrants 1 and 3 represent the added cost per unit of added gain and estimate the cost-effectiveness of treatments that fall into those categories, which can be evaluated compared to the willingness-to-pay threshold ($20,000 to $100,000 per QALY gained in Canada).

Consider the following hypothetical study estimating the ICER of two screening strategies for complications of diabetes: a more intensive screening strategy targeted to diabetics with hypertension and the usual screening practice (Table 2). By comparing the two strategies using the ICER, the efficiency of spending $5,000 extra per person on targeted screening can be estimated. A clinical study showed that screening targeted to people with hypertension resulted in an average of 2.5 life years, with the patients experiencing an average of 80% of full health, for a total of 2.0 QALYs (i.e. 2.5 years times 0.80). The usual screening practice yielded 2.0 life years with patients experiencing 75% full health over the time period, or 1.5 QALYs (i.e. 2.0 years times 0.75). After calculating the difference in costs ($5,000) and effects (0.5 QALYs), the resulting ICER for targeted screening would be $10,000/QALY gained (i.e. ICER = ΔC/ΔE = $5,000 / 0.50 QALYs). Given that this ICER falls well below the lower $20,000 threshold limit, this intervention could be considered cost-effective in Canada with economic evidence supporting its adoption.

Table 2. Types of Economic Evaluations

Strategy	Expected Cost	ΔC	Expected Effect	ΔE	ICER
Hypertension	$15 000	$5 000	2.0 QALYs	0.5 QALYs	$10 000 per QALY
Usual Practice	$10 000		1.5 QALYs		

Discussion

It is the unfortunate reality that resources in health care are limited and decisions must be made regarding allocation. CEA is an important tool for decision-makers in all areas of the health care system to utilize when attempting to maximize these resources at a population level. CEA studies are useful for policy makers, administrators, and clinical practitioners involved in allocating resources across programs for groups of patients.[6] Physicians asked to participate on Canada's national drug reimbursement panels must consider both clinical and economic evidence before marking a funding recommendation (e.g. see www.pcodr.ca). CEA can also support decision-making at the patient level. Among other responsibilities, physicians are committed to both professional competence and to ensuring a just distribution of health care resources.[12] By understanding both the relative effectiveness and costs of available interventions, clinicians can ensure they are providing the best possible care for their patients while honouring their commitment to equity and responsible resource allocation. The efficiency with which we spend scarce resources, however, is not the only issue that needs to be considered. Despite an intervention being labeled as cost-effective, limitations on budget, distribution, demand, and equity can affect whether or not a treatment is made available (e.g. through a Ministry of Health decision to fund it). Conversely, an intervention with an unattractive cost-effectiveness estimate may be funded as an appropriate treatment when few alternative treatments exist (e.g. a new, expensive treatment for a rare disease).

How, then, can clinicians utilize economic evaluations? CEA can be used as a reference when considering whether or not a treatment is viewed as a good use of resources. Physicians consolidate information from a variety of sources when discussing treatment options with their patients. A physician may choose not to suggest a new, more expensive drug with little added benefits compared to an equally effective therapy already available. On the other hand, when no attractive alternatives exist, prescribing treatments with an unfavourable cost-effectiveness estimate may still be viewed as a responsible use of resources given that attention is paid to other non-efficiency concerns. Through an understanding of economic evaluations and the methods by which they are performed, physicians can improve their knowledge of the types of therapies available and the extent to which they can be viewed as good value. Value for money considerations are crucial in health care given that resources are not reusable. Well-informed decisions regarding resource allocation can help us provide better care for both individual patients and the population as a whole.

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