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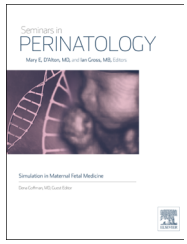

Costs and cost-effectiveness of periviable care

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ABSTRACT

With increasing concerns regarding rapidly expanding healthcare costs, cost-effectiveness analysis allows assessment of whether marginal gains from new technology are worth the increased costs. Particular methodologic issues related to cost and cost-effectiveness analysis in the area of neonatal and periviable care include how costs are estimated, such as the use of charges and whether long-term costs are included; the challenges of measuring utilities; and whether to use a maternal, neonatal, or dual perspective in such analyses. A number of studies over the past three decades have examined the costs and the cost-effectiveness of neonatal and periviable care. Broadly, while neonatal care is costly, it is also cost effective as it produces both life-years and quality-adjusted life-years (QALYs). However, as the gestational age of the neonate decreases, the costs increase and the cost-effectiveness threshold is harder to achieve. In the periviable range of gestational age (22–24 weeks of gestation), whether the care is cost effective is questionable and is dependent on the perspective. Understanding the methodology and salient issues of cost-effectiveness analysis is critical for researchers, editors, and clinicians to accurately interpret results of the growing body of cost-effectiveness studies related to the care of periviable pregnancies and neonates.

1. Introduction

Increases in healthcare costs continue to outpace inflation.[1] In 2011, total expenditures on healthcare were greater than $2.7 trillion dollars, 17.9% of GDP.[2–4] In this setting, healthcare systems, health insurance providers, healthcare providers, the government, and patients themselves are increasingly aware of the rising costs and are interested in controlling them. However, while payers are primarily interested in reigning costs in, other stakeholders such as providers and patients are also concerned with maintaining access to quality healthcare. These potentially competing interests led Don Burwick to coin the phrase, the Triple Aim of healthcare reform, which is increased quality, increased access, and lower costs.[5]

Efforts to balance healthcare quality with expenditure have led to a new emphasis on comparative effectiveness research, which examines both the differences in outcomes as well as the costs of healthcare interventions. To compare the marginal benefits to be gained from new procedures, medications, and screening tests to their often increased costs, economic evaluations of such innovations are now commonly utilized.[6,7] These analyses may help guide healthcare providers, organizations, professional societies, and policy makers to determine how and to whom particular healthcare services are provided.[8]

Economic analyses have been used for at least three decades to inform the development of healthcare guidelines. Care of the periviable pregnancy or neonate has a number of attributes that make such analyses challenging.[9,10] These

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features include trade-offs of the risks and benefits to both the mother and fetus, balancing short- and long-term outcomes, ethical issues regarding decisions such as mode of delivery, fetal monitoring, or resuscitation vs. non-resuscitation, and the incorporation of patient preferences which can range widely for the possible outcomes including neonatal mortality or long-term neurodevelopmental disability. The following review will discuss the different types of economic analyses commonly utilized in healthcare with a particular focus on care of the periviable pregnancy or neonate.

2. Economic analyses in healthcare

The simplest economic analysis in healthcare takes into account only the costs. Such a *cost analysis* or *cost-only analysis* may be limited to just the direct costs of the provision of healthcare or may be expanded to incorporate the indirect costs of patients' travel time and lost work productivity. A *cost–benefit analysis* (CBA) assumes that the health outcomes from two or more strategies are essentially equal and makes a comparison between multiple programs or strategies on a purely financial level. In a CBA, all direct and indirect costs of healthcare are included as well as economic valuations of the outcomes. For example, if one of the possible outcomes is the loss of use of the lower extremities, this is converted into the costs of treatment (surgery, assisted living, wheelchair, etc.) plus the lost productivity experienced by someone who no longer has the use of the lower extremities. In this purely financial analytic tool, only economic distinctions are made between the value to society or individuals of having particular health outcomes.

The term *cost-effectiveness analysis* (CEA) is often used loosely to describe many types of economic analyses in healthcare. However, it specifically refers to an analysis in which costs and outcomes between two or more healthcare programs or strategies are compared. A cost-effectiveness ratio is composed of a numerator, which is the difference between the costs of two programs, and a denominator, which is the difference between the outcomes of two programs. The denominator in a CEA can be any of a variety of outcomes, including the commonly used years of life saved (life-years), number of diagnoses made, or number of cases prevented. Within a particular clinical arena, these may all be reasonable outcomes to compare. However, attempts to compare the outcomes from disparate procedures such as routine dental care and cardiothoracic surgery are more difficult, suffering from the "apples-to-oranges" problem. Comparing the cost-effectiveness of different programs is not particularly important if the new program is both cheaper and leads to better outcomes (*a dominant strategy*), in which case the new program should be adopted. A careful comparison is also less important if the new program both costs more and leads to worse outcomes (*a dominated strategy*). However, for new strategies that cost more and lead to better outcomes or cost less but lead to worse outcomes, CEA is a useful tool to evaluate differences between programs.

It is relatively straightforward to make comparisons between programs in different clinical arenas utilizing CBA. By converting all of the outcomes into financial ones, they become comparable. However, CBA is limited when considering outcomes that lead not to financial burdens, but rather to burdensome morbidities. A way to compare such outcomes is by quality-adjusting the value of one's life using utilities. *Utility* is the unit of value that some product or outcome or, in this case, health state, brings to an individual's life. Some might say it is the measure of happiness from being in a particular health state. It is the common valuation given to consumption of goods and services in economics and is defined as ranging from 0 (no utility or death) to 1 (perfect health or happiness). In CEAs, these valuations are defined as 0 for death and 1 for perfect health, with all other health states falling between these two. There is occasionally debate about whether there are certain health states that should be scored as worse than death, but most analyses utilize death as the bottom anchor of utilities, which is assigned the value 0. Once utilities are assigned to particular health states they can be multiplied by the time spent in that particular health state to generate *quality-adjusted life-years* (QALYs). When QALYs are used as the outcome measure in the denominator of a CEA, the analysis is considered a *cost–utility analysis* (CUA).

Estimation of utilities has been done in many ways, but the two most commonly used are the standard gamble and time trade-off metrics.[11] In the standard gamble, patients are asked what probability of death they would be willing to take to avoid a particular health outcome and live in perfect health.[12] For example, if an individual is willing to take a 5% chance of death to avoid losing their sight, then the sightless state has a utility of 0.95 (1 − 0.05). In the time trade-off, an individual is asked how many years of life they would give up to avoid a particular health outcome and live in perfect health.[13] Thus, if a 25-year-old individual has a life expectancy of 50 additional years and is willing to give up 5 years of life to avoid losing their sight, a valuation of 0.9 (1 − 5/50) would be the estimated utility. Methodologic concerns with these metrics include realism and avoidance of loss of life in standard gamble and different valuations for different times of life in time trade-off. Despite these problems, their estimation allows comparison between different clinical outcomes.

Given the importance of estimating the benefits from different interventions in healthcare, these economic analytic techniques can be quite useful. However, like any research approach, rigorous methodology is important to obtain robust estimates of the outcomes in these analyses. The U.S. Public Health Service convened a panel in 1996 to establish strict criteria for the effective application of CEA.[14] These criteria have been utilized to analyze the methodologic quality of published CEAs in healthcare[15,16] and specifically in obstetrics and gynecology.[17,18] These criteria should be carefully considered when either performing or evaluating a CEA.

3. CEA methodology

Ten principles for CEA have been derived from guidelines established by the Panel on Cost-Effectiveness in Health and Medicine convened by the United States Public Health Service.[13] These principles, summarized below with examples from prenatal diagnosis, comprise an appropriate minimum standard