Cost-Effectiveness of Old and New Technologies for Aneuploidy Screening

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KEYWORDS

• Cost-benefit analysis • Cost-effectiveness analysis • Down syndrome • Economics • Prenatal diagnosis–economics • Noninvasive prenatal screening

KEY POINTS

- Cost-effectiveness analyses allow assessment of whether marginal gains from new technology are worth the increased costs.
- Several studies have examined cost-effectiveness of Down syndrome (DS) screening and found it to be cost-effective across most clinical scenarios.
- Noninvasive prenatal screening also appears to be cost-effective among high-risk women with respect to DS screening, but not for the general population as a first-line screening tool.
- Chromosomal microarray (CMA) is a genetic sequencing method superior to but more expensive than karyotype; it is cost-effective when used for prenatal diagnosis of an anomalous fetus.

INTRODUCTION

Increases in health care costs continue to outpace inflation.[1] In 2011, total expenditures on health care were greater than $2.7 trillion, or 17.9% of the gross domestic product.[2] In this setting, health care systems, health insurance providers, health care providers, the government, and patients themselves are increasingly aware of rising costs and interested in controlling them.

Efforts to balance health care quality with expenditures have led to a new emphasis on comparative effectiveness research, which examines both the differences in outcomes and the costs of health care 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

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used.[3,4] These analyses may help guide health care providers, organizations, professional societies, and policymakers to determine how and to whom particular health care services are provided.[5]

Economic analyses have been used for decades to inform the development of prenatal screening and diagnosis guidelines. Prenatal diagnosis has several attributes that make such analyses challenging.[6,7] These features include tradeoffs of the risks and benefits to both the mother and the fetus, redundancy of screening and diagnostic tests both in the current pregnancy and in subsequent pregnancies, balancing short- and long-term outcomes, ethical issues regarding termination of pregnancy, and the incorporation of patient preferences, which can range widely for the possible outcomes. This review discusses the different types of economic analyses commonly used in health care with a particular focus on the diagnosis of Down syndrome (DS), the use of chromosomal microarray (CMA) among fetuses with sonographically detected anomalies, and the cost-effectiveness of noninvasive prenatal screening.

ECONOMIC ANALYSES IN HEALTH CARE

The simplest economic analysis in health care 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 health care 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 2 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 health care are included as well as economic valuations of the outcomes. In this purely financial analytical tool, only economic distinctions are made between the value to society or individuals of having particular health outcomes.

The term cost-effectiveness analysis (CEA) specifically refers to an analysis in which costs and outcomes between 2 or more health care programs or strategies are compared. A cost-effectiveness ratio is composed of a numerator, which is the difference between the costs of 2 programs, and a denominator, which is the difference between the outcomes of 2 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, and 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 using 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. It is the common valuation given to consumption of goods