outcomes (treatment benefits), including quality of life, be valued in monetary units. Many decision makers in the health sector find this transformation difficult or unethical, not only because they consider life to be priceless and because that life cannot easily be valued, but also because each patient values his or her life differently. Thus, cost benefit analysis is used less frequently than cost-effectiveness analysis in the medical literature.

Cost-effectiveness analysis: Cost-effectiveness analysis provides an alternative approach to the dilemma of assessing the monetary value of health outcomes as part of the evaluation of new services or other products. Outcomes might be reported in a single unit of measurement, either a conventional clinical outcome, such as years of life saved, or a measure that combines several outcomes on a common scale.[10] Alternatively, health outcomes can be reported in terms of a change in an intermediate clinical outcome, such as cases with a complete response to treatment[8] or costs *per* mm Hg reduction in blood pressure. If an analysis employs quality-adjusted survival outcomes, it is called a cost-utility analysis, a form of cost-effectiveness analysis measuring outcomes in terms of their value to patients.[10]

Cost-effectiveness analysis has been used to compare costs and years of life saved for interventions using various outcomes. Life years and quality-adjusted life years are the most widely used outcomes. There are many examples: screening for breast cancer,[11] colorectal cancer,[12] and left main coronary artery disease.[13] These papers have "years of life saved" as an outcome. Quality-adjusted life year was used as an outcome in treatment of chronic myelogenous leukemia,[14] bypass surgery for coronary artery disease,[15] and vaccination against pneumococcal pneumonia[16] (see cost-utility analysis). Sometimes, intermediate outcomes such as percent reduction in blood cholesterol level with drugs[17] were used. The results of a cost-effectiveness analysis can be summarized in a series of cost effectiveness ratios that show the cost of achieving one unit of health outcome (e.g. the cost *per* year of life saved) for different kinds of patients and interventions.[18]

The additional or "incremental" cost of an intervention (e.g. the difference in cost between a new therapy and conventional medical care) may be compared with its additional or "incremental" benefit or effectiveness. If the cost of a new therapy and conventional therapy is C_N and C_C, respectively, and if the effectiveness of a new therapy and conventional therapy is E_N and E_C, respectively, the incremental cost-effectiveness is $(C_N - C_C)/(E_N - E_C)$ as in Table 1. Incremental analysis is generally preferred to comparisons of the totals because it allows the analyst to focus on the differences between any two treatment modalities rather than between a treatment modality and doing nothing. In assessment using the same measure of health outcome, such as cases of a particular disease prevented, the same comparator, and the same analytic method, one can rank interventions on the basis of their cost-effectiveness ratios (e.g. among C/E, C′/E′, and C″/E″).

Figure 2 shows the possible combinations of incremental cost and incremental effectiveness. Programs that are cost-saving with improved or equivalent treatment outcomes are said to be dominant and should always be adopted. Programs that cost more and are more effective should be adopted if both their cost-effectiveness and incremental cost-effectiveness ratios fall within an acceptable level, and the budget for the program is acceptable. Programs that cost more and have worse clinical outcomes are said to be dominated and should never be adopted. Programs that cost less and have reduced clinical outcomes may be adopted depending upon the magnitude of the cost and outcome changes.[8]

Unlike cost-benefit analysis, the cost-effectiveness approach does not always allow the comparison of programs and activities with widely differing outputs, such as health, education, defense, energy, transportation, and other areas. If the same outcome, such as lives saved, is used, cost-effectiveness can be compared across these sectors (assuming life years are equivalent across treatments being compared; for example, life years for

Table 1 Incremental Cost-Effectiveness and Cost-Effectiveness Ratio

	New Therapy	Conventional Therapy
Cost	C_N	C_C
Effectiveness	E_N	E_C
Cost-effectiveness Ratio	C_N/E_N	C_C/E_C
Incremental Cost-effectiveness	$(C_N - C_C)/(E_N - E_C)$	

	Improved or Equal Clinical Outcome as a Result of Treatment Strategy (+)	Worse or Equal Clinical Outcome as a Result of Treatment Strategy (−)
Decrease in Medical Costs as a Result of Treatment Strategy (+)	+/+	−/+
Increase in Medical Costs as a Result of Treatment Strategy (−)	+/−	−/−

Adapted from Schulman and Yabroff 1995

Fig. 2 Results of an economic study.