Research Techniques Made Simple: Cost-Effectiveness Analysis

Connie R. Shi[1,2] and Vinod E. Nambudiri[2]

Cost-effectiveness analysis (CEA) is a research method used to determine the clinical benefit-to-cost ratio of a given intervention. CEA offers a standardized means of comparing cost-effectiveness among interventions. Changes in quality-adjusted life-years, disability-adjusted life-years, or survival and mortality are some of the common clinical benefit measures incorporated into CEA. Because accounting for all associated costs and benefits of an intervention is complex and potentially introduces uncertainty into the analysis, sensitivity analyses can be performed to test the analytic model under varying conditions. CEA informs the identification of high-value clinical practices and can be used to evaluate preventative, diagnostic, and therapeutic interventions in dermatology.

Journal of Investigative Dermatology (2017) **137,** e143–e147; doi:10.1016/j.jid.2017.03.004

CME Activity Dates: 21 June 2017
Expiration Date: 20 June 2018
Estimated Time to Complete: 1 hour

Planning Committee/Speaker Disclosure: All authors, planning committee members, CME committee members and staff involved with this activity as content validation reviewers have no financial relationship(s) with commercial interests to disclose relative to the content of this CME activity.

Commercial Support Acknowledgment: This CME activity is supported by an educational grant from Lilly USA, LLC.

Description: This article, designed for dermatologists, residents, fellows, and related healthcare providers, seeks to reduce the growing divide between dermatology clinical practice and the basic science/current research methodologies on which many diagnostic and therapeutic advances are built.

Objectives: At the conclusion of this activity, learners should be better able to:
- Recognize the newest techniques in biomedical research.
- Describe how these techniques can be utilized and their limitations.
- Describe the potential impact of these techniques.

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WHAT IS COST-EFFECTIVENESS ANALYSIS?

Cost-effectiveness analysis (CEA) is a research method that characterizes the costs of interventions relative to the amount of benefit that they yield. CEA provides a standardized means of comparing interventions to identify those that provide maximal clinical effect per incremental unit of cost. CEA can be applied to preventive, diagnostic, and therapeutic interventions. Outcomes captured by such analyses can include mortality benefit, symptom reduction, or improved quality of life after a treatment or procedure. CEA is one type of economic analysis used in health services research; other related but separate concepts are outlined in Table 1.

Given the interest in delivering high-value care across all clinical specialties including dermatology, research identifying clinical practices that deliver a high level of

[1]*Harvard Medical School, Boston, Massachusetts, USA; and* [2]*Department of Dermatology, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA*

Correspondence: Vinod E. Nambudiri, 221 Longwood Avenue, Boston, Massachusetts, 02115 USA E-mail: vnambudiri@partners.org

Abbreviations: CEA, cost-effectiveness analysis; DALY, disability-adjusted life-year; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year

SUMMARY POINTS

What is cost-effectiveness analysis?

Cost-effectiveness analysis (CEA) is a research method used to determine the clinical benefit-to-cost ratio of interventions. CEA offers a standardized means of comparing cost effectiveness among interventions.

Changes in quality-adjusted life-years (QALYs), disability-adjusted life-years (DALYs), or survival and mortality are some of the common outcome measures of clinical benefit incorporated into CEA.

CEA can be used to evaluate screening, preventative, diagnostic, and therapeutic interventions.

Limitations of cost-effectiveness analysis

Accounting for all associated costs and benefits of an intervention is complex, potentially introducing uncertainty into the analysis. Sensitivity analyses can be performed to test the analytic model under varying conditions.

There remains no universally accepted standard for cost-effectiveness thresholds.

Table 1. Comparison of concepts in health economics analysis

Concept	Definition
Cost analysis	Calculation of the costs associated with an intervention
Cost-benefit analysis	Characterization of the cost of an intervention relative to the monetary benefit of its outcome
Cost-effectiveness analysis	Characterization of the cost of an intervention relative to the clinical benefits of the outcome, measured in nonmonetary values
Comparative effectiveness research[1]	A field of research that aims to discriminate among clinical interventions according to their clinical effectiveness, cost effectiveness, and appropriateness

[1]Nambudiri and Qureshi, 2013.

effectiveness at a relatively lower cost can be valuable in guiding policy on allocation of health care resources. It is thus increasingly relevant for dermatologists to understand CEA and demonstrate cost-effectiveness in current practice.

METHODS IN COST-EFFECTIVENESS ANALYSIS

Core elements of cost-effectiveness analysis include identifying clinical interventions, accounting for all associated costs, and defining outcome measures for analysis. The Panel on Cost-Effectiveness in Health and Medicine provides recommendations on variables that should be included in cost and outcome definitions used in CEA (Sanders et al., 2016). Cost calculations should include not only the price of administering an intervention but also costs associated with facility and staff resources, intervention adverse effects, and indirect costs of patient suffering and lost productivity, among others.

Table 2 outlines various outcome measures used in CEA. The most commonly used outcome measures are the disability-adjusted life-year (DALY) and quality-adjusted life-year (QALY). For both DALYs and QALYs, a value of 1 is assigned to a single year lived with perfect health. To determine the DALYs associated with a condition, a disability weight is assigned based on the level of impairment caused by the condition, with larger disability weights correlated with greater impairments to health (Jamison et al., 2006). The disability weight is then subtracted from 1 to determine the DALY. QALYs are calculated in a similar fashion but incorporate quality of life changes into the measurement. Standardized quality of life surveys such as the EuroQol five dimensions questionnaire (EQ-5D) are commonly used to derive QALY values (Prieto and Sacristán, 2003). DALY and QALY determinations are informed by standardized disease severity, symptom, and quality of life measurements and in many cases are preferable markers of health outcomes over simply counting life-years prolonged (Jamison et al., 2006). Dermatology-related instruments that have been developed and validated include the Dermatology Life Quality Index (DLQI), Children's Dermatology Life Quality Index, Psoriasis Area and Severity Index (PASI), SCOring Atopic Dermatitis (SCORAD), and Functional Assessment of Cancer Therapy Melanoma (FACT-M), among others.

Decision analysis models are used to analyze large volumes of patient outcomes in CEA. A decision tree, which allows visualization of the different clinical pathways being compared and their possible outcomes, is an example of a simple decision analysis model (Figure 1). Probabilities of an intervention's success or failure are estimated from existing literature on efficacy, and the decision tree allows for the incorporation of outcomes such as cost and QALYs. However, the decision tree is less well adapted to handling recurrent conditions and longer-term outcomes. The Markov model, an iterative model that accommodates transitions among various disease states, can be better suited for representing conditions that recur, evolve, and progress over time (Sonnenberg and Beck, 1993).

Table 2. Definitions of selected outcome measures used in CEA[1]

Outcome measure	Definition
Mortality (deaths averted)	The number of deaths prevented by an intervention
Life-years gained/lost	The remaining life expectancy at the time of an averted death, weighted in favor of younger persons.
Disability-adjusted life-years gained/lost	A unit of the amount of health lost because of a condition, taking into account the burden of morbidity associated with the condition
Quality-adjusted life-years gained/lost	A unit of the years of life saved and adjusted for health-related quality of life with that condition

[1]Adapted from Jamison et al., 2006.