Cost-Effectiveness Using Decision-Analytic Models

Kee Chan, PhD

Assistant Professor, Boston University

VA Center for Health Quality, Outcomes and Economic Research (CHQOER), Edith Nourse Rogers Memorial Veterans Hospital, in Bedford, Massachusetts

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HERC Seminar Series

Speaker Contact Information

Kee Chan, PhD

VA Center for Health Quality, Outcomes and Economic Research *(*CHQOER*)*
Bedford, Massachusetts

Assistant Professor

Department of Health Sciences

Boston University

Email: keechan@bu.edu

Overview

- This presentation will focused on the decision-making process and fundamental models used in cost-effectiveness analysis.
- Examples of Cost-Effectiveness Analysis
- Limitations and strengths will be discussed.
- Resources for further discussion.

Learning Objectives

- At the end of the presentation, you will learn the following for your own study design:
  - the decision-making process.
  - the framework used in decision-analytic model.
  - the application in cost-effectiveness analysis.

Outline of Presentation

1. Concept of “PROACTIVE” in Modeling.
2. Structure of Decision Analysis
3. Components of Cost-Effectiveness Analysis
4. Research Studies
5. Limitation and Strengths
6. Resources

Decision Analysis

"A good decision is a logical decision – one based on *uncertainties, values, and preferences* of a decision-maker."

Ronald Howard

Professor, Stanford University

PROactive

Step 1: Defining the problem

P: Problem

R: Reframe the perspective

O: Objectives of interest

pro**ACT**ive

Step 2: What are the alternatives, consequences and trade-offs?

A: Consider Alternatives.

C: Model Consequences

T: Identify Trade-offs.

proact**IVE**

Step 3: Integration and exploration

I: Integrate evidence

V: Optimize Expected Value

E: Evaluate Uncertainty.

PROACTIVE

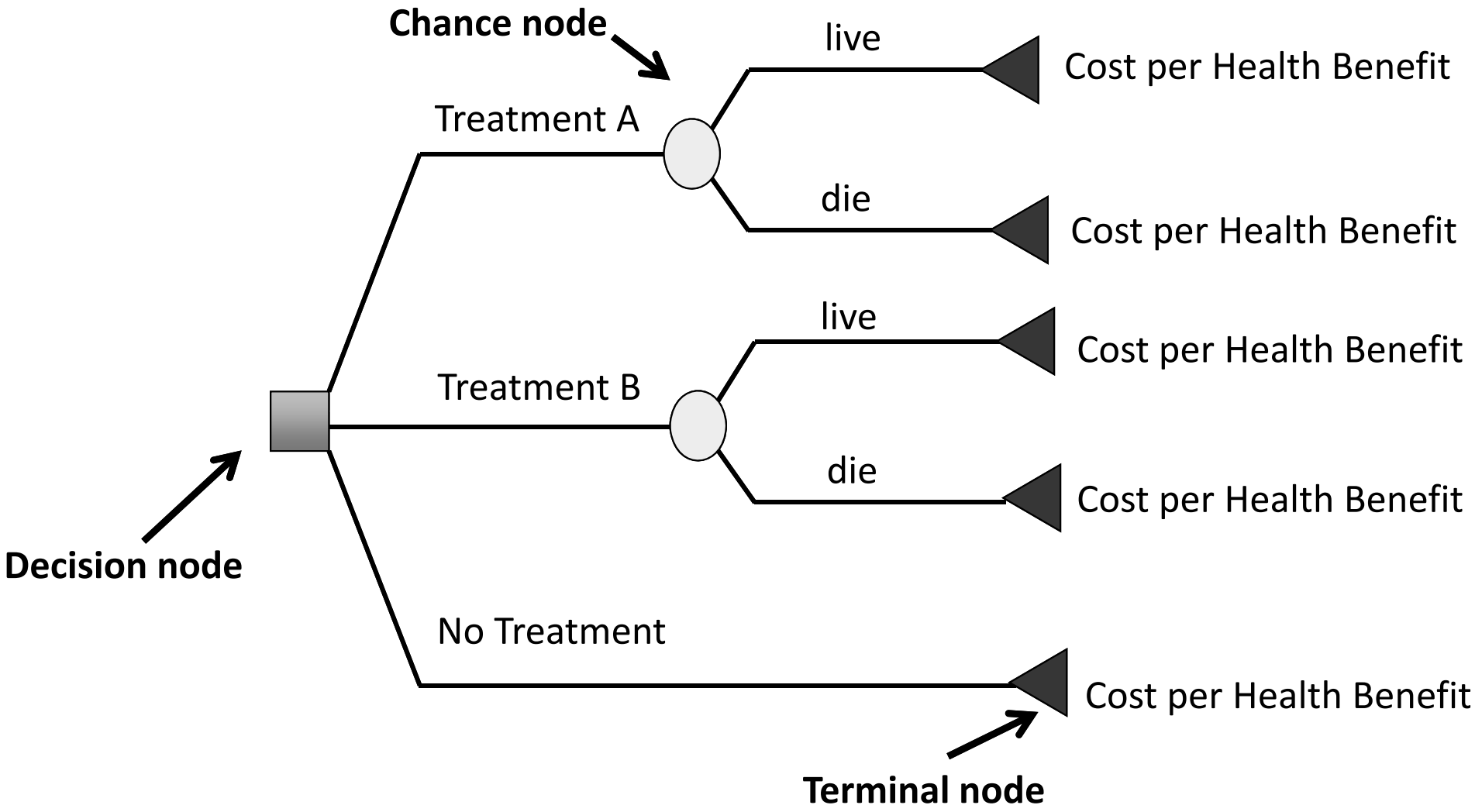
P: Problem
R: Reframe
O: Objectives
A: Alternatives
C: Consequences
T: Trade-offs
I: Integrate
V: Value
E: Evaluate

A Decision Tree

A visual representation of all the possible options and the consequence that may follow each option.

Decision Analysis Tree

Step 1: **PRO**active — Step 2: pro**ACT**ive — Step 3: proact**IVE**



Cost-Effectiveness

- Using decision-analytic models to consider the economics costs of health care.
- Health resources are consumed in order to produce health benefits.

Research Questions

- What is the most efficient use of this health resources, given the alternative uses?
  - Time
  - Resources
  - Cost

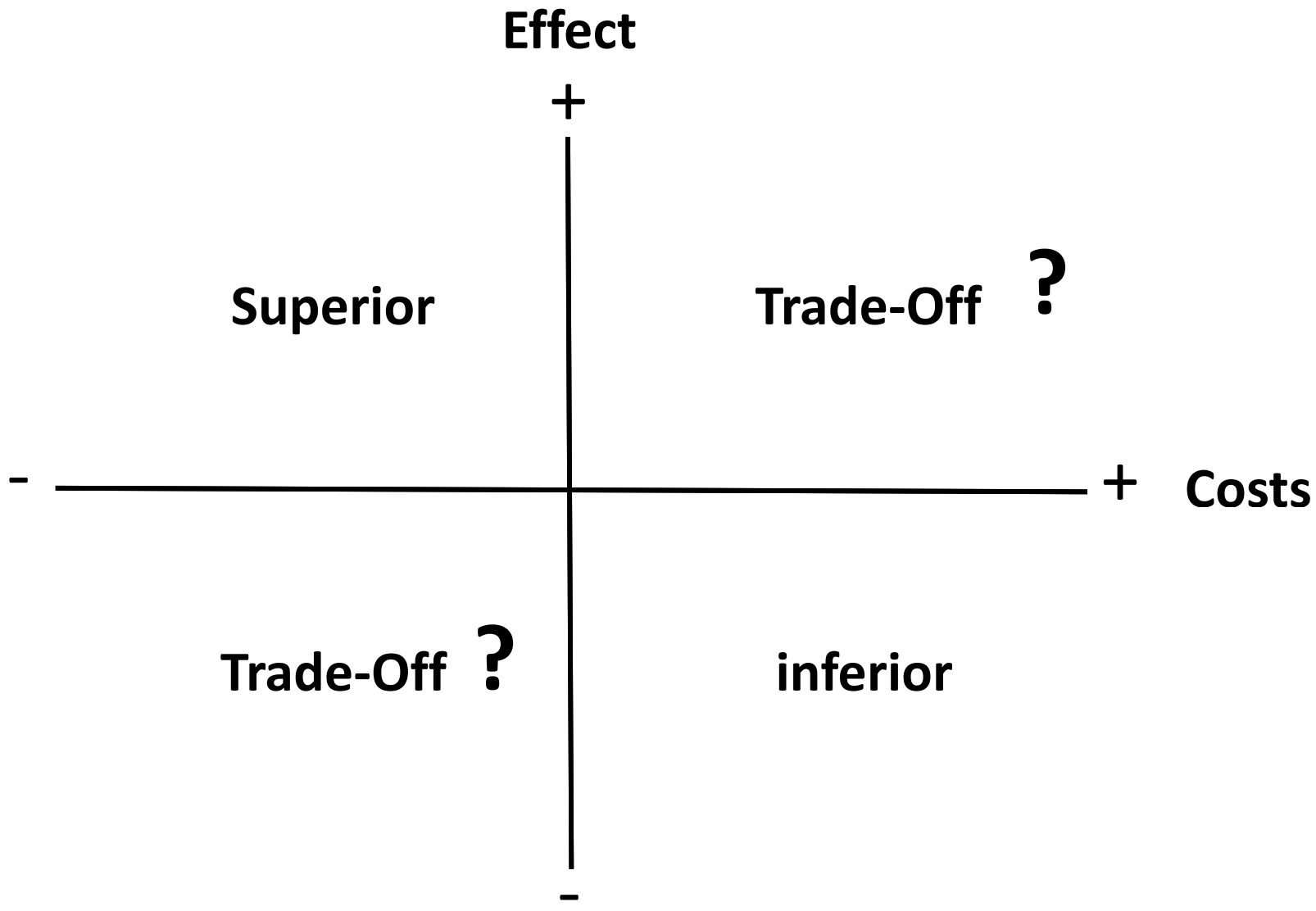
Time-effectiveness

An hour of a physician's time spent with one patient is unavailable for another patient.

Resource-effectiveness

- Health resources are consumed in order to produce health benefits.
- Resources used for one program cannot be spent to increase the program use of another or invest in new program.

Cost-Effectiveness Graph



Cost-effectiveness

- Common measure of costs & health effectiveness.
- Measure can be expressed as
  - Cost
  - Case of disease prevented
  - Lives saved
  - Years of life saved
  - Quality adjusted life year

Perspective

- A range of decision-makers confront these decisions.
  - Societal perspective
  - Patient
  - Provider
  - Organizational

Different Types of Cost

- *Total Resource Use* includes different types of cost
  - Health care resource
  - Nonhealth care resource

Cost Calculation

- Laying out the cost
- Categorize the cost in term health vs. non-health cost
- Organize the sequence of event
  - Initial cost
  - Induced cost
  - Adverted cost
- Consider short or long-run resource cost

Probabilities

- Probability is the chance of the event.
- Range in 0 to 1.0
- 0 = event is impossible
- 1 = event is certain
- 0.5 = the event is equally as likely to occur as not to occur

Preferences

- Preference-based measures reflect the values an individual has for a particular health states or the relative desirability of health outcome.

Effectiveness

- Health benefits in CEA can be expressed as
  - Single measure of health outcome
    - Number of Cases Prevented
    - Number of Cases of Cancer Detected
    - Number of Hospital Days Reduced
  - Combined measures
    - Quality Adjusted Life Years (QALYs)

Using cost-effectiveness analysis

- Cost-effectiveness using decision-analytic modeling
  - summarize large amount of information.
  - clarify the decision-making process.
  - compare the different scenarios in complex system.

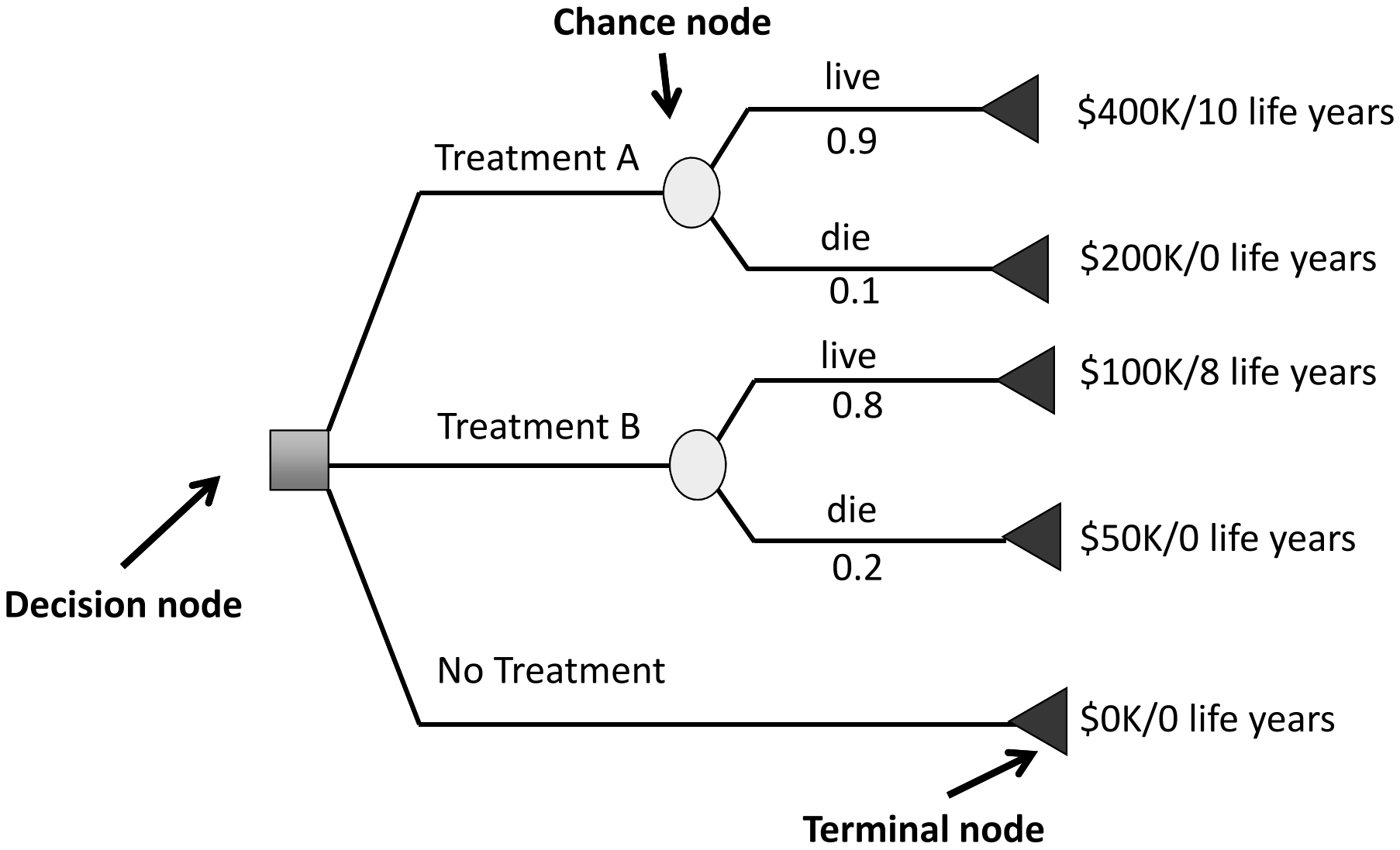
Incremental Cost-effectiveness ratio (ICER)

Incremental cost-effectiveness ratio (ICER)

– costs to benefits and is expressed as $ per life saved or the cost per QALY saved.

$$\frac{\textbf{Cost}_{\text{intervention A}} - \textbf{Cost}_{\text{intervention B}}}{\textbf{Effectiveness}_{\text{intervention A}} - \textbf{Effectiveness}_{\text{intervention B}}}$$

Decision Analysis Tree



Incremental Cost-Effectiveness Ratio (ICER)

Question: Is the extra health benefit worth the extra cost?

$$\frac{\textbf{\$400K}_{\text{intervention A}} - \textbf{\$100K}_{\text{intervention B}}}{\textbf{10 life years}_{\text{intervention A}} - \textbf{8 life years}_{\text{intervention B}}}$$

ICER =

$300 K per 2 life years = $150K / life year

Answer: If intervention A is chosen, the additional investment of $150K results in one additional life year, relative to Intervention B.

Handling Uncertainty

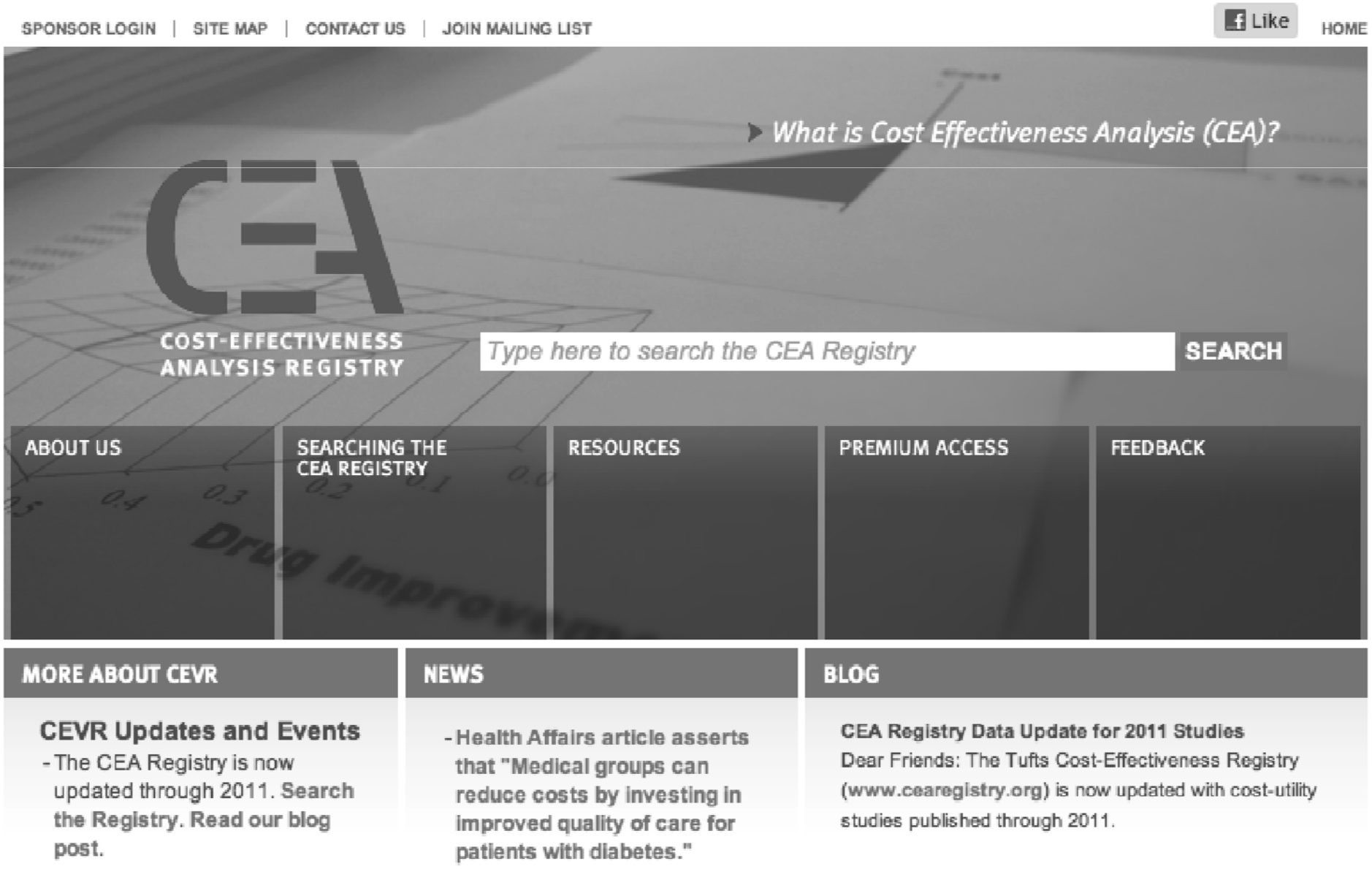
Parameter and Model structure uncertainty addressed using sensitivity analyses.

- One-Way
- Two-Way
- Multi-way
- Probabilistic

Examples

Cost-effectiveness Studies Registry

https://research.tufts-nemc.org/cear4/



Limitations

- Availability of Data
- Modeling vs. Real-time Experiment
- Assumption
- Uncertainty

Strengths

- Illustrate a Visual Aid.
- Formulate Objective.
- Evaluate Complex System.
- Inform Policy and Guidelines.
- Guide Research.

References and Resources

- *Cost-effectiveness in Health and Medicine*, Gold, Siegel, Russell, and Weinstein, eds. (1996), New York: Oxford Univ. Press.
- *Decision Making in Health and Medicine*, Hunink, and Glasziou (2001), Cambridge University.
- *Decision Modelling for Health Economic Evaluation*, Briggs, Claxton, and Sculpher (2007), Oxford Univ. Press.
- *Designing and Conducting Cost-Effectiveness Analyses in Medicine and Health Care, 2nd Ed.*, Muennig. (2007), New York: Oxford Univ. Press.
- Software: TreeAge

HERC resources

http://www.herc.research.va.gov/home/default.asp

Research Societies

Summary

- Use “PROACTIVE” modeling in your design.
- Construct a decision analysis tree.
- Use cost-effectiveness analysis.
- Compare research studies.
- Understand the limitations and strengths.
- Find resources and references.

Contact Information

If you have any questions or would like to collaborate, please contact me:

Kee Chan, PhD

Assistant Professor

Department of Health Sciences

Boston University

Tel: 617-358-6025

Email: keechan@bu.edu