Methodological Overview of Medical Cost-Effectiveness Analysis

David Meltzer MD, PhD
University of Chicago

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Objectives

- To provide a background on the rationale for medical cost-effectiveness analysis (CEA)
- To discuss core methodological issues in CEA
  - Role of theoretical foundations
- To introduce important theoretical innovations in cost-effectiveness analysis

Background: Increases in Health Care Costs

- Nominal Terms:
  - $27 Billion in 1960
  - >$2.5 Trillion today
- As a percentage of GNP:
  - 5% in 1960
  - 18% today

Background: Increases in Health Care Costs

- Since 1960, health care spending has grown by 2.5% more per year than the rest of the economy
- Reasons:
  - Growth in quantity: 1.6% per year
  - Growth in prices: 0.9% per year
- Much of growth in prices is growth in quantity
- Spending rising because we are doing more
- High potential for greater value

Growth in Demand for Cost-Effectiveness Analysis

- Academic medicine
- Government, especially outside the U.S.
  - e.g. in U.S., Office of Technology Assessment, recent CMS, FDA interests
  - e.g. in U.K., National Institute for Health and Clinical Excellence
- Private payers
- Clinicians
- Pharmaceutical companies
  - “Pharmacoeconomics”

Methodological Issues in Cost-Effectiveness Analysis

- Type of analysis
- Perspective
- Definition and measurement of costs
- Definition and measurement of benefits

Type of Analysis

- Cost minimization:
  - Least expensive method to accomplish a fixed objective
  - Problem: assumes objective should be met; objective should be to maximize benefits with available resources
- Cost-benefit:
  - Costs and benefits measured in dollar terms
  - Select all treatments for which net benefit > 0
  - Problem: placing dollar value on outcomes
- Cost-effectiveness: Δcost / Δbenefit
  - Select treatments with lowest cost-effectiveness ratios

Utility Maximization and CEA

- $Max_{C,M}\ U(C,M)$ s.t. $I=p_cC+p_mM$
- $Max_{C,M}\ U(C,M) + \lambda*(I-p_CC-p_MM)$

First order condition: $U_C/P_C = U_M/P_M = \lambda$ (utility/$)

CEA: $U_M/P_M = \lambda$

CBA: $U_M/\lambda = P_M \rightarrow U_M/\lambda - P_M = 0$

NHB: $U_M = \lambda P_M \rightarrow U_M - \lambda P_M = 0$

Costs and Effectiveness

	Effectiveness Decreases	**Effectiveness Increases**
Cost Increases	Never do	CEA
Cost Decreases	CEA	Always do

Cost-Effectiveness of Medical Interventions

Intervention	Cost/LY
Neonatal PKU screening	<0
Sec. prev. hyperchol. men age 55-64	2,000
Sec. prev. hyperchol. men age 75-84	25,000
Pri. prev. mild hyperchol. men age 55-64	99,000
Screening exercise test men age 40	124,000
Screening ultrasound every 5 yr. for AAA	907,000

Perspective

- Private
  - HMO, consumer
- Public
  - Medicare, Medicaid, state mental health system
- Societal
  - Include all costs and benefits no matter to whom they accrue
  - Policy analysts (i.e., Panel on Cost-Effectiveness in Health and Medicine)

Benefits

- Specific Outcomes --> General Outcomes
  - Cancers detected
  - Cancers cured
  - Life-years saved
  - Quality-adjusted life years (QALYs) saved
    - Life-years weighted by quality of life weights between 0 (death) and perfect health (1)
    - “Cost-utility analysis”
    - Endorsed by Public Health Service Panel on Cost-effectiveness in Health and Medicine

QALYs

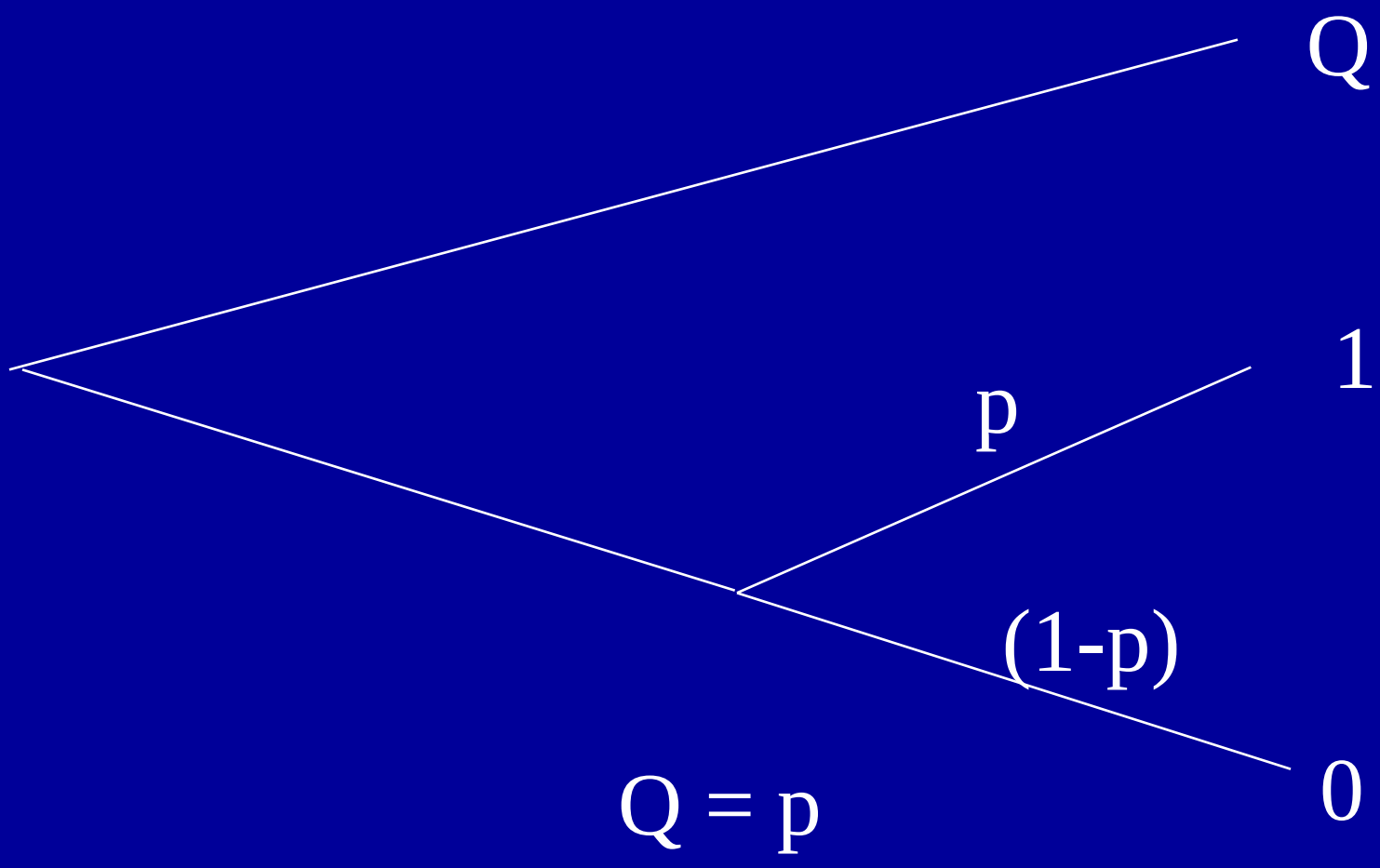
- Total years lived with each year weighted between 0 (death) and 1 (perfect health)
- QALYs = $\Sigma \beta^t S_t Q_t$
  - S_t survival probability
  - Q_t quality of life adjustment
  - $\beta < 1$ time preference discount factor
- Despite concerns, clearly dominant methodology
  - More than 1000 studies
  - Endorsed by U.S. Panel on Cost-Effectiveness Health and Medicine

Methods for Quality of Life Adjustment

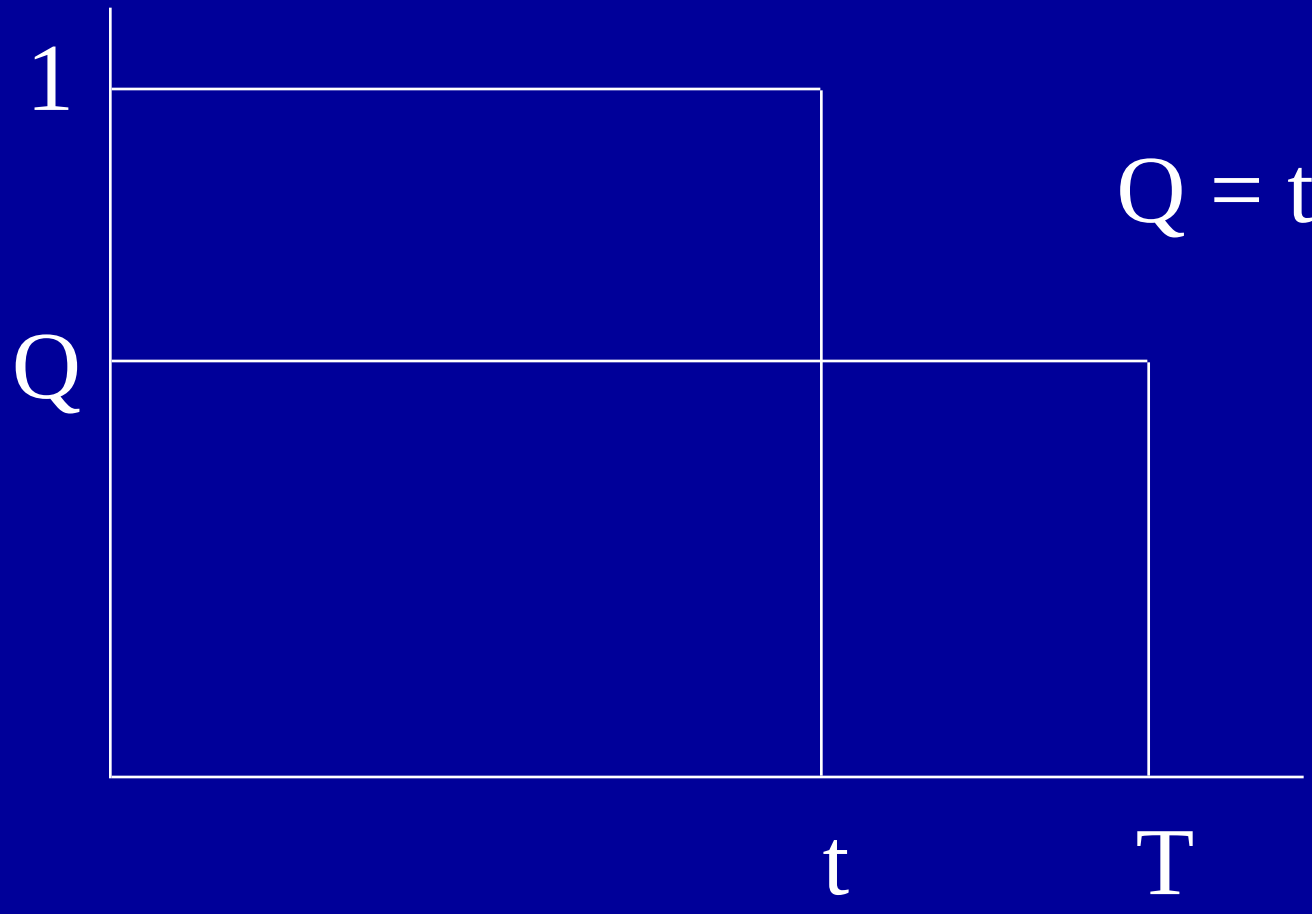
- Linear analog scale
- Standard gamble
- Time trade-off

Linear Analog Scale

Standard Gamble



Time Trade-off



Costs: Principles

- Opportunity cost
  - The value of the best alternative which is forgone
- Incremental (marginal) cost
  - The change in costs associated with an intervention
  - Incremental cost-effectiveness (example PAP smears)

Cost-Effectiveness of Pap Smears

Frequency	Increase in LE vs. no screening	Increase in Cost vs. no screening	Average Cost per Life-Yr Saved	Marginal Increase in LE	Marginal Increase in Cost	Marginal Cost per Life-Yr Saved
3 years	70 days	$500	$2,600/LY	70 days	$500	$2,600/LY
2 years	71 days	$750	$3,900/LY	1 day	$250	$91,000/LY
1 year	71 days 8 hours	$1,500	$7,300/LY	8 hours	$750	$830,000/LY

Value of 70 days = $9600 vs. Cost = $500
Value of 1 day = $137 vs. Cost = $250
Value of 8 hours = $ 45 vs. Cost = $750

Role of Theoretical Issues

- Advances in core approaches
  - Uncertainty / value of research
  - Future costs, productivity costs
  - Heterogeneity, self-selection, and empirical CEA
- Dilemmas of welfare maximization
  - Distribution / Arrow Impossibility Theorem
  - Alternate views of CEA exercise (extra-welfarist)
- Practical approach
  - Does it change the answer?
  - Value of promoting discussion (Pauker)
  - D-Day (Arrow)