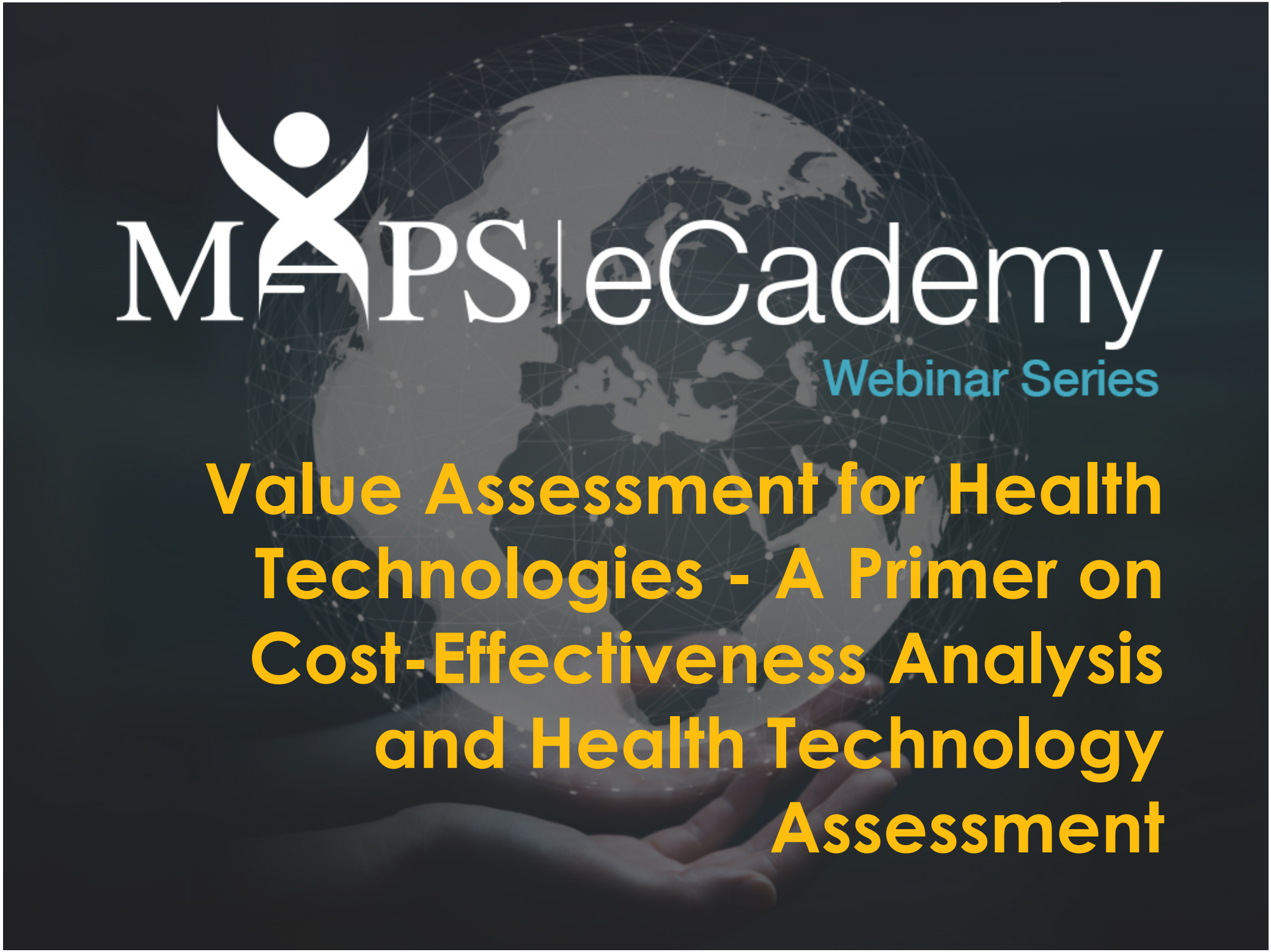
MAPS eCademy
Webinar Series
Value Assessment for Health Technologies - A Primer on Cost-Effectiveness Analysis and Health Technology Assessment

Introduction

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University of Arizona

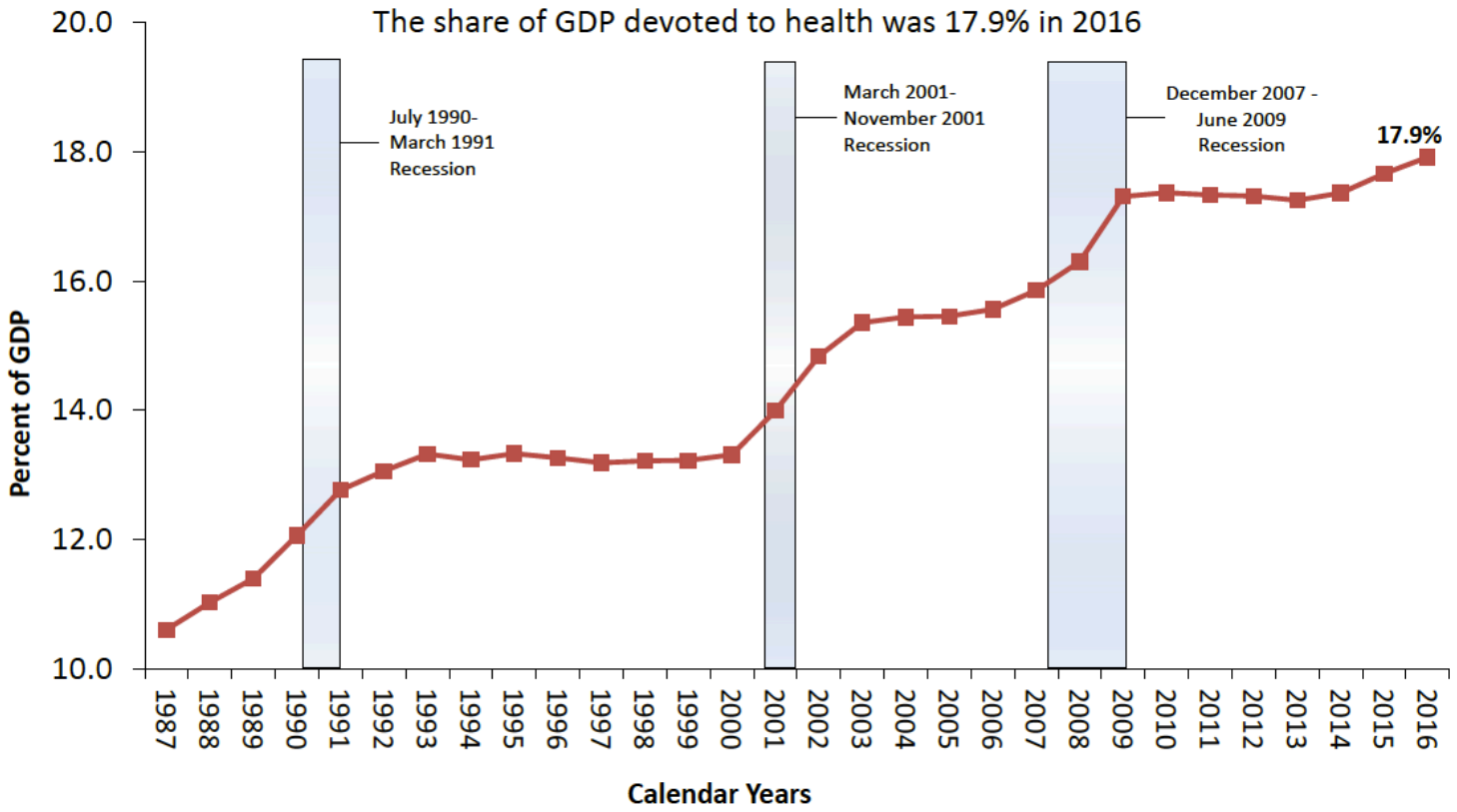
Disclaimer

The views expressed in this Webinar are those of the presenters, and are not an official position statement by MAPS, nor do they necessarily represent the views of the MAPS organization or its members.

ANOTHER VIEW

United States Healthcare Spending

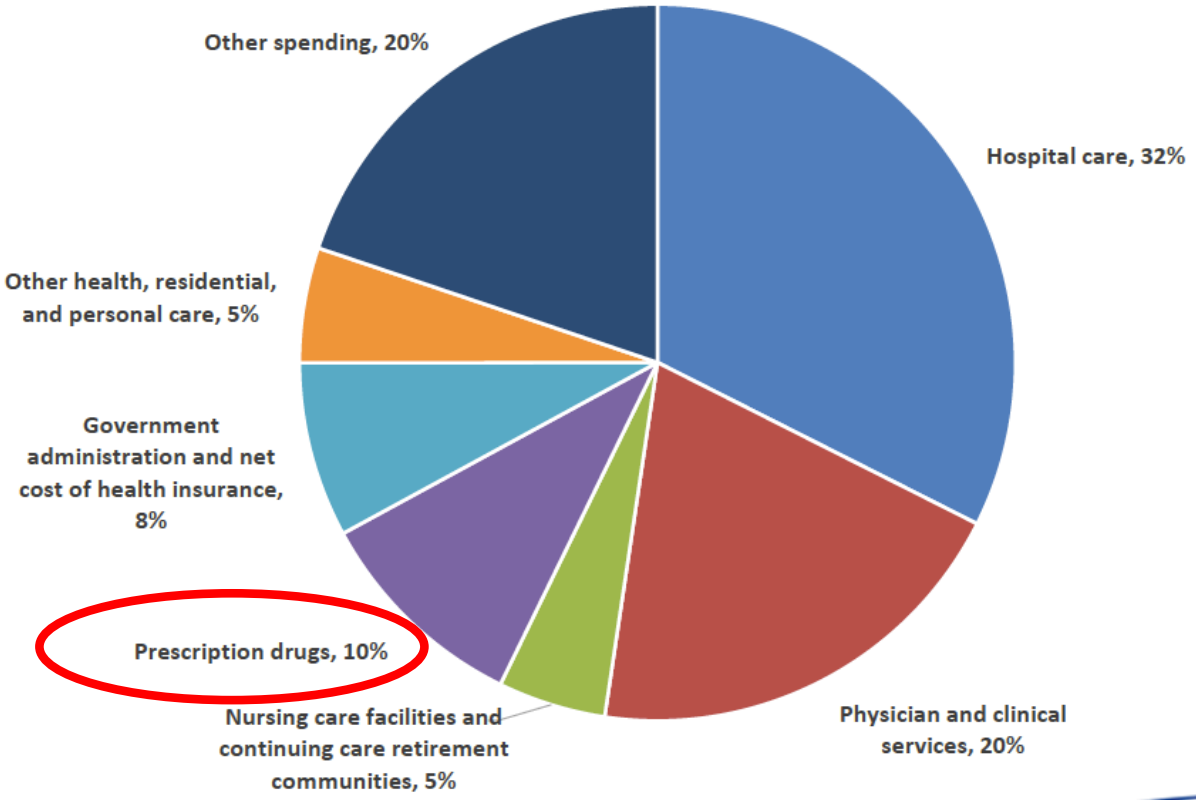
National Health Expenditures as a Share of Gross Domestic Product, 1987-2016



SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary, National Health Statistics Group; U.S. Department of Commerce, Bureau of Economic Analysis and National Bureau of Economic Research, Inc.

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES
OFFICE OF THE ACTUARY

The Nation's Health Dollar, Calendar Year 2016: Where It Went



NOTE: "Other spending" includes Dental services, Other professional services, Home health care, Durable medical equipment, Other nondurable medical products, Government public health activities, and Investment.

SOURCE: Centers for Medicare & Medicaid Services, Office of the Actuary, National Health Statistics Group.

CMS
CENTERS FOR MEDICARE & MEDICAID SERVICES
OFFICE OF THE ACTUARY

Is extra benefit worth the extra expense?

$12,000

With air conditioner
$13,000

Pharmacoeconomics: History

Early 1970's:

- Economic evaluation of health care began after passage of Medicare/Medicaid
- Economic evaluation in pharmacy began with the evaluation of pharmacokinetic services

Late 70's, early 80's:

- Economic evaluation of pharmaceuticals began
- "Pharmacoeconomics" coined 1986

Pharmacoeconomics: Today

- Determine most appropriate treatment based on Economic, Clinical and Humanistic Outcomes
- Guide selection of future programs/products
- Improve medication use decisions
- Allocation of scarce resources
  - National (e.g., UK, Australia)
  - Regional (e.g., health systems)
  - Local (e.g., P & T committees)

Economic Decision Making Principles

- Resources are scarce
- Must choose how to allocate resources
  - Identify relevant alternatives
  - Understand the viewpoints of all concerned
  - Evaluate the alternatives relative to each other
  - Evaluate the resource allocation and its repercussions

Pharmacoeconomic Research

Describes & analyzes the
costs & consequences of
pharmaceutical products & services

Always involves
a comparison

Goals of Pharmacoeconomic Research

- Every resource expended generates the maximum benefit in patient outcomes
- Decision-making "tool", not "decision-maker"
- Complements evidence-based medical decisions

Costs

Resources consumed when providing a treatment or service

Pharmacoeconomic analysis includes all costs associated with an intervention

- Drugs/Vaccines
- Office visits
- Hospitalization
- Procedures
- Treat adverse effects

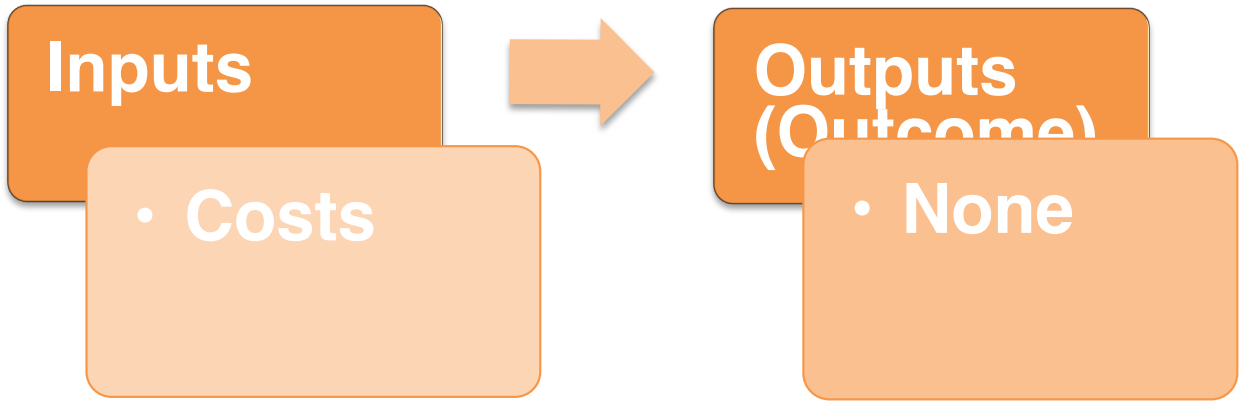
Consequences

Effects, outputs, outcomes associated with providing a product or service

- Surrogate outcomes vs. final outcome measures
- Pharmacoeconomic analysis includes outcome in denominator:
  - Infection avoided
  - Life year gained
  - Cure
  - Successfully treated patient
  - Quality Adjusted Life Year (QALY)

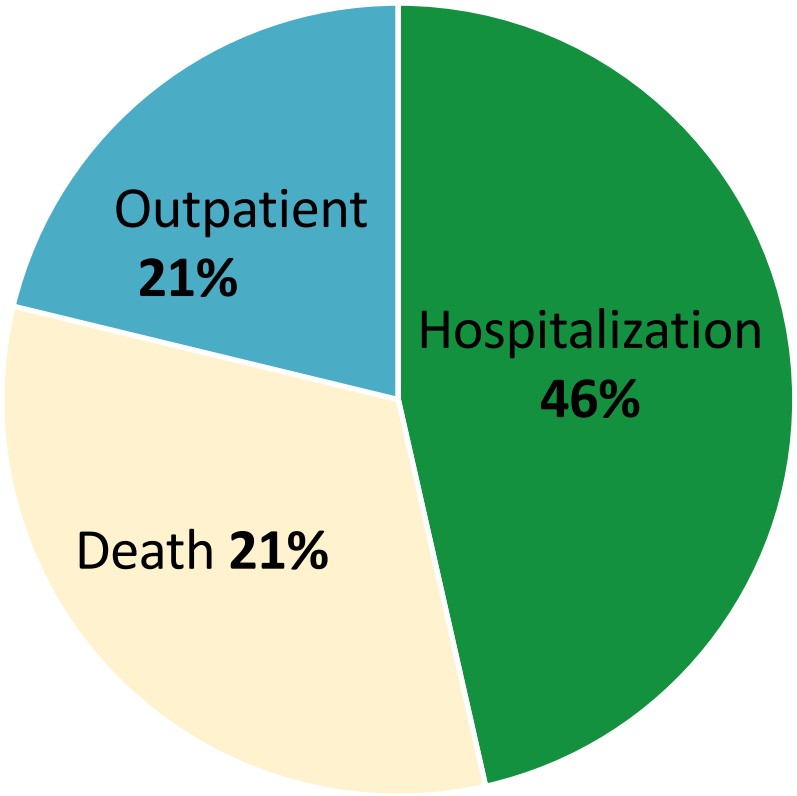
Cost of Illness (COI) Analysis

- Only identifies cost of a disease or condition
  - Cannot determine how costs change due to a new tx
- Can include costs re: treatment, disease, work loss, morbidity, and mortality
- Clinical outcomes are not formally incorporated
- Not “true” (full) economic evaluation



COI Study Example: 2003 Total Cost of Seasonal Influenza among US Seniors

Annual average *direct medical* costs: $ 4.2 billion



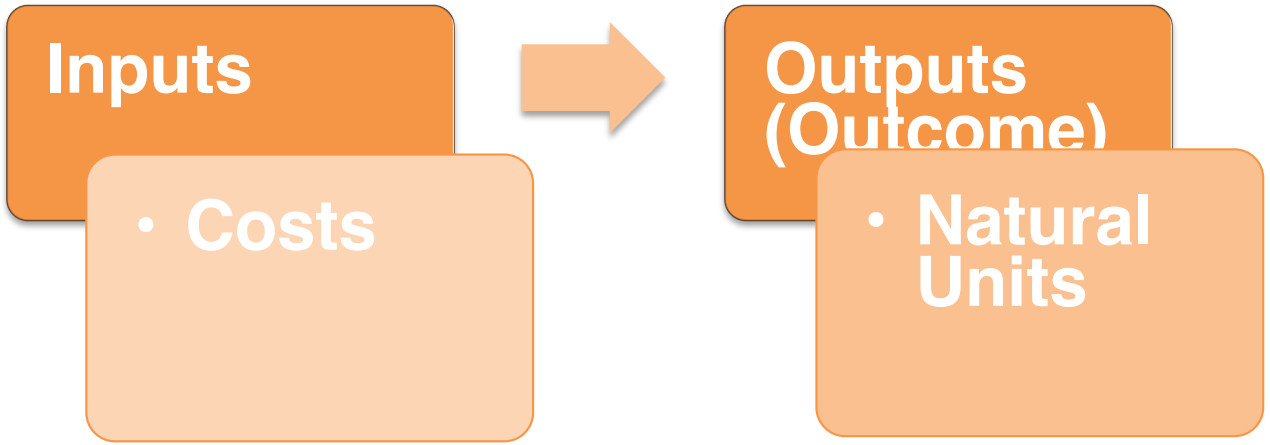
Molinari et al. The annual impact of seasonal influenza in the US: measuring disease burden and costs. Vaccine. 2007 Jun 28;25(27):5086-96.

Comparative Analyses
CEA, CBA, CUA

- How to "value" health?
  - How much is NOT getting the flu worth?
  - If we prevent long-term complications of diabetes – how much is this worth?

Cost-Effectiveness Analysis

Compares cost and benefits of a medical intervention to determine whether it is of sufficient value to adopt or reimburse



Cost-Effectiveness Analysis

Advantages:

Don't have to put a dollar value on clinical outcomes

- Can compare different treatments that have the same goal
- Decision makers have higher "comfort" level with natural unit outcomes

Disadvantage:

- Hard to compare similar outcomes

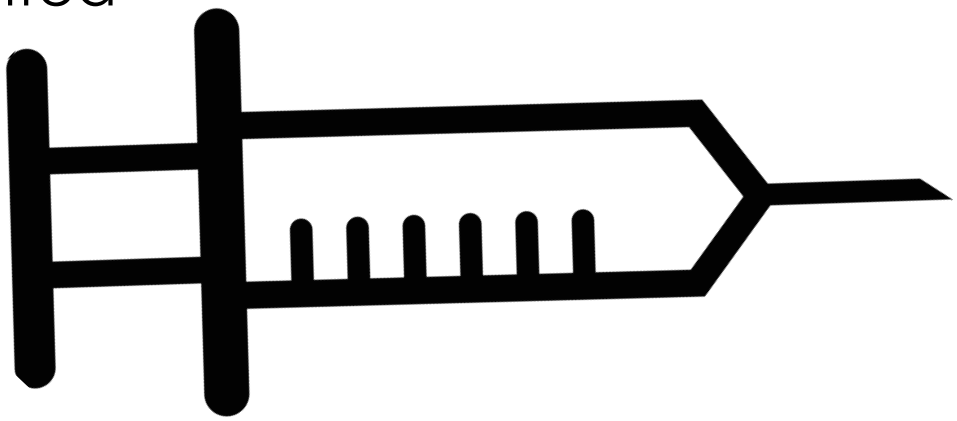
CEA Example: Vaccination

Vaccine A for 100 patients

- Total cost = **$10**
- Effectiveness = **10** episodes prevented

Vaccine B for 100 patients

- Total cost = **$60**
- Effectiveness = **50** episodes prevented

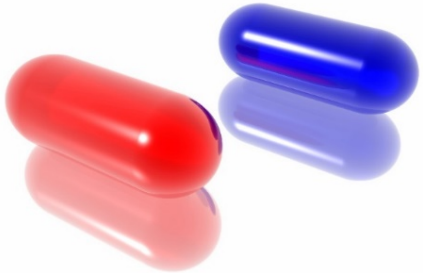


Influenza Vaccination Example: Average CE

Agent	Total Costs for 100 patients	Episodes prevented
Vaccine A	$1,000	10
Vaccine B	$6,000	50

Incremental Cost-Effectiveness Ratio (ICER)

Interpret ICER as the cost to achieve a ***one unit*** increase in outcome (e.g., one additional year of life saved) between alternatives



$$\textbf{ICER} = \frac{\Delta \text{ Cost}}{\Delta \text{ Effect}} = \frac{\textbf{Cost TxB} - \textbf{Cost TxA}}{\textbf{Effect TxB} - \textbf{Effect TxA}}$$

Incremental Cost-Effectiveness Ratio (ICER)

$$\text{ICER} = \frac{\Delta \text{ Cost}}{\Delta \text{ Effect}} = \frac{\text{Cost TxB} - \text{Cost TxA}}{\text{Effect TxB} - \text{Effect TxA}}$$

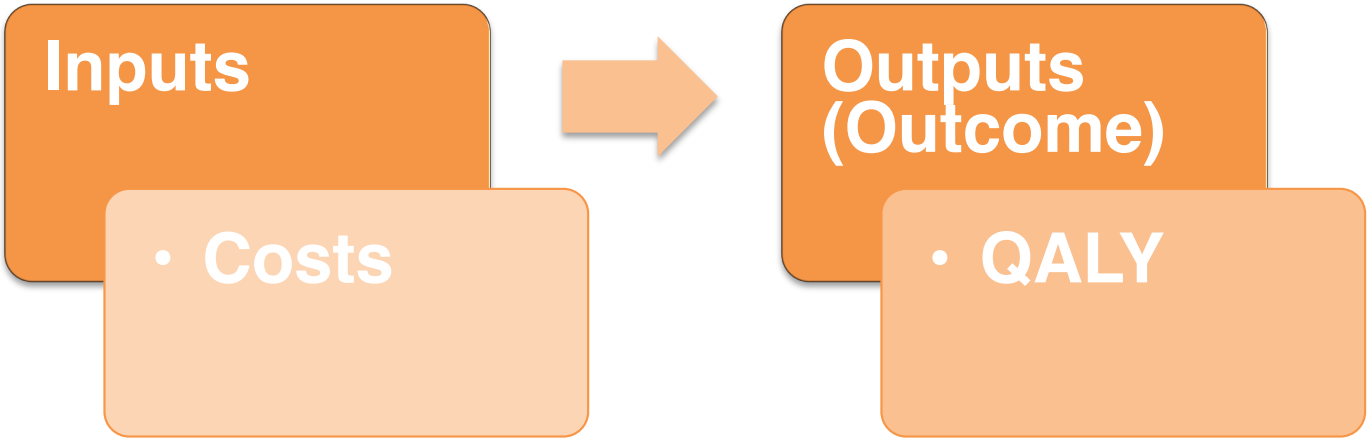
$$= \frac{\$6{,}000 - \$1{,}000}{50 - 10}$$

$$= \frac{5{,}000}{40}$$

= **$125** per additional influenza episode prevented

Cost-Utility Analysis (CUA)

Incorporates both morbidity and mortality (i.e. quality and quantity of life)



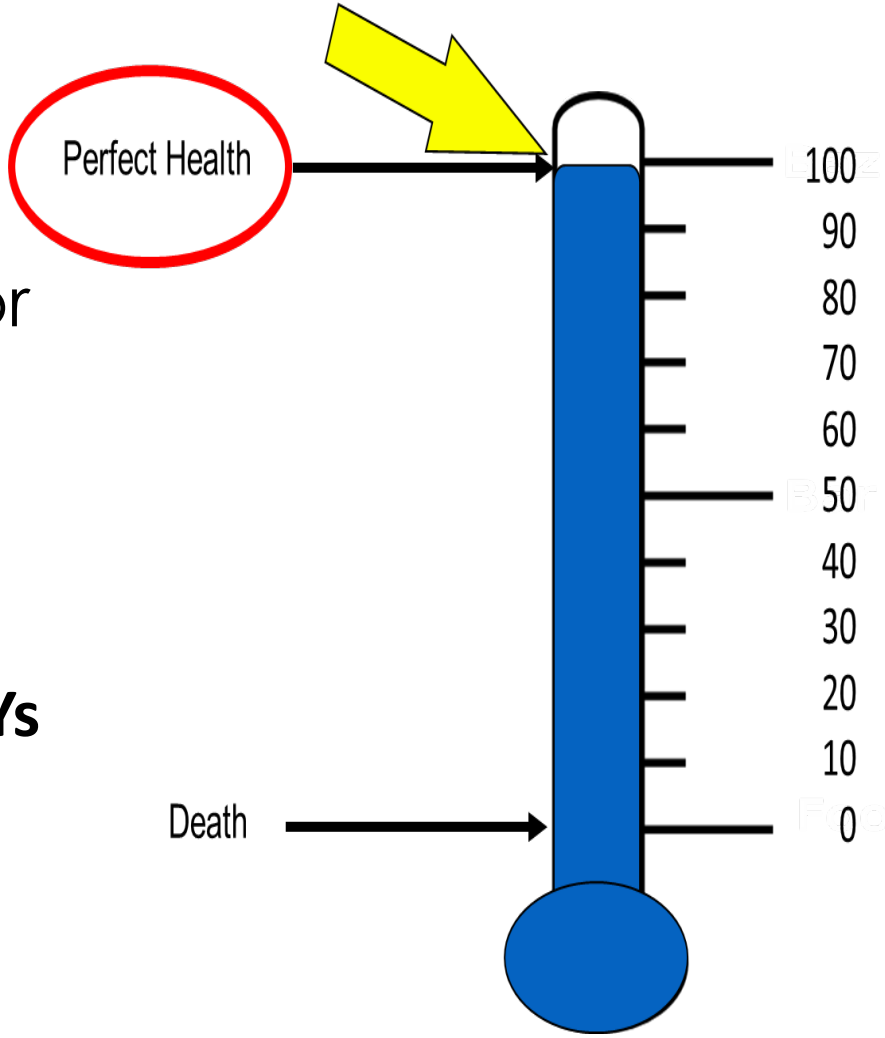
Utility

Desirability/preference that individuals exhibit for a condition

Anchored from

0 (death) to **1 (perfect health)**

Required for calculating **QALYs** *(**Q**uality **A**djusted **L**ife **Y**ears)*



Examples of Utility Estimates

Disease State	Utility
Perfect health	1.00
Vaccine adverse event	0.90
Renal transplant	0.84
HIV	0.79
Moderate atopic eczema	0.69
Hospital dialysis (pts, public)	0.58, 0.56
Hospital confinement	0.33
Death	0.00

How to Incorporate Utilities

Hepatitis drug extends life by **10 years,** but at a low utility, say **.40**

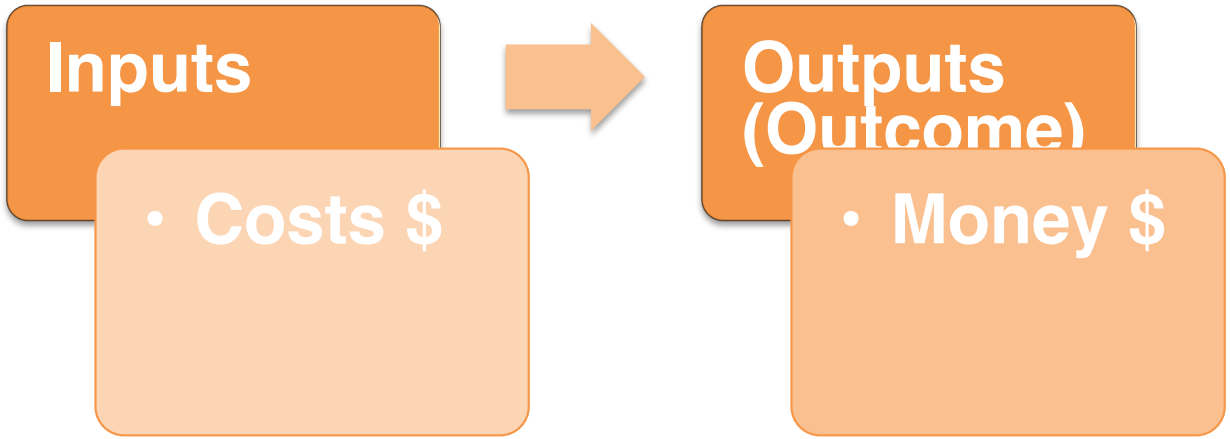
Drug does not get credited with providing 10 years

With QALYs, the years are adjusted:

10 years X 0.4 = 4 QALYs

Cost-Benefit Analysis (CUA)

Compares two or more treatments (scenarios) with outcomes being assigned a monetary value



Cost-Benefit Analysis

- Most commonly used to evaluate prevention programs
  - Vaccination
  - Cancer screening
  - Short- and Long-term complications from disease

Example

Home Blood Pressure Monitoring

Cost–Benefit Analysis of Home Blood Pressure Monitoring in Hypertension Diagnosis and Treatment

An Insurer Perspective

Alejandro Arrieta, John R. Woods, Nan Qiao, Stephen J. Jay

Clinic Blood Pressure Monitoring vs.
Home Blood Pressure Monitoring

Source: Hypertension 2014: 64:891-896

Costs and benefits of home blood pressure monitoring

- Costs: BP device
- Benefits: (reduction in rates of)
  - Myocardial infarction
  - Transient ischemic attack
  - Stroke
  - Congestive heart failure

Source: Hypertension 2014: 64:891-896

Findings:

Table 2. Cost–Benefit Analyses Results: ROIs by Health Plan Type and Age Group

	Investment Horizon			
Plan/Age Group	Year 1	Year 3	Year 5	Year 10
Employee plan: 20–44 y				
Net savings (dollars)	$33.75	$155.11	$245.36	$414.81
ROI	0.94	4.34	5.52	8.37
Employee plan: 45–64 y				
Net savings (dollars)	$32.65	$161.79	$255.32	$439.14
ROI	0.85	4.20	4.98	7.50
Medicare: ≥65 y				
Net savings (dollars)	$166.17	$557.00	$846.86	$1364.27
ROI	3.75	12.59	13.83	19.34

ROIs are expressed as the ratios of net savings to costs. indicates return on investment.

Source: Hypertension 2014: 64:891-896

Pharmacoeconomic Study Designs

	Numerator (costs based on perspective)	Denominator
Cost of Illness (COI)	$	-----
Cost Minimization Analysis (CMA)	$	Assumed equal
Cost-Effectiveness Analysis (CEA)	$	Natural units (i.e., clinical)
Cost-Utility Analysis (CUA)	$	QALY (humanistic outcomes)
Cost-Benefit Analysis (CBA)	$	$ (change in health state valued in monetary terms)

Cost-Effectiveness Analysis

- Formal method for comparing costs and benefits of interventions
- Costs measured via resources consumed units and valued in monetary units
- Effectiveness is measured in natural units of health improvement (e.g., clinical outcome measure, life years gained (LYG), life years saved (LYS), prevention of event
- Cost-utility analysis uses Quality-Adjusted Life Years (QALYs

Cost-Effectiveness Analysis

Presenting results

- Mathematically
  1. Statement of costs and consequences with no ratios

Cost-Effectiveness Analysis

Presenting results

- **Mathematically**
  1. Statement of costs and consequences with no ratios
  2. **Simple (Average) Cost-Effectiveness Ratio**
     - Interpreted as **average cost per outcome**

$$CE = \frac{Cost}{Effect} = \frac{Cost_A}{Effect_A}$$

Cost-Effectiveness Analysis

Presenting results

- **Mathematically**
  1. Statement of costs and consequences with no ratios
  2. Simple (Average) Cost-Effectiveness Ratio
  3. **Incremental Cost-Effectiveness Ratio**
     - Interpreted as cost to achieve a 1 unit increase in **outcome** (e.g., 1 additional year of life saved) between alternatives

$$ICER = \frac{\Delta Costs}{\Delta Effects} = \frac{Cost_A - CostB}{Effect_A - EffectB}$$

Cost-Effectiveness Analysis

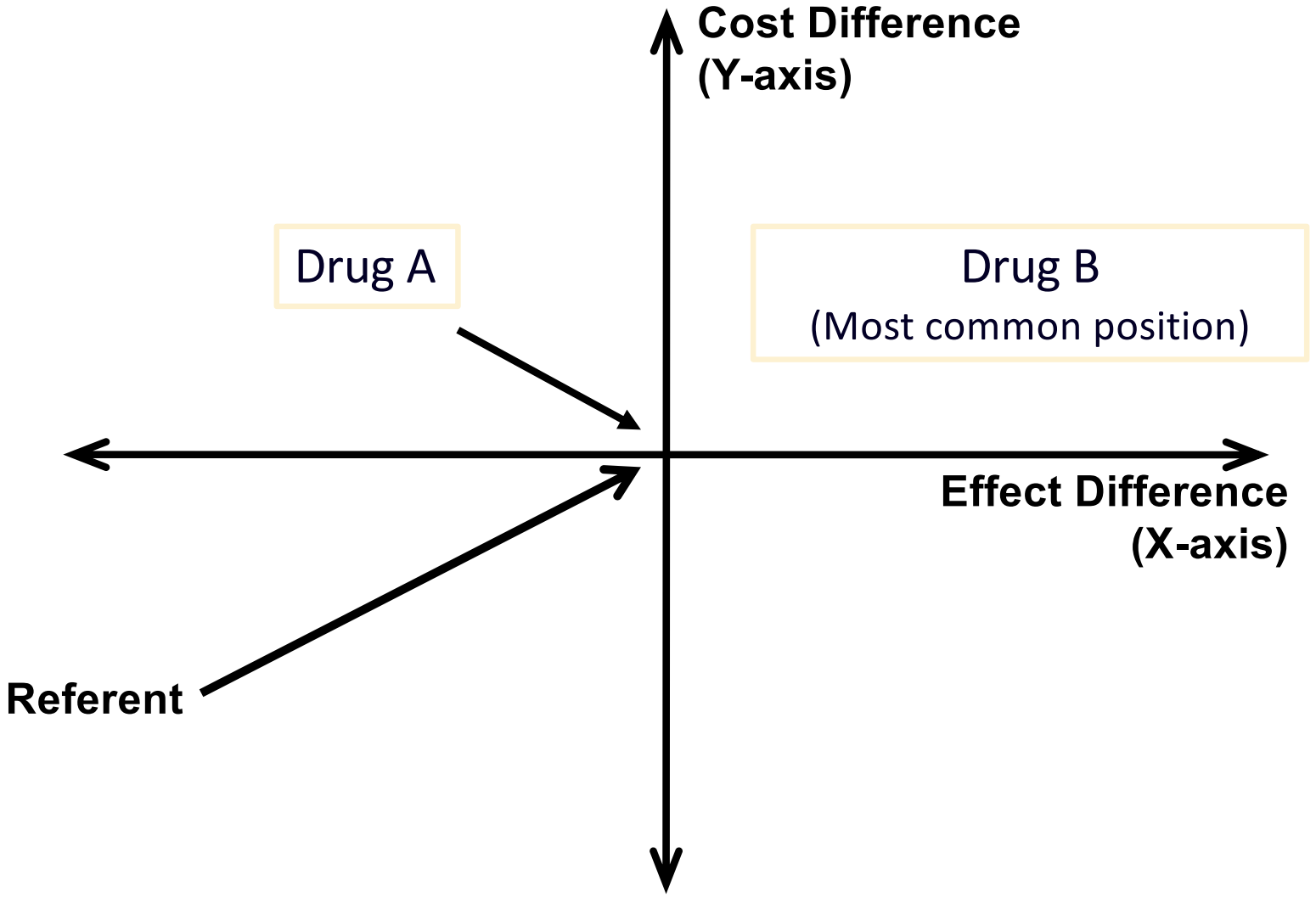
Presenting results

- **Mathematically**
  1. Statement of costs and consequences with no ratios
  2. Simple (Average) Cost-Effectiveness Ratio
  3. Incremental Cost-Effectiveness Ratio (ICER)
  4. **Others (e.g., Net Monetary/Health Benefit)**

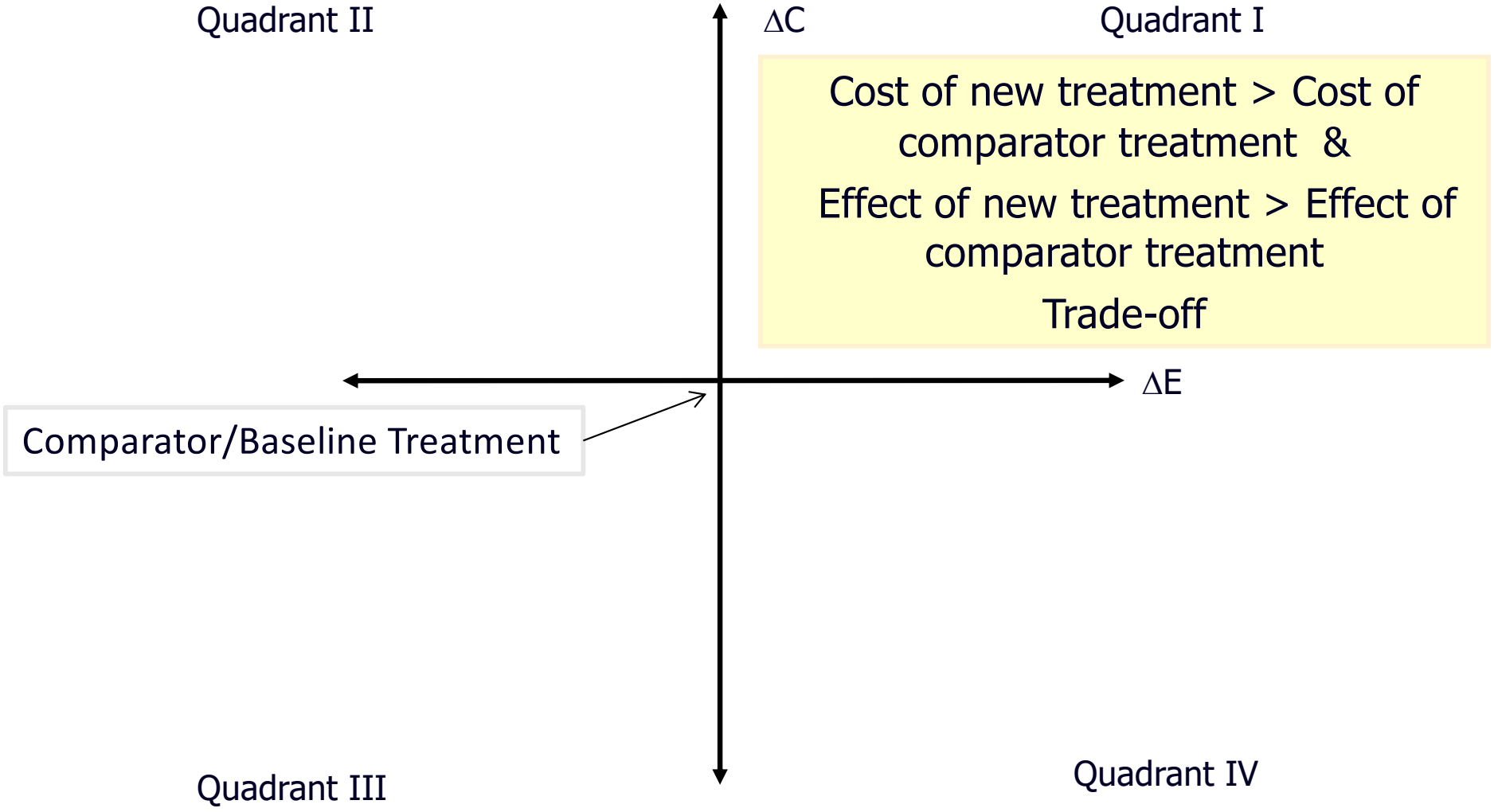
Cost-Effectiveness Analysis

Presenting results

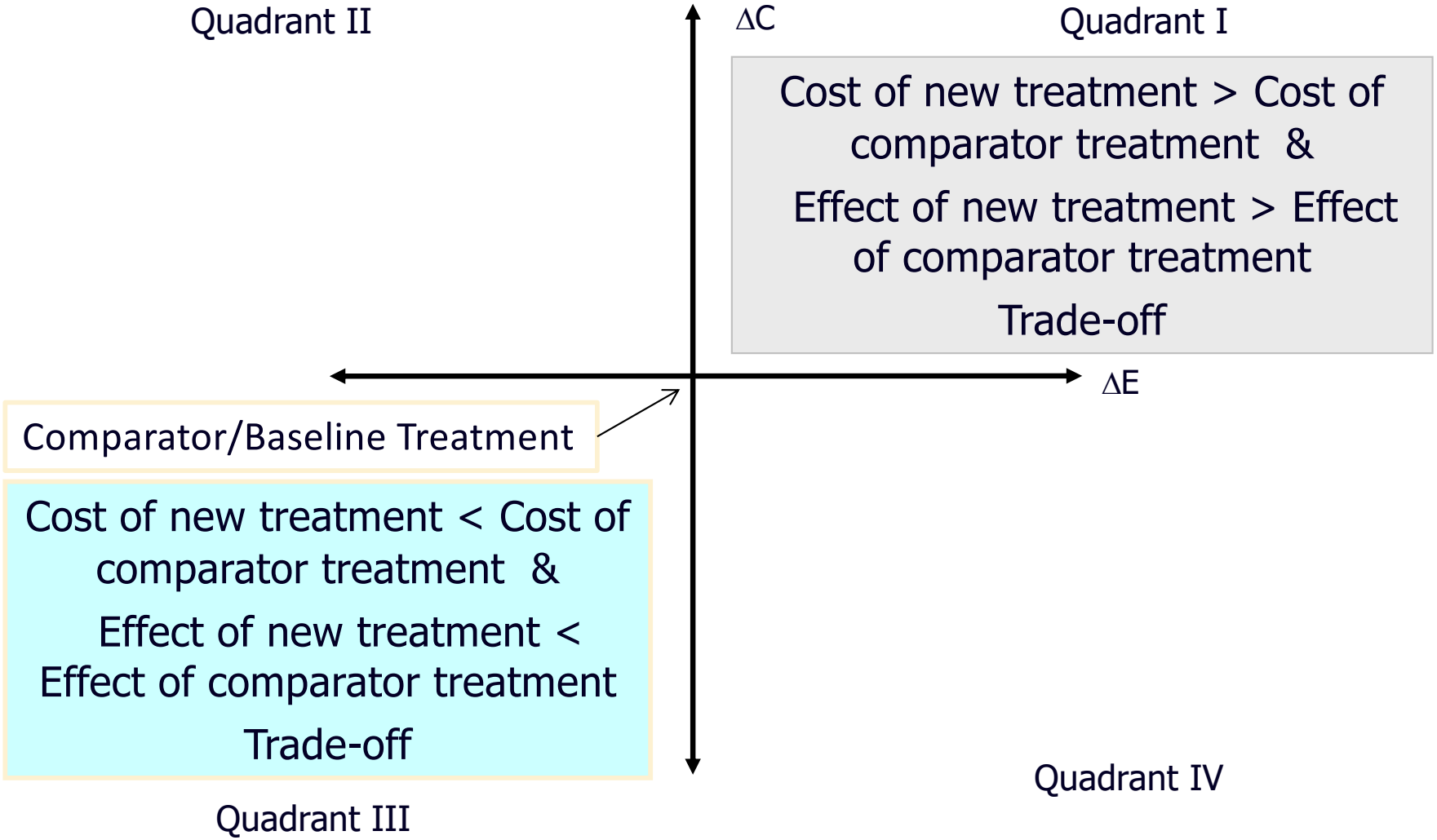
- Mathematically
- **Graphically**
  1. **Cost-effectiveness plane**
  2. **Cost-effectiveness Acceptability Curve (CEAC)**


Cost Difference
(Y-axis)
Drug A
Drug B
(Most common position)
Effect Difference
(X-axis)
Referent

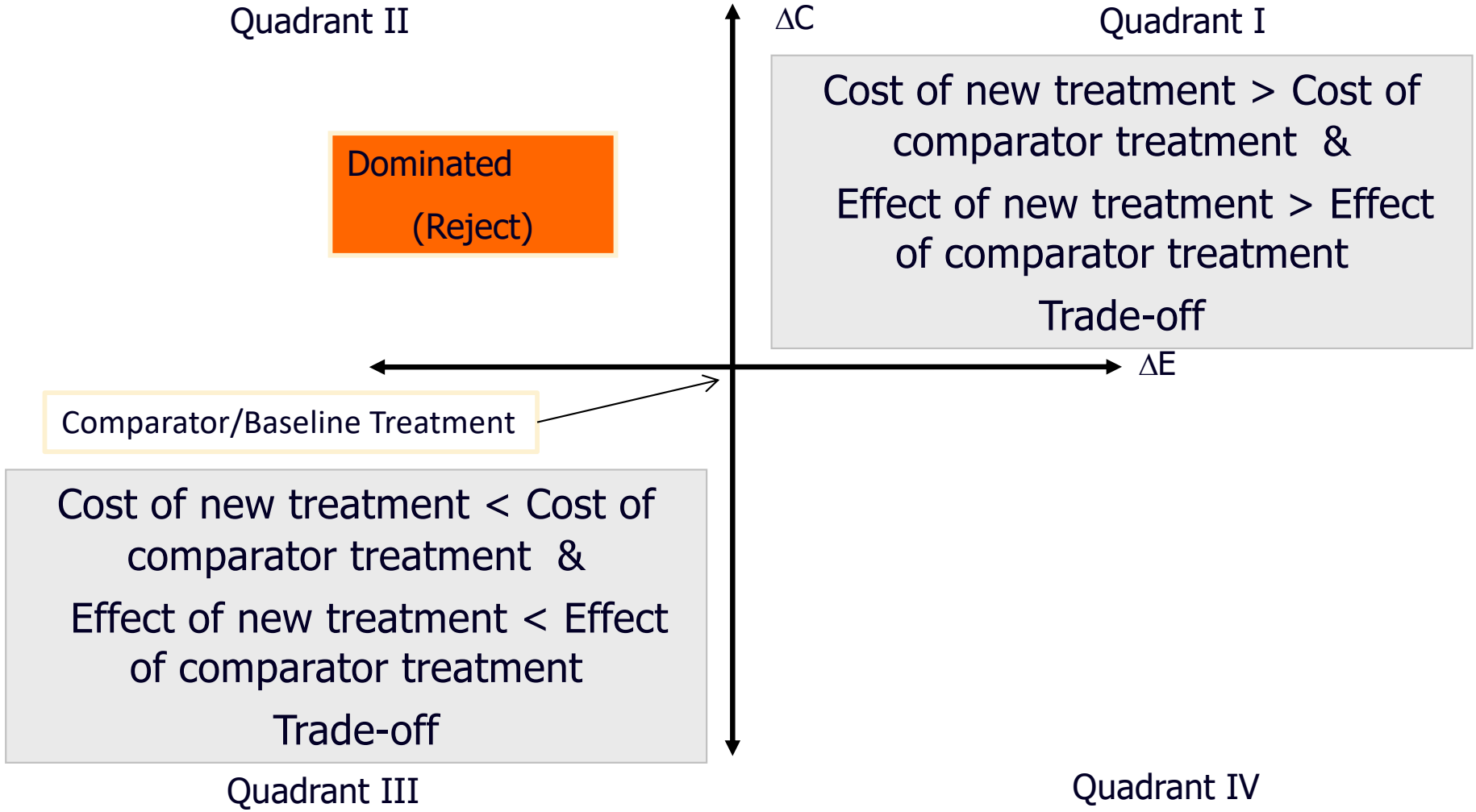
The Cost-Effectiveness Plane



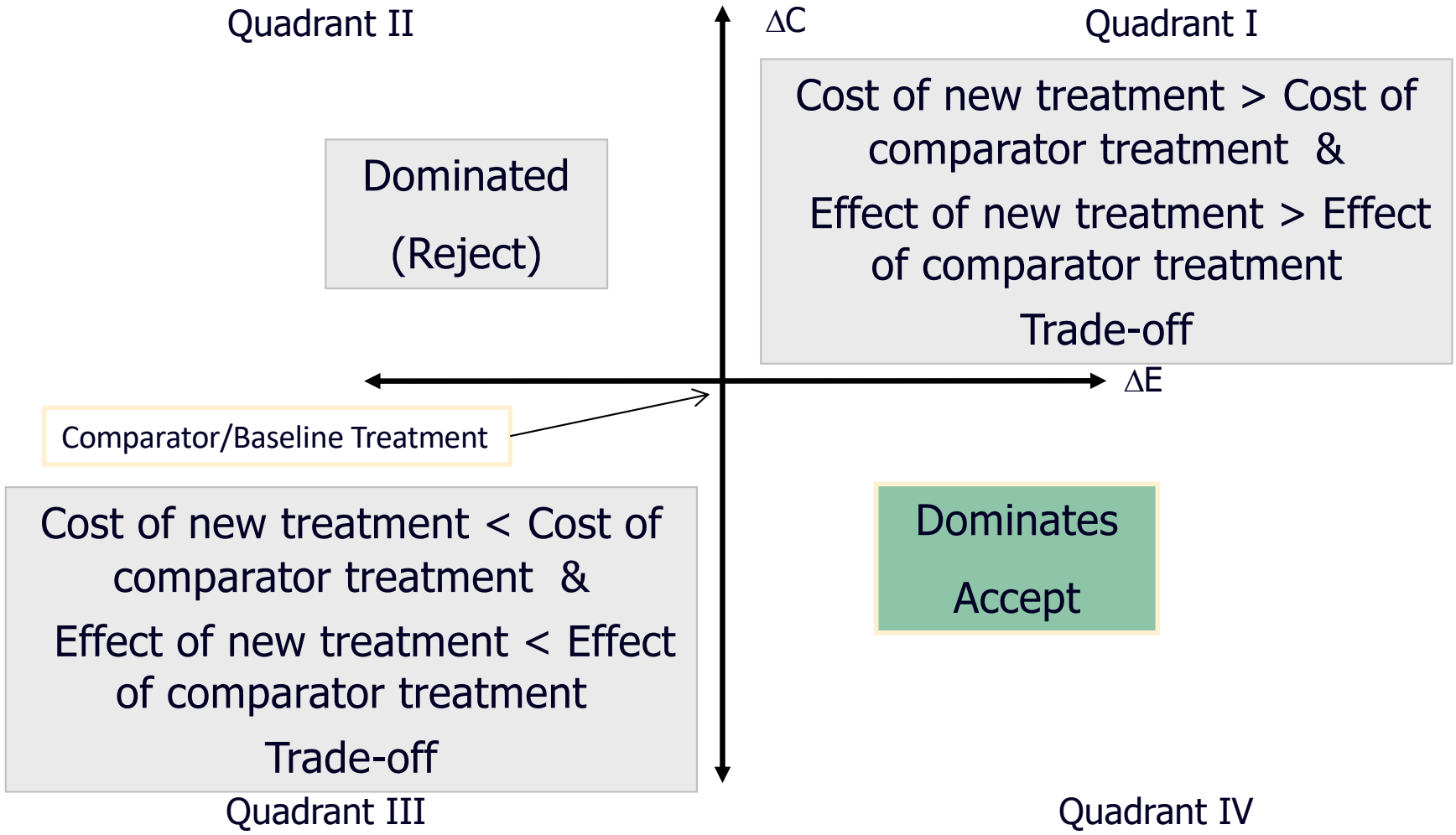
The Cost-Effectiveness Plane



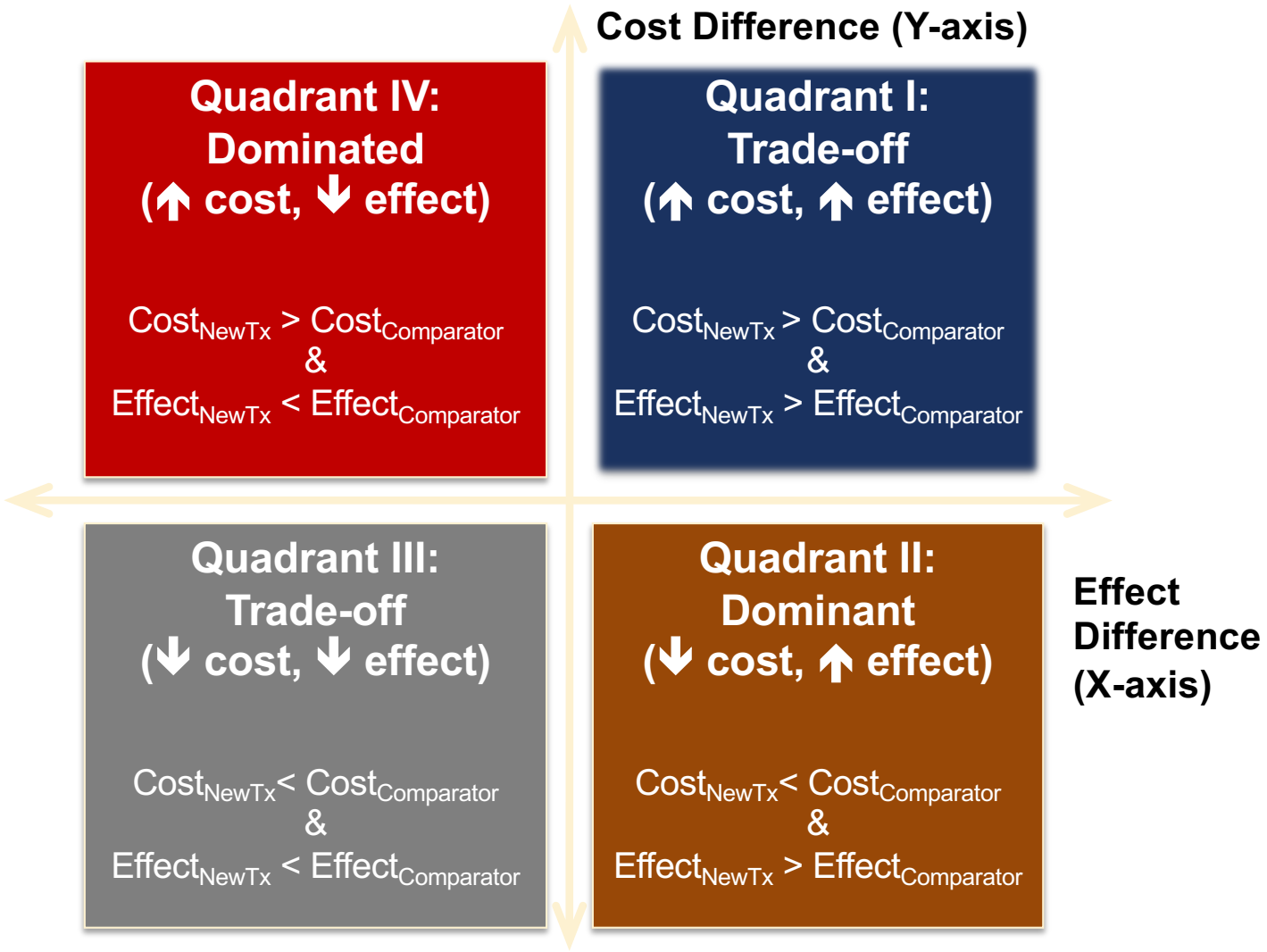
The Cost-Effectiveness Plane



The Cost-Effectiveness Plane



Cost-Effectiveness Plane



Cost-Effectiveness Plane

Just Say No

Just Do It

Why the Cost-Effectiveness Plane is necessary for ICER Interpretation

Why the Cost-Effectiveness Plane is Required to Evaluate Technologies

Scenario 1:

- Assume the following:
  - New Drug B has cost $75, with an effectiveness of 50%
  - Old Drug A has a cost of $100, with an effectiveness of 30%

Incremental Analysis for Scenario 1

$$ICER = \frac{TC_B - TC_A}{E_B - E_A}$$

$$ICER = \frac{\$75 - \$100}{0.50 - 0.30}$$

$$ICER = \frac{-\$25}{0.2}$$

= -$125 per additional successfully treated patient

Why the Cost-Effectiveness Plane is Required to Evaluate Technologies

Scenario 2:

- Assume the following:
  - New Drug C has a cost $125, with an effectiveness of 10%
  - Old Drug A has a cost of $100, with an effectiveness of 30%

Incremental Analysis for a Scenario 2

$$ICER = \frac{TC_c - TC_A}{E_c - E_A}$$

$$ICER = \frac{\$125 - \$100}{0.10 - 0.30}$$

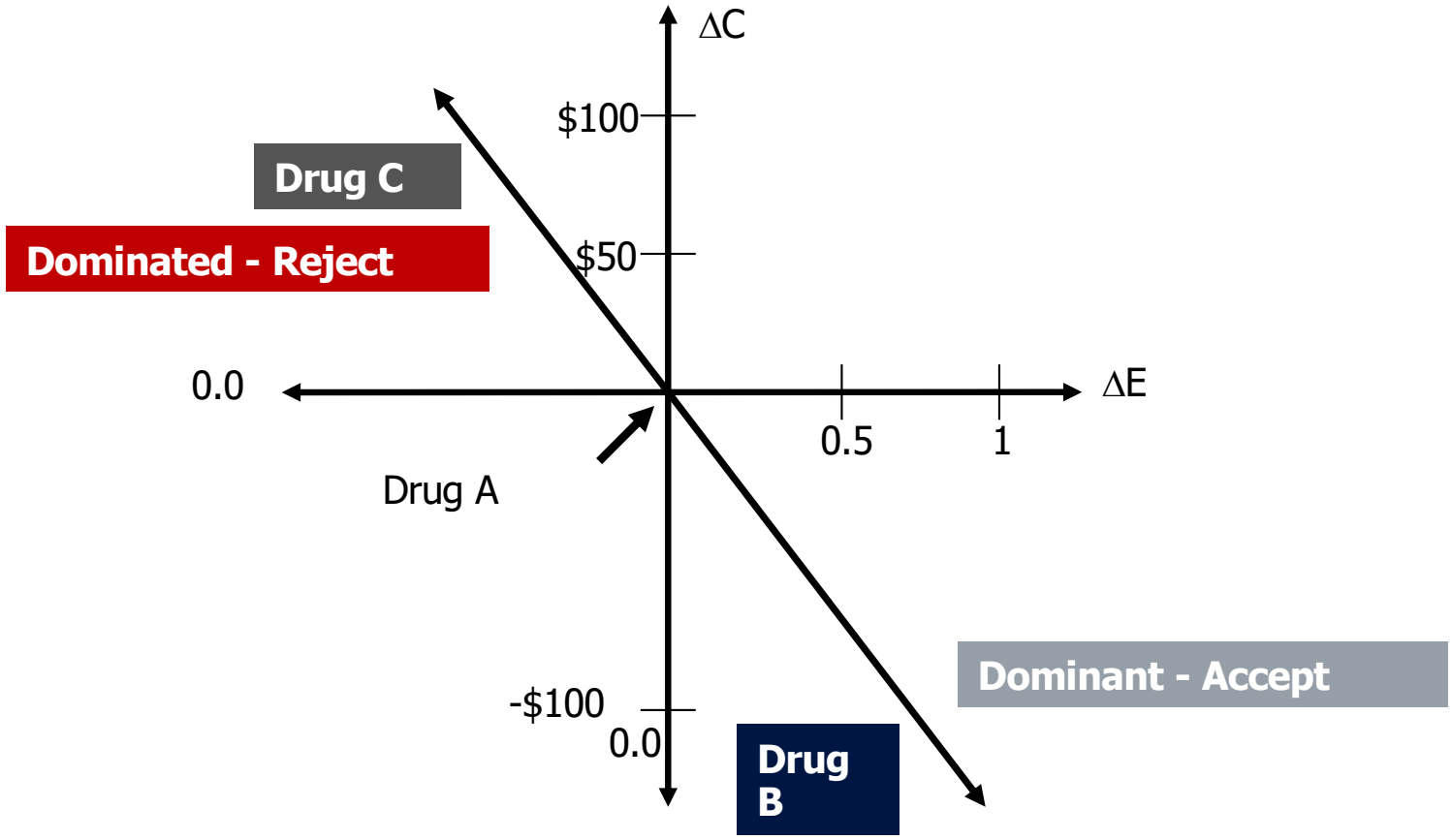
$$ICER = \frac{\$25}{-0.2}$$

= -$125 per additional successfully treated patient

Summary of Scenario 1 and 2

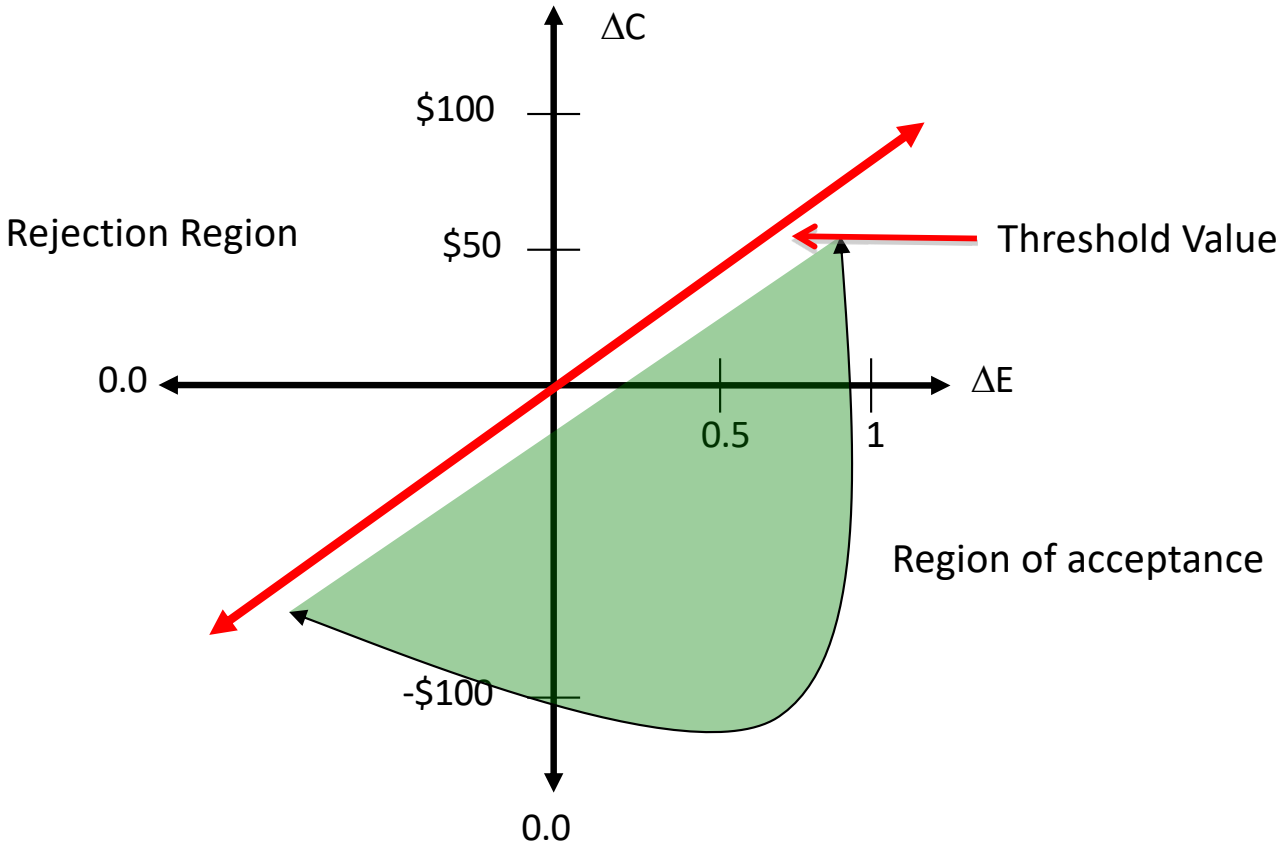
- Both analyses use the same formula
- Both analyses involve 2 products
  - Drug B vs. Drug A
  - Drug C vs. Drug A
- Both analyses obtain the same number
  - - $125 per outcome
- Interpretation of the each result is substantially different

Interpretation of CEA Results

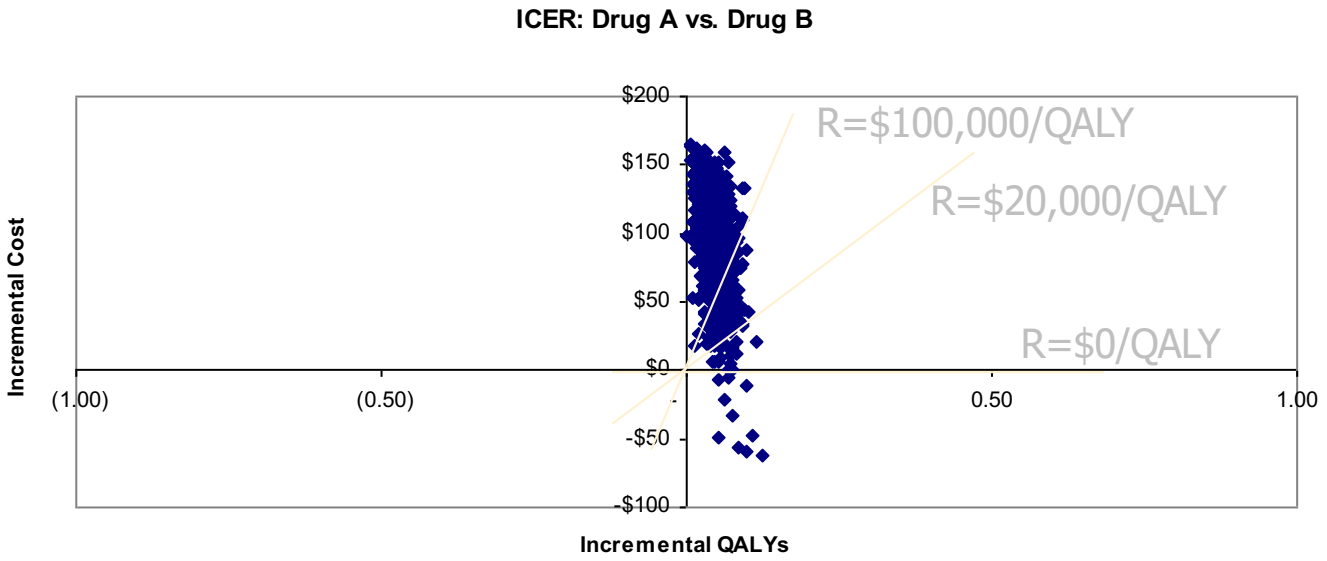


Thresholds for Cost-effectiveness

What is Cost-Effective?



Varying “Cost-Effectiveness” Thresholds



What is your Threshold?

- $50,000 / QALY?
- $64,000 / QALY?
- $100,000 / QALY?

AHA/ACC Framework – Quantifying Value

Label	Thresholds	Qualifying Statements
High	< $50,000 / QALY gained	Better outcomes at lower cost (dominant) or threshold value
Intermediate	$50,000 to $150,000 / QALY gained	
Low	> $150,000 / QALY gained	
Uncertain		Insufficient data to draw conclusions
Not assessed		Value not assessed by guideline committee

Source: Journal of the American College of Cardiology 2014; 63(21):2305-2322

Summary

- Cost-Effectiveness uses “clinical” outcomes in the denominator
- Don’t use the “Average” cost-effectiveness number
- Incremental cost-effectiveness ratios can be positive or negative
- Use the cost-effectiveness plane to evaluate ICER values graphically
- Cost-Effectiveness acceptability curves alternative to cost-effectiveness plane

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