Intersection of Genomics and Health Economics

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Three Challenges

1. Incentives for test/evidence development
2. Measuring personal utility and policy development
3. Impact on healthcare system – behavior of patients and providers

I. Health Economics Overview

There is a need for a systematic approach to informing complex decisions

- Two very important and very basic concepts:
  - Include all relevant factors
  - Use same approach for all decisions
- 'Cost effectiveness analysis' (CEA) is a formal set of approaches to address this need

What is CEA?

- Evaluation of costs and benefits of a healthcare intervention to assist in decision making
- Does an intervention when used to prevent, diagnose, or treat an illness:
  - improve clinical outcomes…enough to
  - justify the additional dollars spent compared with alternative uses of the same money?

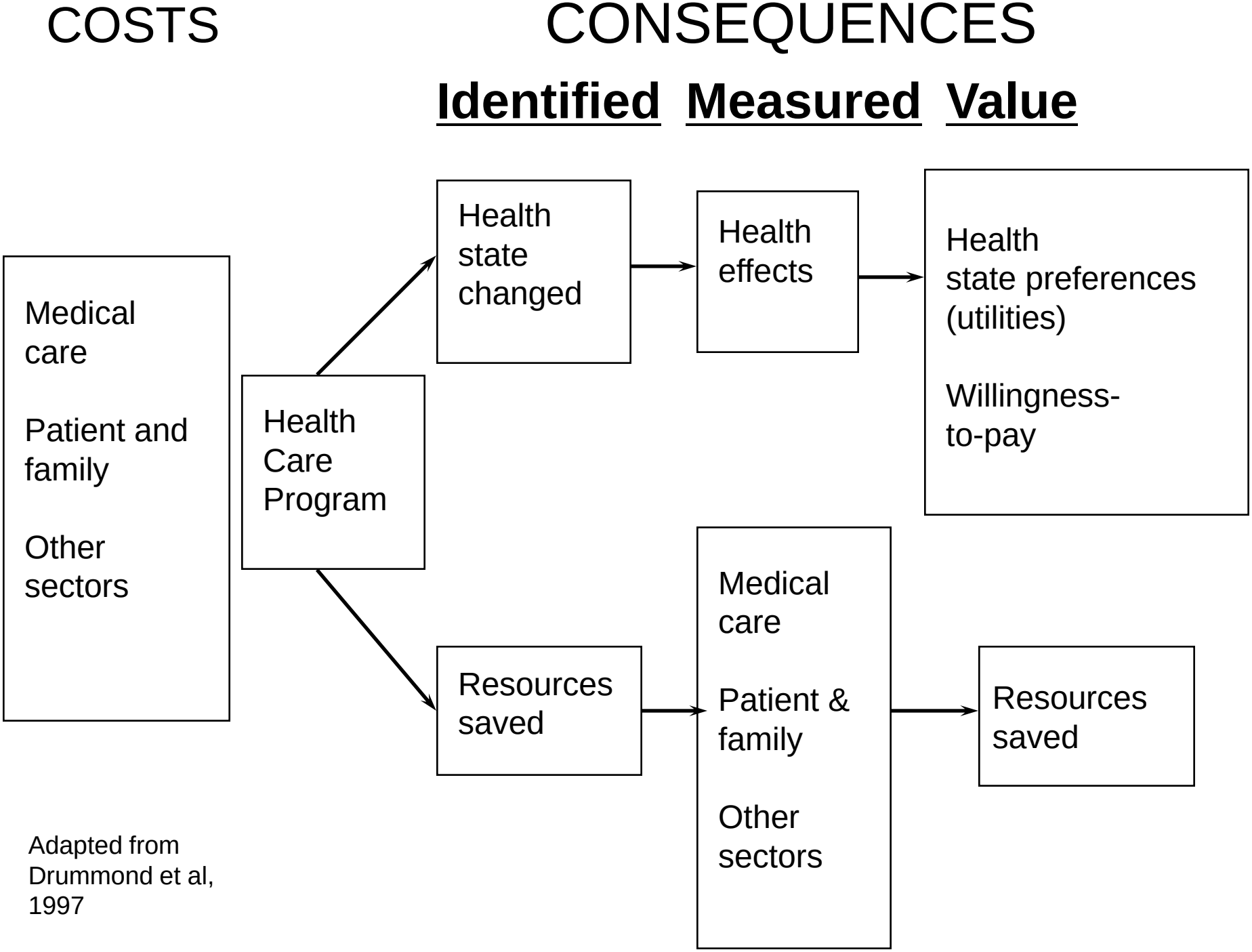
Cost-effectiveness analysis

- Quantitative framework for evaluating the complex and often conflicting factors involved in the evaluation of health care technologies
- Evaluate many types of costs and benefits
- Provides comparison to alternative treatment strategies

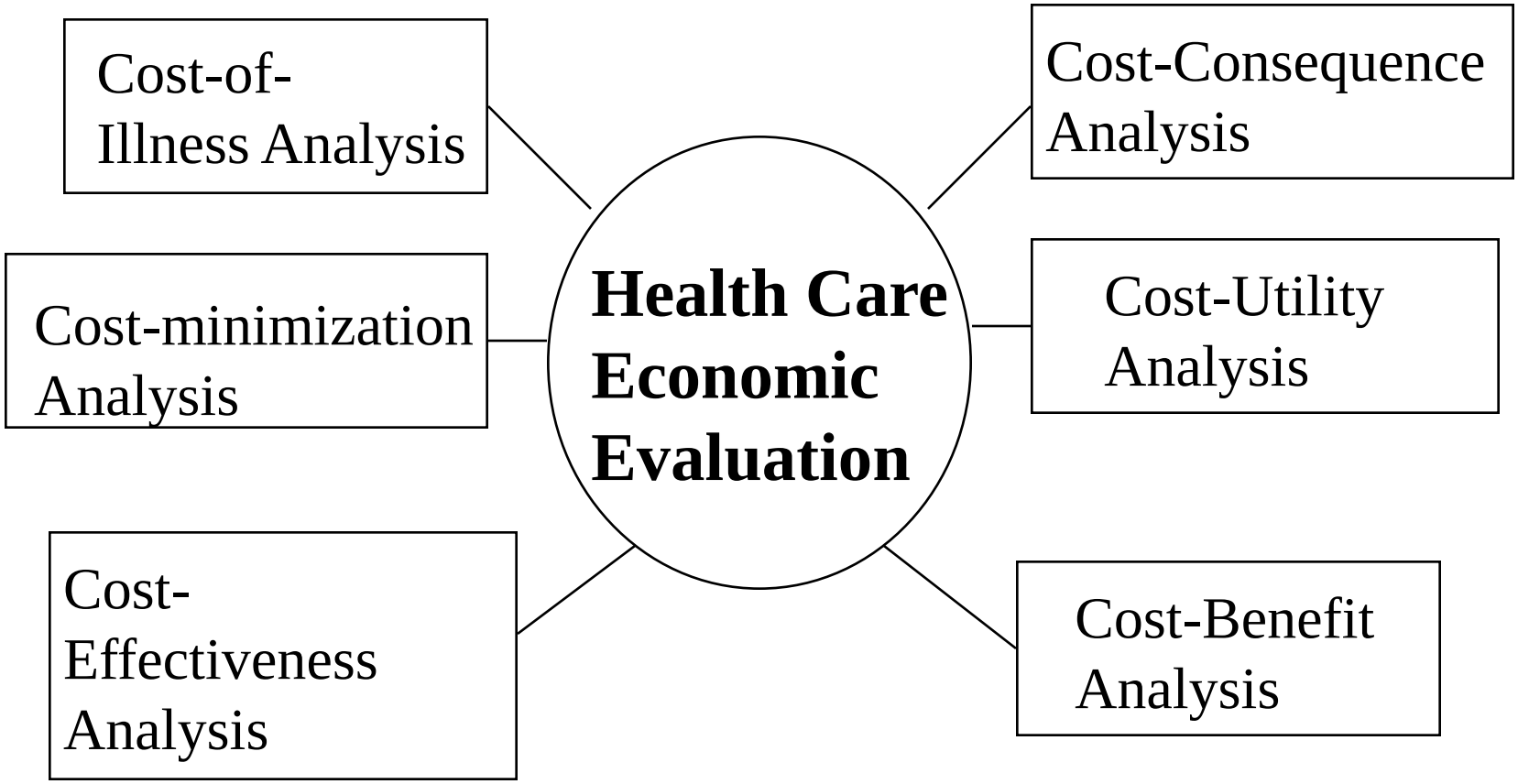
What is CEA not?

- It is not:
  - A method to show which interventions reduce costs.
  - A method that removes individual (patient) or group responsibility for making clinical and financial decisions.
  - A method that generates distribution-neutral results.

Tools



Adapted from Drummond et al, 1997


Cost-of-Illness Analysis
Cost-Consequence Analysis
Cost-minimization Analysis
Health Care Economic Evaluation
Cost-Utility Analysis
Cost-Effectiveness Analysis
Cost-Benefit Analysis

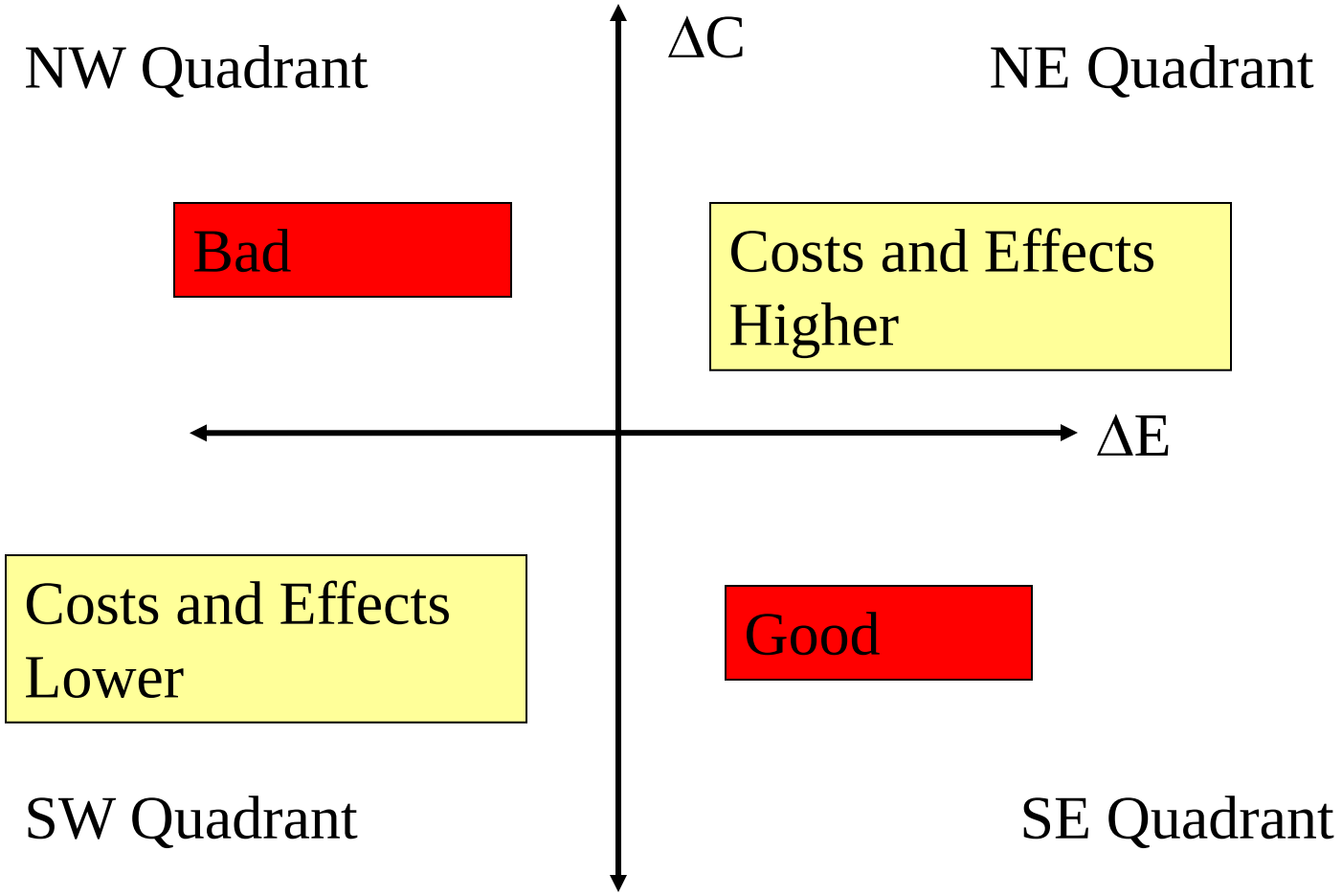
A multitude of approaches

Types of Economic Evaluation in Health Care				
Study Design	**Costs Measured?**	**Outcomes Measured?**	**Strengths**	**Weaknesses**
Cost-minimization	Yes	Not necessary	Easy to perform	Useful only if outcomes are the same for both interventions
Cost-benefit	Yes	Yes, in monetary terms	Good theoretical foundation; can be used within health care and across sectors of the economy	Less commonly accepted by health care decision makers; evaluation of benefits methodologically challenging
Cost-effectiveness	Yes	Yes, in clinical terms (events, life years)	Relevant for clinicians; Easily understandable	Cannot compare interventions across disease areas when using disease specific endpoints.
Cost-utility	Yes	Yes, in **quality-adjusted life-years (QALY)**	Incorporates quality of life; Comparable across disease areas and interventions; Standard	Requires evaluation of patient preferences; Can be difficult to interpret

Incremental Cost-Effectiveness Therapy A vs. Therapy B:

$$\frac{\text{Cost (B) - Cost (A)}}{\text{Effectiveness (B) - Effectiveness (A)}}$$

Interpretation of CEA results



Deciding what interventions to pay for using CEA

- Each ratio must be compared with others to determine a rank order list for setting funding priorities.

Cost-effectiveness of commonly used interventions (per life-year gained)

ABMT for relapsed Hodgkins	$421,000
Liver transplantation	$237,000
Mammography (<50 yo)	$232,000
2-vessel CABG	$106,000
ACE for moderate HTN	$82,600
Mammography (>50 yo)	$20-50,000
HCTZ for moderate HTN	$23,500
Left main CABG	$17,400
Treatment A	$10,000
Smoking cessation (men)	$1,300

What is the budget constraint of the health plan or Institution?

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Health Economics Summary

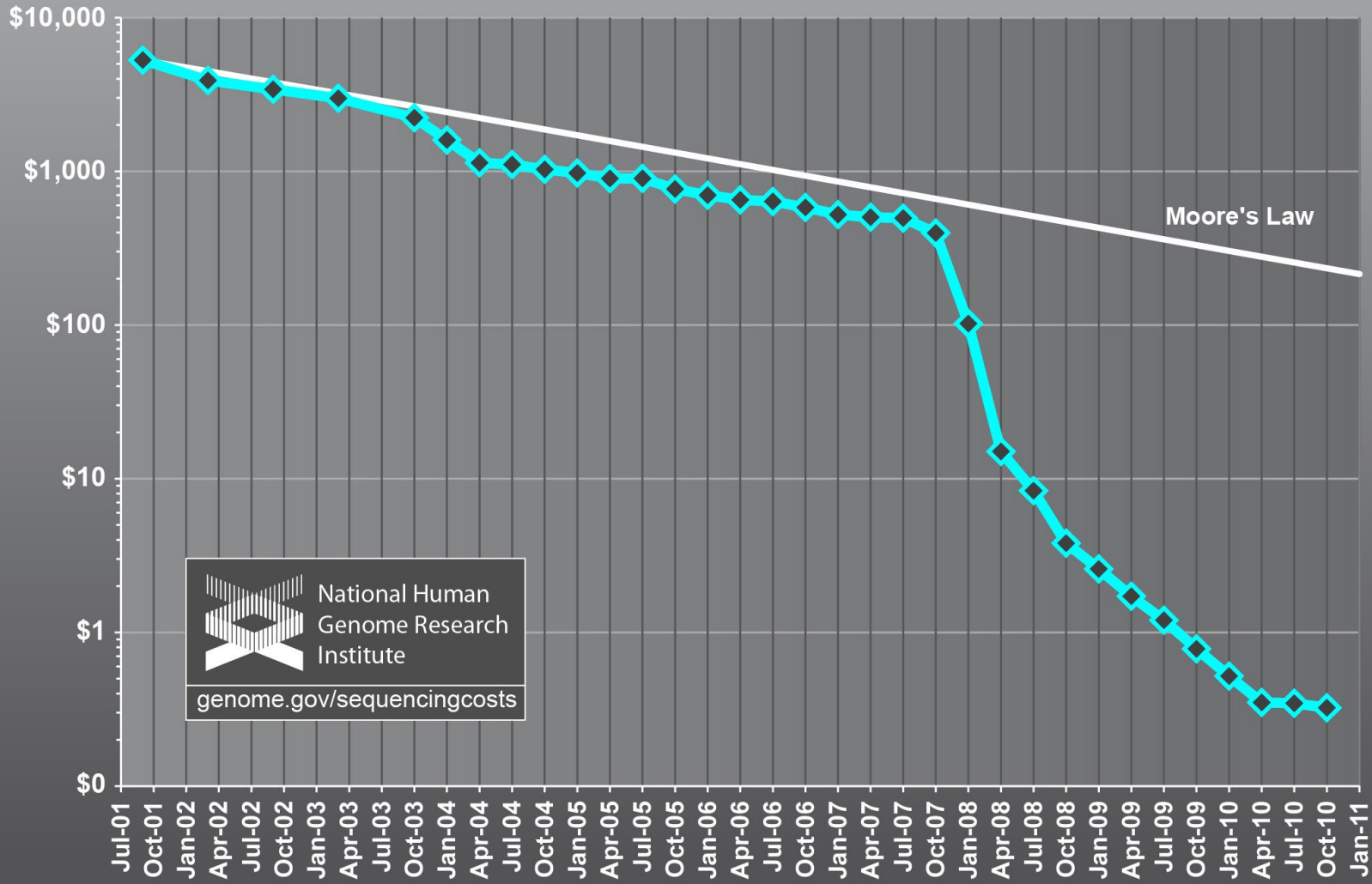
- Helping people to understand what's at stake – what's the decision
- Careful CEA is about analyzing decisions
  - Clarify assumptions
  - Evaluate uncertainties
  - Not primarily about costs, but about trade-offs

Simple Misconceptions

1. ‘Cost-effective’ = ‘Cost-saving’
2. Expensive interventions are not cost-effective.
3. Inexpensive interventions are cost-effective.

II. Is Genome Sequencing Cost Effective?

Cost per Megabase of DNA Sequence



Is NextGen Sequencing Cost Effective?

- It's not about the cost, as much as …

  what is the outcome being measured?

  - base pairs sequenced
  - number of variants identified
  - diagnoses
  - clinical actions
  - patient outcomes – morbidity and mortality

- … and what is the comparator?

Cost-effectiveness framework

TABLE 36.1 Factors that influence the cost-effectiveness of genomic testing strategies

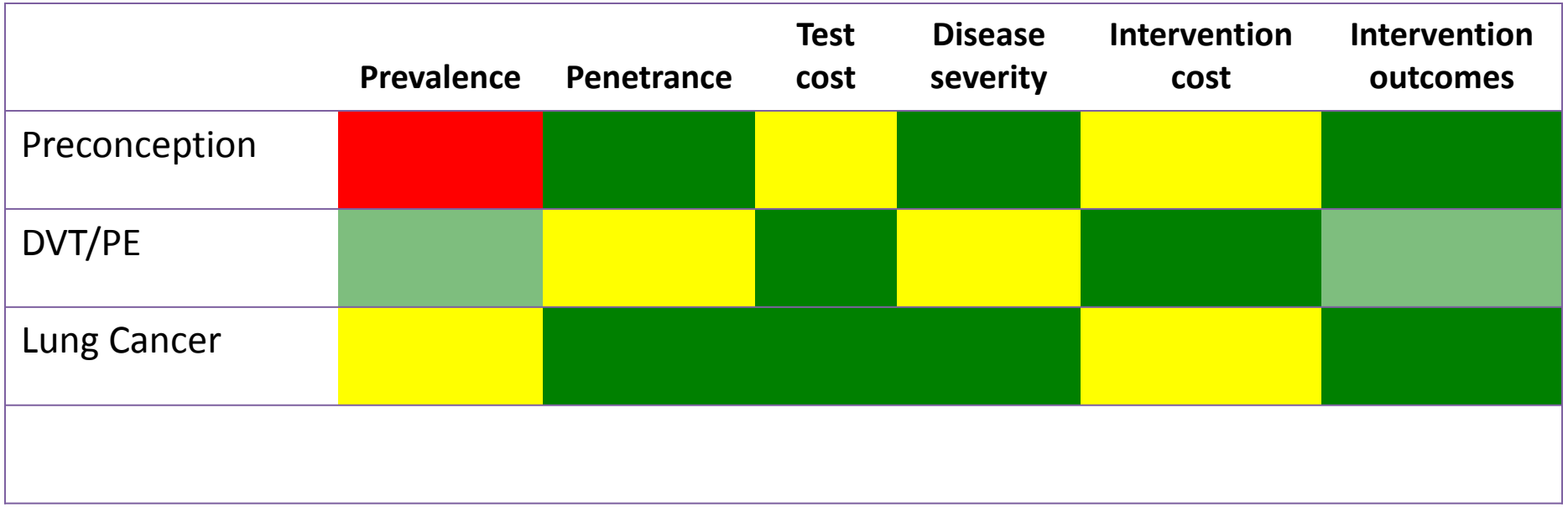
	Factors to assess	Features that favor cost-effectiveness
Gene	Prevalence Penetrance	• Variant allele is relatively common • Gene penetrance is high
Test	Sensitivity, specificity, cost	• High specificity and sensitivity • A rapid and relatively inexpensive assay is available
Disease	Prevalence	• High disease prevalence in the population
	Outcomes and economic impacts	• High untreated mortality • Significant impact on quality of life • High costs of disease management using conventional methods
Treatment	Outcomes and economic impacts	• Reduction in adverse effects that significantly impact quality of life or survival • Significant improvement in quality of life or survival due to differential treatment effects • Monitoring of drug response is currently not practiced or difficult • No or limited incremental cost of treatment with pharmacogenomic strategy

Adapted from Flowers and Veenstra (2004).

Scenarios for Discussion

- 3 points in lifetime
  - preconception care
  - pulmonary embolism
  - lung cancer
- 3 types of Care
  - targeted sequencing
  - WGS but targeted return + high effect IFs
  - WGS with full disclosure

A WGS ‘Value Chip’?



III. Three Challenges

1. Incentives for test development
   - Private vs. public role
2. Evidence-based policy
   - Evidence thresholds
   - Measuring personal utility
3. Impact on healthcare system
   - Behavior of patients and providers
   - Healthcare systems
   - Health insurance

Challenge 1 – Test Development

- At what point in decreasing sequencing cost are incentives for test development a problem?
- Does provision of clinical interpretation become the value proposition?
- Are reimbursement systems designed to reward this?
  - Value-based payment policies

Ramsey,…Billings, et al, Am J Managed Care 2006

Challenge 2 – Policy Development: Personal Utility

- Does the 'value of knowing' to an individual matter?
  - to whom?
- Patient-centered outcome
- How do we measure it?
  - Conjoint analysis, aka
  - Discrete Choice Experiments (DCE)

Regier et al, Clin Gen 2009; Grosse et al, Gen Med 2008

Challenge 2 – Policy Development: Evidence thresholds

- Does a lower cost of obtaining information lead to lower evidence threshold for using that information?
- Value of Information (VOI) analysis may provide a framework for 'evidence-based' decision making in an environment of very limited evidence

Thariani et al, Mol Oncol 2012

Challenge 3 – Healthcare Impacts

- How will patients respond? Providers?
  - Need for comparative studies
- Healthcare system response?
  - Investment in services
  - Pathways of care
- Insurance
  - What will be covered?
  - What won't GINA solve?

IV. Comparative Effectiveness Research (CER)

The NEW ENGLAND JOURNAL of MEDICINE

Perspective

MAY 7, 2009

Does Comparative-Effectiveness Research Threaten Personalized Medicine?

Alan M. Garber, M.D., Ph.D., and Sean R. Tunis, M.D.

What's unique about CER? It includes all of the following

- Stakeholder-informed prioritization and design of studies
- Direct, head-to-head comparisons
- A broad range of beneficiaries:
  - patients, clinicians, purchasers, and policy makers.
- Study populations representative of clinical practice
- Focus on patient-centered decision-making
  - tailor the test or treatment to the specific characteristics of the patient.

Patient-Centered Outcomes Research Institute (PCORI): Recent RFA

- Studies that investigate the key determinants of the outcomes patients experience following treatment decisions…
- Special emphasis is placed on studies … considering … that results may differ among patient groups based on patient characteristics
- Studies that compare the use of prognostication/risk-stratification tools with usual clinical approaches

Summary

- The intersection between genome sequencing and health economics is multifaceted and dynamic
- It's not about costs (only)
- Health economics can provide a variety of tools and frameworks to help guide implementation of genome sequencing in clinical practice

Thank You