DEPARTMENT OF GLOBAL HEALTH

UNIVERSITY of WASHINGTON

Introduction to Economic Evaluation in Healthcare

UW Medicine
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We all are (applied) economists!

- We evaluate costs and effects everyday
- We prioritize our choices
- We make resource allocation decisions with limited budgets

Comparative Analysis in Real Life

Economic Perspective on Health and Medical Care Production

- Health care production is complex: economists think of it as a "Health Production Function."
  - General Production Function:
    - Output = f(Inputs)
  - Health Production Function:
    - Health = H(hospital stays, doctor visits, drugs, OTHER)
    - At a population level, OTHER (e.g., the social determinants of health, such as diet, lifestyle, income, etc., are important)

- Individuals trade off health versus other economic goods.
  - The physician acts as the "patient's agent" in organizing and advising on this process.
  - The demand for medical care is "derived demand" from the demand for health.

Economics vs. Health Economics

- Economics is the study of how societies allocate their inherently scarce resources to satisfy the demands of their citizens.
- Health economics focuses on how these scarce resources are allocated to produce health and well-being, and, in particular, the roles that medical care and health insurance play.
- Economics posits that private markets are generally an "efficient" mechanism for allocating resources, maximizing the benefits received from the limited resources.
- However, in the case of health care markets, a number of special circumstances occur that require special interventions and adaptations to improve efficiency.

What is unique about the economics of health care?

- Healthcare markets have special features—very different from markets for other products
- The main difference is the pervasiveness of uncertainty
  - **In terms of what works and doesn't work**
  - **The demand for services difficult to predict**
- Another key difference is "Informational asymmetry" between providers and patients and between insurers and subscribers

Ken. Arrow, Uncertainty and the Welfare Economics of Medical Care. American Economic Review, 1963

Special adaptations of healthcare markets?

- Interventions and institutions have arisen in response to this uncertainty:
  - **Insurance and its regulation**
  - **Provider licensure**
  - **Drug and device regulation**
  - **Subsidized education**
  - **Health technology assessment**

Ken. Arrow, Uncertainty and the Welfare Economics of Medical Care. American Economic Review, 1963

Defining Economic Evaluation

- **Comparison** of two or more alternative health interventions, treatments, or programs in terms of their **costs** and **effectiveness**—with effectiveness measured in the same units
- Costs refer to the value of resources involved in providing a treatment or intervention
- Consequences (health outcomes) are the health effects of the intervention

Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL, . Methods for the Economic Evaluation of Health Care Programmes (Oxford University Press, 2005)

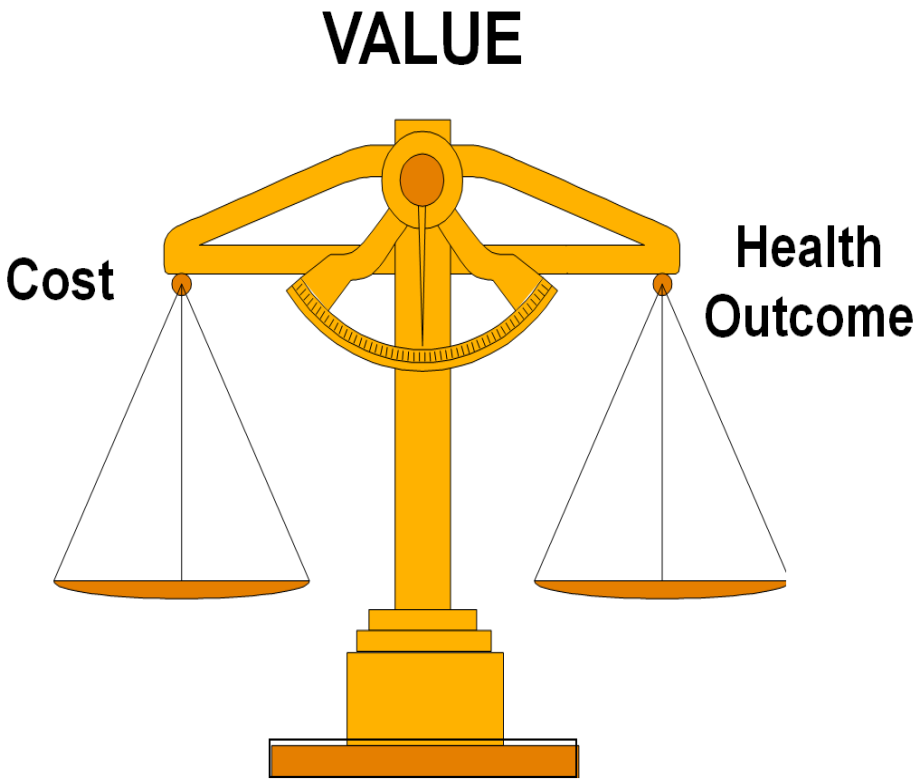
The Importance of Defining a Comparator

- Analysts need to define a comparator or "base case" and define both policy and specific interventions as changes from the base case
- For specific interventions e.g. clinical procedures, the natural base case is the status quo or standard of care
- The base case is less obvious for policy interventions
- Probably best to define policy base cases that are close to the current reality for policy makers—incremental CEAs from these bases provide more interpretable information
- Sometimes it is important to consider the impact of doing less than is being done in the base case thereby generating negative costs and effects.
  - **Such negative intervention may prove to be highly cost-effective**

Comparative Analysis in Healthcare

- Assuming **two** health interventions for comparison in an health economic evaluation
  - **Intervention A is the existing intervention**
  - **Intervention B is the new or novel intervention**
- As an analyst, you would like to compare the value of intervention B (the new intervention) to intervention A (the old intervention)
  - **The comparative analysis considers the costs and health outcomes (effectiveness) of A and B**
  - **Gold standard of effectiveness measures is quality-adjusted life-year (QALY) or disability-adjusted life-year (DALY), both measure that combine length and quality of life**
    - Cost per DALY averted
    - Cost per QALY gained

Trade-offs and Balance



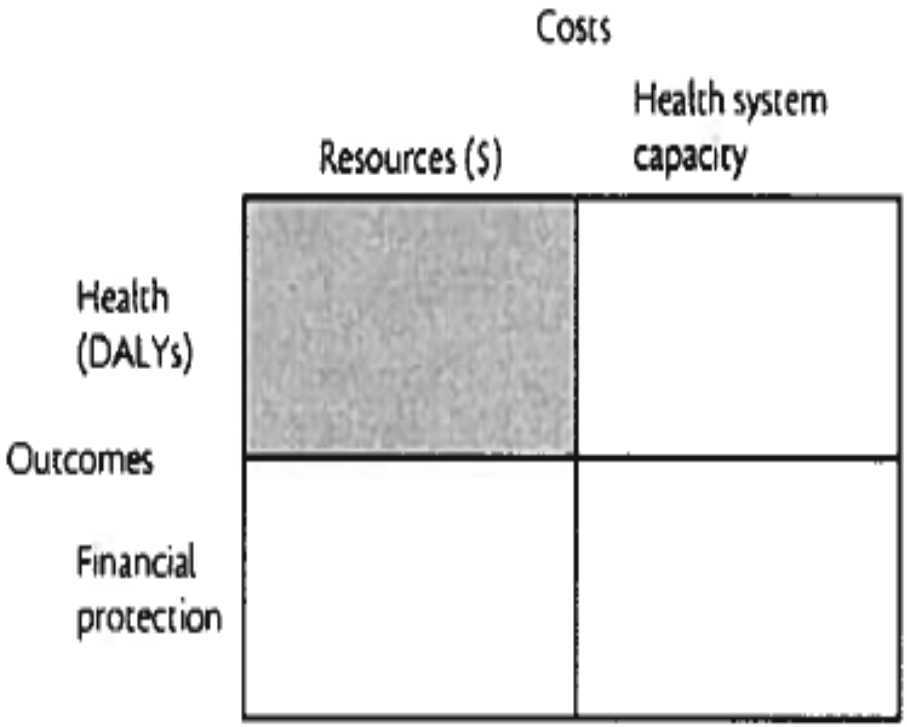
Resources for Healthcare

- Monetary resources i.e., $, ¥, €, £, etc.
- Health system capacity e.g. human resources, infrastructure, etc.
- To implement an intervention, the system uses some of each resource
  - **Some interventions need more of one or the other**
- In poor countries with low health system capacity, it is important to select interventions that require relatively little health system capacity

Jamison, Dean T. "Cost effectiveness analysis: concepts and applications." In R. Detels, J. McEwen, R. Beaglehole, H. Tanaka (eds.) Oxford Textbook of Public Health: Volume 2, The Methods of Public Health, Fifth edition. Oxford: Oxford University Press, 2009. Pp. 767-782.

Intervention Costs and Effects

Adapted from Jamison (2009)



Shaded box represents the traditional domain of **Value Assessment** in healthcare which do not include Financial Risk Protection and Health System Capacity in their calculations

Rationale for Economic Evaluation in Healthcare

- Information on efficacy and effectiveness is necessary but not sufficient for making healthcare decisions
  - **It is also necessary to consider the opportunity costs (benefits forgone) of alternative courses of action**
- Healthcare does not have a typical market where supply and demand are brought together using a price mechanism
  - **Governments intervene (to different extents) to deliver and finance healthcare**
- Given scarce resources and the absence of a price signal, policy makers need a means to allocate resources between competing demands
  - **Explicit consideration of the opportunity cost of alternative courses of action is necessary**

Uses of Economic Evaluation in Healthcare

- To guide decision makers (usually public sector) on whether/when to change intervention mix or whether/when to change intervention coverage levels.
  - **Often the questions asked pertain to specific health problems.**
- To inform health policy.
  - **Health policy can be defined as the "decisions, plans, and actions that are undertaken to achieve specific health care goals within a society. [WHO]**
- To generate cost-effectiveness generalizations to support or undermine broad generalizations in healthcare policy options.

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Use of Economic Evaluations by Policy Makers

- Policy makers need evidence
  - **They don't do stuff because of divine intervention but because evidence was generated and synthesized**
- Estimates of costs, effectiveness and cost-effectiveness provide clear guidance to policy-makers when:
  - **The effectiveness target is clear and the economic evaluation seeks to minimize the expenditure needed to achieve the target**
  - **The budget constraint is clear and the aim is to maximize health benefits within the given budget**
  - **The acceptable threshold cost-effectiveness is clear and explicitly stated**

Value for Money in Healthcare is Important in Rich and Poor Countries

- Poor countries spend very little annually per capita on health and achieve poor outcomes
  - **With a high burden of treatable and preventable diseases, a few extra dollars, used without formal assessment of value i.e. misspent, would mean a lost opportunity to postpone many deaths and prevent substantial disability.**
- Rich countries spend large amounts annually per capita on health and achieve good outcomes.
  - **With the high (and rising) cost of healthcare, an improved intervention mix might reduce healthcare spending (or at least reduce the rate of growth of healthcare spending).**
  - **Many new and expensive interventions are approved every year; which of these should payers reimburse?**

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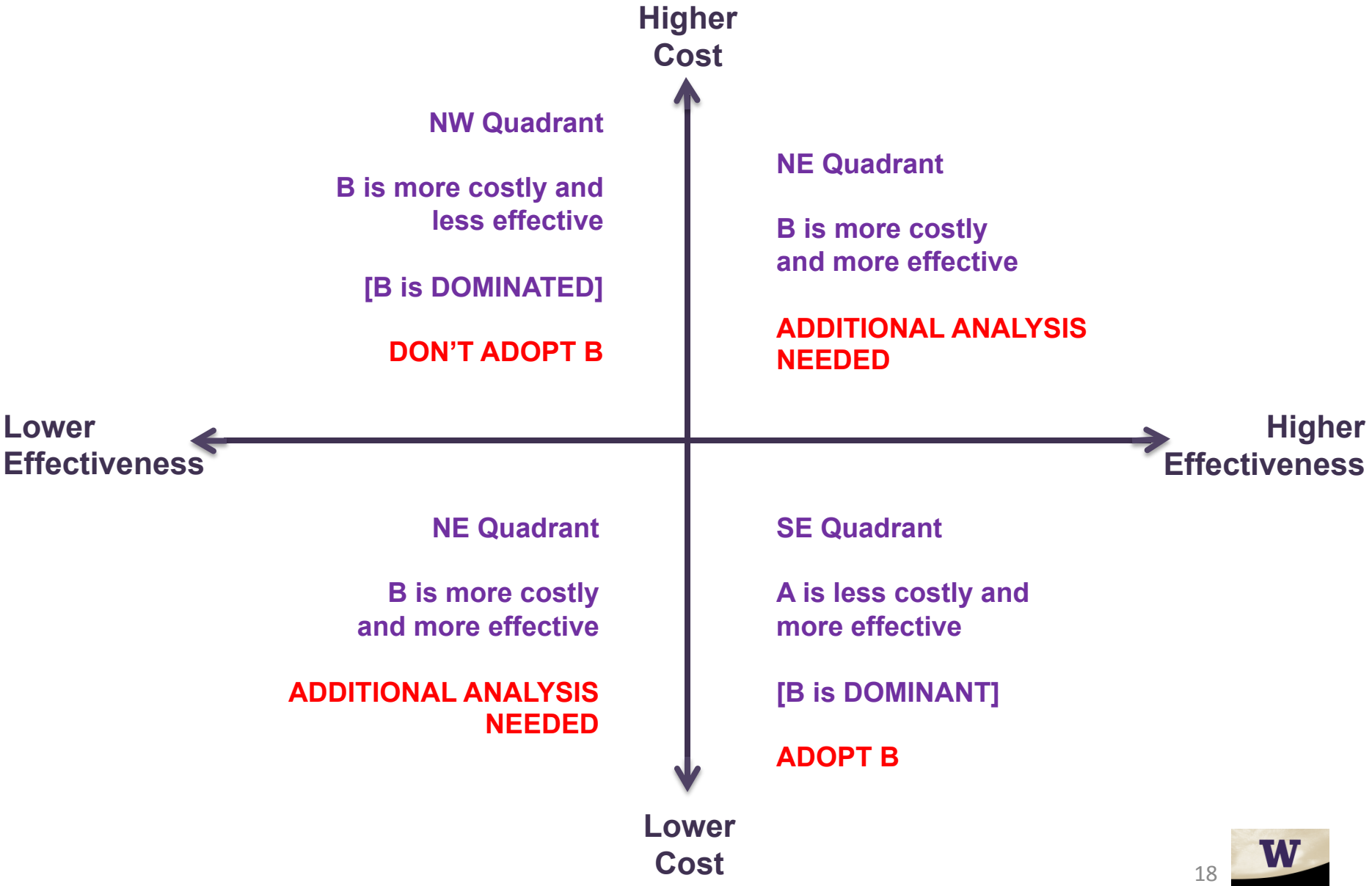
Comparing A and B: The Cost-Effectiveness Plane



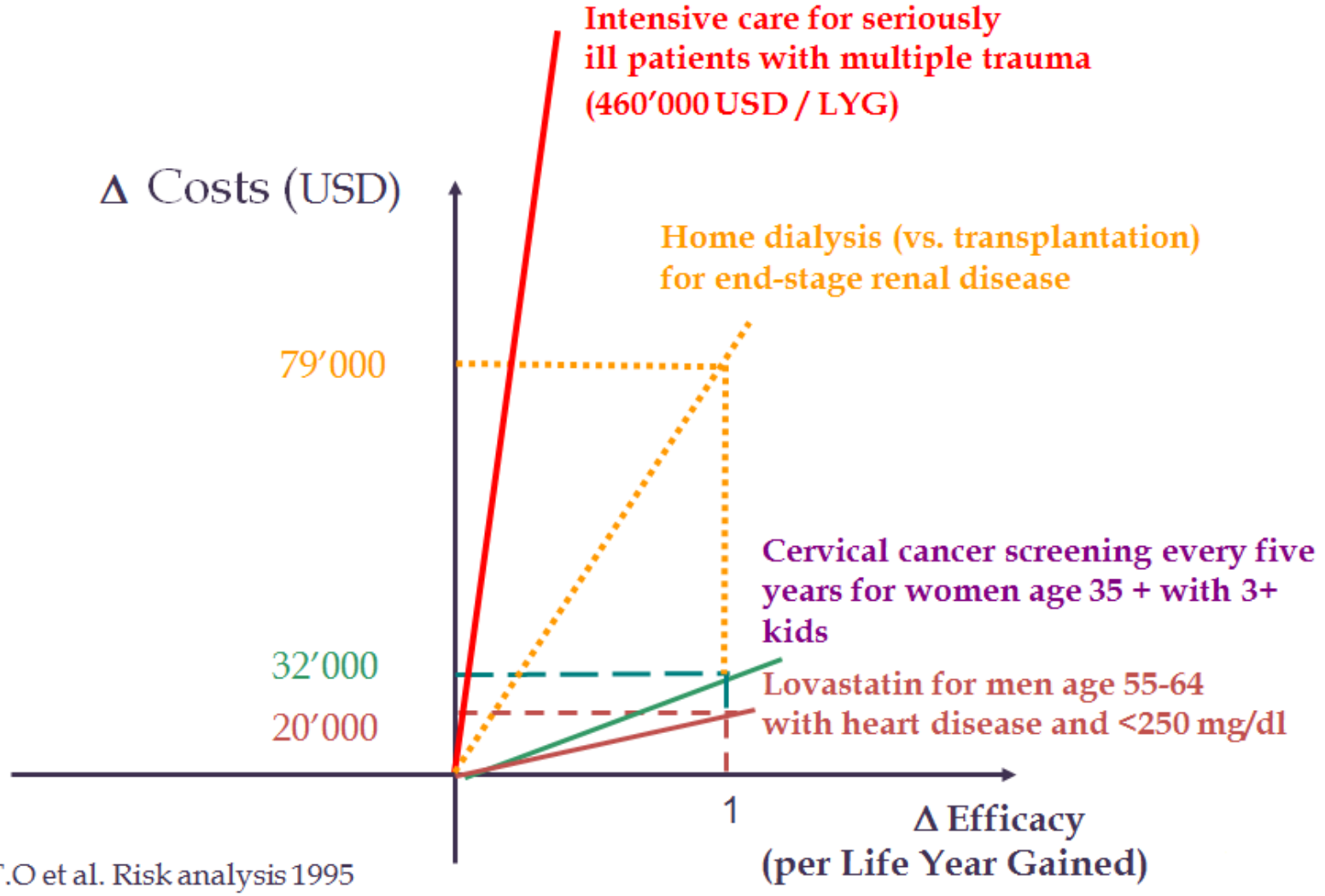
NE Quadrant — The ICER

- Intervention B is both more costly and more effective than intervention A
- This situation is the most common
  - **Innovative technologies tend to increase effectiveness relative to standard of care at an added cost (a premium on innovation)**

$$\text{ICER} = \text{Mean Cost}\,(\text{B}) - \text{Mean Cost}\,(\text{A}) / \text{Mean Outcome}\,(\text{B}) - \text{Mean Outcome}\,(\text{A})$$

- Costs are always measured and presented in currency units ($, £, €, UGX, etc.)
- Outcomes are measured in a variety of ways but must be in the same units for comparators A and B

Some Examples of ICERs



Tengs T.O et al. Risk analysis 1995

ICERs and Cost-Effectiveness

- Three approaches to determine if an ICER ($/DALY averted or $/QALY saved) represents value for money in a given society
  - **Thresholds**
  - **Benchmark interventions**
  - **League tables**

Thresholds

- Most common threshold in LMICs is GDP-based
  - **Highly cost-effective — ICER < GDP per capita**
  - **Cost-effective — ICER between GDP per capita and 3 X GDP per capita**
- Limitations of GDP-based threshold
  - **Obscures important comparisons**
  - **Thresholds are easily attained**
  - **Based on untested assumptions and no empirical data**
  - **Affordability not adequately appraised**
- High-income country thresholds vary but tend to be higher
  - **UK (NICE) — £20,000 to £30,000 per QALY**
    - Recent study suggests that this is too high and that £13,000/ QALY is more accurate (£13,000 of NHS resources adds one QALY to the lives of NHS patients)
  - **US — $50,000 to $200,000 per QALY**

Benchmark Interventions

- Citation of the cost-effectiveness of a benchmark intervention that has already been adopted
  - **Example is dialysis as the basis of (traditional) $50,000 per QALY in the US**
- Suggests that willingness to pay has already been decided
- Therefore overall health benefits will increase by transferring funds from interventions that cost more to interventions that cost less than benchmark
- Approach exhibits better local relevance
- Limitations of benchmark interventions
  - **ICER for benchmark may be a high or low outlier**
  - **Benchmarks don't take affordability into account**
  - **There might be available options that have a better ICER than either the benchmark intervention or the intervention under evaluation**

League Tables

- With league table approach, no need for thresholds; all interventions that have potential for scale are ranked in league table according to ICERs
- Assumes that health outcomes are maximized if implementation starts with interventions with the smallest ICER (at top of league table)
- Different kinds of league tables, big and small
  - **WHO league tables**
  - **TUFTs CEA registry**
- Limitation of league tables
  - **ICERs may not be available for many relevant options or settings**
- Advantages of league tables
  - **Consider affordability**
  - **need not be comprehensive to support improved resource allocation**
    - Can indicate benefit of cancelling some programs and funding new ones

League Table Example

Marseille et al. (Bull World Health Organ 2015)

Table 1. **A cost–effectiveness league table for malaria interventions: Africa D region**[a]

Intervention (description)	Annual cost (million I$) per million people	Annual no. of DALYs averted per million people	Incremental no. of DALYs averted per million people	Incremental cost	
				Million I$ per million people	I$ per DALY averted
MAL-27 (case management with ACT, 80% coverage)[b]	0.25	26 426	26 426	0.25	9
MAL-7 (MAL-27 but 95% coverage)	0.33	31 470	5 044	0.08	16
MAL-17 (combination of ACT, IPTP and ITNs, 95% coverage)	1.07	44 115	12 645	0.74	59
MAL-20 (MAL-17 plus IRS)	1.59	49 518	5 403	0.52	96

ACT: artemisinin-based combination therapy; DALY: disability-adjusted life-year; I$: international dollars; IPTP: intermittent preventive therapy for pregnant women; IRS: indoor residual spraying; ITNs: insecticide-treated nets.

[a] A list of countries in the Africa D region is available from: http://www.who.int/choice/demography/african_region.

[b] The costs and DALYs averted by MAL-27 were compared with no intervention. Each of the other three options was compared with the next cheapest intervention, i.e. the intervention in the row above.

Data source: World Health Organization.[6]

SW Quadrant — The "Decremental" CER (DCER)

- In theory, limited benefits could be sacrificed for substantial resource savings, permitting reallocation of resources to higher-value alternative
- In the SW quandrant, the CER is a measure of savings per outcome loss
  - **A higher DCER is better**
- Decrementally cost-effective innovations have potential for maximizing health benefits while minimizing costs.
  - **May be especially attractive in poor countries**
- Examples in the literature
  - **Watchful waiting in inguinal hernia (Stroupe et al, 2006)—DCER=$194,300/QALY**
  - **Percutaneous coronary intervention for multi-vessel coronary artery disease (Weintraub et al, 2004)—DCER=$3,210,000/QALY**
  - **Pharmacy refill compared to physician follow-up for HIV care (Babigumira et al, 2011)—DCER=$13,500/favorable immune response**

Importance of Incremental Analysis

- Classic example – the "sixth stool guaiac" (Neuhauser and Lewicki, 1975)
- In mid-1970s, when colon cancer was suspected, each stool sample was tested 6 times
  - **Test 1 part of the sample and if positive, do additional tests**
  - **If negative, test 2nd part of sample and if positive, do additional tests**
  - **On up to 6th part of sample to declare individual negative**

Average Analysis — Average CE Ratio (ACER)

Cases of colon cancer detected per 10,000 population with six sequential tests

No. of tests	Total cases detected	Total costs	Calculation	ACER
1	65.0465	$77,511	$77,511/65.0456	$1,192
2	71.4424	$107,690	$107,690/71.4424	$1,507
3	71.9003	$130,199	$130,199/71.9003	$1,811
4	71.9385	$148,116	$148,116/71.9385	$2,059
5	71.9417	$163,141	$163,141/71.9417	$2,268
6	71.9420	$176,331	$176,331/71.9420	$2,451

Incremental Analysis — Incremental CE Ratio (ICER)

Incremental cases detected and incremental costs with six sequential tests

No. of tests	Total cases detected	Inc. cases	Costs	Inc. costs	ICER
1	65.0465		$77,511		
2	71.4424	6.3959	$107,690	$30,179	$4,718
3	71.9003	0.4579	$130,199	$22,509	$49,157
4	71.9385	0.0382	$148,116	$17,917	$469,031
5	71.9417	0.0032	$163,141	$15,025	$4,695,313
6	71.9420	0.0003	$176,331	$13,190	$43,966,667

Types of (Full) Economic Evaluations

Method of Analysis	Cost Measurement	Outcome Measurement
Cost-Consequences Analysis	$	Multi-dimensional listing of outcomes
Cost-Minimization Analysis	$	Equivalence demonstrated or assumed in comparative groups
Cost-Effectiveness Analysis	$	Single “natural” unit outcome measure
Cost-Utility Analysis	$	Multiple outcomes—life-years adjusted for quality-of-life
Cost-benefit Analysis	$	$

Thanks very much

- babijo@uw.edu (Joseph)
- lgarisn@uw.edu (Lou)