

Cost-Effectiveness

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Efficacy vs. Effectiveness

- Efficacy –can it work?
“the extent to which interventions achieve health improvements under ideal circumstances”
- Effectiveness—does it work in the real world?
“the extent to which interventions achieve health improvements in real practice settings”
- Cost-Effectiveness – are improvements worth the additional cost?

Types of Cost Comparisons

Method	Interventions With	Measure	Summary Measure
Cost-Benefit Analysis	Outcomes in different units (health and non)	Dollars	Cost/benefit ratio Or net benefit
Cost-Effectiveness	Common Outcomes	Health in common units	Incremental CE ratio; cost/case averted
Cost-Utility Analysis	Morbidity or mortality outcomes	Quality adjusted life years (QALY)	Cost/QALY
Comparative Effectiveness (ACA)	Common Outcomes	Health in common units	Outcome difference (no cost)

Outline

- I. Why Use Cost-Effectiveness Analysis?
- II. CEA Methods
- III. Outcomes
- IV. Costs
- V. Summary

I. Why Is Cost/Effectiveness Analysis Used?

- Evaluating new treatment or policy
 - How much additional benefit does the new policy bring?
 - Is it worth the added cost?
- Allocating budget over set of projects
 - Which set of projects brings greatest benefit for a given budget?

Why Is This Important?

- Need to consider benefits and costs of new interventions, procedures
 - Not just cost minimization, also consider gains
- Government has budget constraint
 - Allocate spending to get the greatest benefit for given spending
 - Be conscious of trade-off. Spending on one program reduces budget for others
- Document your effect
- Useful tool to advise policy makers

II. How

Always compare one alternative to another, even the status quo

Compare $\frac{C_1}{O_1}$ to $\frac{C_2}{O_2}$

OR

$$\text{CER} = \frac{C_1 - C_2}{O_1 - O_2}$$

What is the added cost to get an additional unit of outcome (e.g., an averted infection)?

Identify Alternatives

- “Next best” option is relevant comparison
 - Either usual care (status quo)
 - Or another widely accepted treatment
 - Yet, most drug studies compare to placebo
- Misleading to compare to an inferior alternative or no intervention at all
- Determine costs/outcomes for each alternative

III. What is an Outcome?

- CEA Measures Outcomes Directly
 - Identification
 - HIV infections
 - Hospitalization, death
- Proximate outcomes (e.g. risk acts; blood pressure) can predict long run outcomes (HIV infections; stroke)
- Proxy outcomes

Examples of HIV Detection Outcomes

- Number of tests for HIV in 6 month period
 - Administrative data
 - Some may test more than once
 - Proportion returning for test results
- Proportion of people who have gotten VCT in a 6 month period
 - Requires survey of individuals
 - Proportion who received their test results
 - Response error?

Examples of Prevention Outcomes

- Reported number of risk acts
 - Number of unprotected sex acts (anal, vaginal)
 - Number of sex partners
 - Know serostatus of sex partners?
 - Needle sharing
- Condom use or purchase
- Number of other STI
- Predicted number of new HIV infections

Predicting HIV Infection From Data on Behaviors

a is per act HIV transmission probability

$1-a$ is probability of staying uninfected if one unprotected sex with HIV+ partner

$(1-a)^u$ is monthly probability of no infection after u unprotected acts over a month, e.g. if $a=.01$ and $u=4$, $(1-.01)(1-.01)(1-.01)(1-.01) = .96$

$[1-(1-c)a]^p$ is monthly prob of no infection after p protected acts with condom efficiency of c

CEA for an HIV Prevention Intervention

	Small Group	Large Group
Group Size	10	50
Risk Acts/Month	10	10
Cost	\$600	\$600
Effect on Risk	-30%	-10%

Which Intervention is more cost-effective?

CEA for an HIV Prevention Intervention

	Small Group	Large Group
Group Size	10	50
Risk Acts/Month	10	10
Cost	\$600	\$600
Effect on Risk	-30%	-10%
Risk Acts Averted	30	50
Cost/Risk Act Averted	$600/30=\$20$	$600/50=\$12$

Choose the Large Group Intervention!!

- Keep goal in mind: reducing total risk acts
- Even though each person in large group reduces risk acts less
- The same budget can prevent 50 risk acts instead of 30—costs less/risk act averted
- If you could increase the budget so that everyone could be in small group, get more reduction

IV. What Is A Cost?

Direct Costs

- HIV test kits, lab costs, salaries, rent
- Medical prices often used instead of costs

Indirect costs --“Opportunity costs” of person who could have been doing something else

- Patient
- Staff

Over what time period?

- Discount to present value

What are costs for a prevention intervention?

An Example

Condom Distribution in L.A. Jail

Cost Calculation

- Monthly Costs of Intervention
 - Personnel \$822
 - Condoms \$ 36
 - Other \$103
 - Total Direct \$961
- Medical care costs saved/HIV infection averted (discounted)
\$ 367,121 in 2009\$

Estimating Number of New HIV Infections Averted

- Data from jails before and after condom distribution
 - # anal sex acts/month/inmate
 - % protected
 - Number of partners/inmate
 - Percentage of inmates HIV+
- Data from the literature
 - Transmission probability/sex act
 - Condom effectiveness

CEA for Condom Distribution in Jails

	Condom Distribution	Status Quo	Difference
# of new infections/mo.	.61	.82	-.21
Cost/month	\$961	0	\$961
Treatment costs (2009\$)	\$223,944	\$301,039	-\$77,095
Net costs	\$224,905	\$301,039	-\$76,134

Condom Distribution in LA Jails Is Cost-Saving

- The discounted cost of distributing condoms is lower than the medical care costs avoided because of HIV infections averted
- Monthly discounted costs saved \$76,134
- Without counting the transmission to others or value of lost lives
- Societal costs or costs to jail system?

V. Summary

- Things to Remember about outcomes
- Things to Remember about costs
- Decision Rules
- Using CEA for Policy

Things to Remember About Outcomes

- Measure outcomes directly, e.g., number of HIV tests conducted
- Predict future outcomes based on current behavior (risk acts; ARV treatment)
- Account for study design in assessing outcomes
 - RCT may not generalize
 - Cross sectional study may have selection bias
 - Cohort study needs control for secular change

Things to Remember About Costs

- Measure both direct and opportunity costs
- Important to measure all costs—
 - Control group may be more difficult
 - May need to estimate from utilization data
- Long term costs and benefits
 - Costs often occur up front; but benefits later
 - Future treatment costs may exceed prevention or screening costs
 - Discount future costs and benefits to present value
- Do not include research study costs

Decision Rules

- Cost-effectiveness is NOT cost-minimization
- If $\text{benefits} \geq \text{costs}$, DO IT!
- If $\text{costs} > \text{benefits}$
 - Consider cost-effectiveness relative to alternatives
 - Rank options like soccer standings, pick the most cost-effective
 - Money is wasted if not spent on cost-effective alternative

Rules of Thumb

- Cost-Saving if decrease in total costs with increased or constant outcomes. Do it!
- US: cost-effective if CE ratio < \$100,000
- UK and Australia CE ratio < \$50,000
- Developing countries
 - Very cost Effective if incremental cost/life year saved < annual GDP/capita
 - Cost-effective if incremental CE/life year saved < 3*annual GDP/capita

(Walensky RP et al. NEJM Oct 31,2012; 369(18):1715-25)

Use of CEA for Policy

- Measure the costs and outcomes as they are in practice (effectiveness) not efficacy
- Choose a reasonable alternative (no straw man)—incremental cost effectiveness ratio
- Time Period - Costs often high up-front, while benefits arrive slowly over time
- Check your analysis by testing sensitivity to assumptions about parameters
- CEA can help to make the case with policymakers

Additional Resources

Marthe R. Gold, et al. *Cost-Effectiveness in Health and Medicine*. New York: Oxford University Press, 1996.

<http://www.cdc.gov/owcd/EET/CostEffect2/1.html>

[http://www.popcouncil.org/horizons/projects/Global
GOALSModel.htm](http://www.popcouncil.org/horizons/projects/Global_GOALSModel.htm)

<http://www.popline.org/docs/1605/283548.html>

<http://www.treeage.com/products/download.html>

<http://www.tufts-nemc.org/cearegistry>

<http://www.academyhealth.org/hsrproj>