

Economic Analysis in Public Health

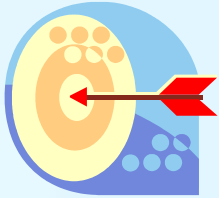
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Learning Objectives

- Describe the types of economic analyses/evaluation
- List the components of a cost-benefit analysis (CBA)
- Use results of Economic Analyses and CBA's to inform decisions about implementing public health interventions



Lesson Overview

- Concepts in economic evaluation
- Types of economic evaluation
- Components of CBA
- Economic analyses for decision-making
- Considerations for implementing interventions

CONCEPTS IN ECONOMIC EVALUATION

How Much Does it Cost to Implement an Intervention?

Here are some examples of costs and resources that may go into establishing and operating an intervention or program:

- Staff salaries and benefits
- Transportation
- Computer equipment
- Software
- Office supplies
- Building rent
- Medical supplies

Why do we use Economic Evaluation in Public Health?

- Choose the best potential intervention, given
 - Resources (inputs) are limited
 - New interventions are available
 - Now more interest in prevention than before
- Systematic way to assess costs and whether an intervention produces the desired result
- Helps decision makers assess whether the output justifies the resources used to produce it

Public Health Interventions



Assigning Value to Intangibles

Examples of Intangibles include the following:

- Health and Wellness
 - Days/Years of being healthy
 - Tasks one is able to perform while healthy
- Pain and Suffering
 - Time spent suffering from disease
 - Tasks one is unable to perform while sick
 - Premature death
 - Disability
 - Loss of a family member

Methods for Assigning Value to Intangibles

- Contingent valuation method
- Disability weights and disability adjusted life years (DALYs)
- Health utility and quality adjusted life years (QALYs)

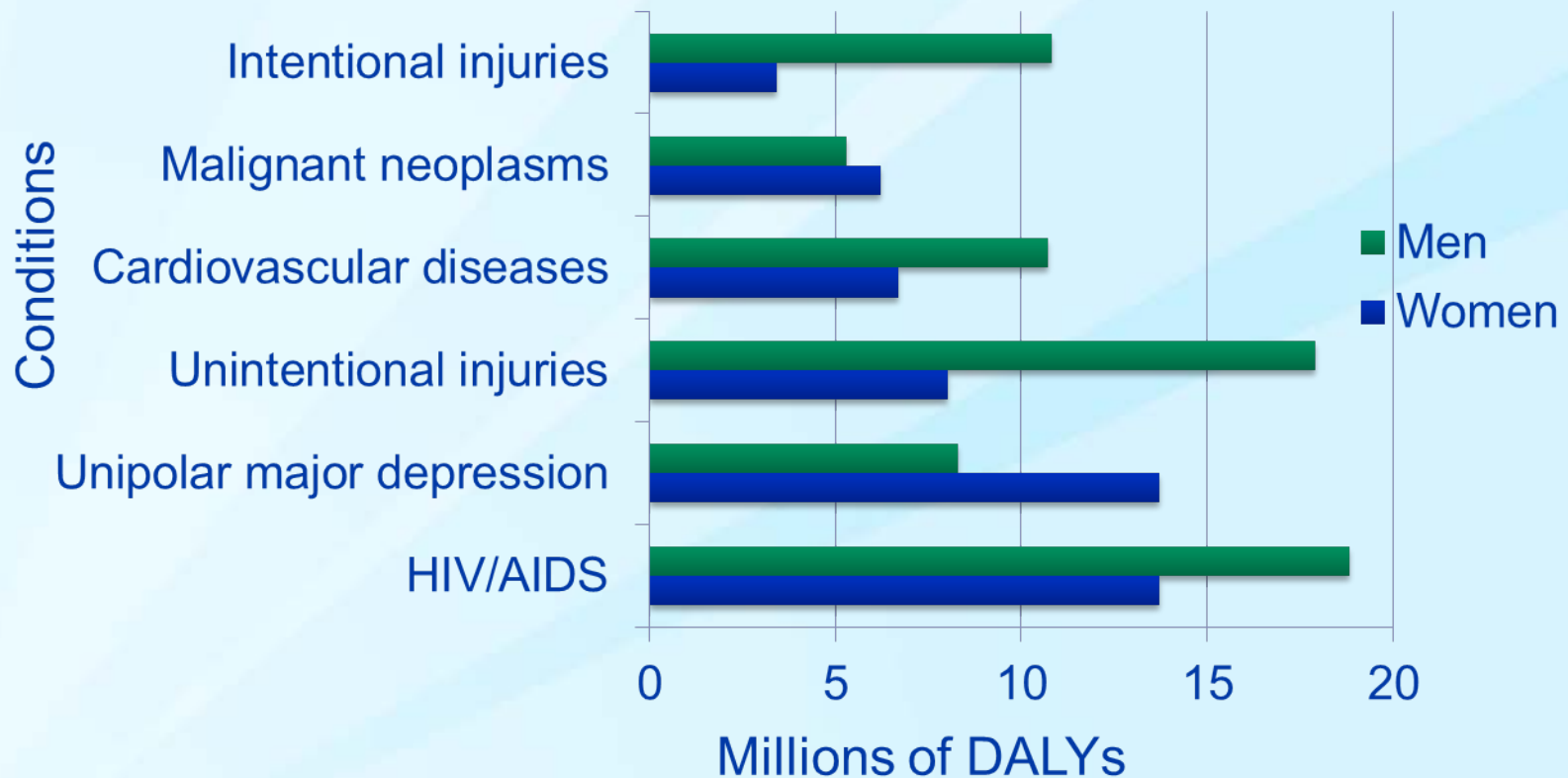
Contingent Valuation Method

- Surveys estimate individuals' maximum willingness to pay or minimum willingness to accept various intangible outcomes
 - Include hypothetical scenarios
- Only apply to the population studied
- Requires regression analysis

The Disability Adjusted Life Year (DALY)

- Measures:
 - Burden of disease and/or effectiveness of an intervention
 - “Gap” between living with disease or disability vs. living in “ideal” or reference health
- Allows for comparison of impact of a program and/or diseases across populations
- Uses disability-specific weights
- Age weighting

Worldwide Burden of Selected Conditions Among Adults Aged 30-44 Years by Sex, Measured by DALYs (2002)



https://www.who.int/healthinfo/global_burden_disease/en/index.html

Limitations of the DALY

- Global estimate of severity
 - Cannot account for subpopulation differences
- Cannot account for comorbidities
- Age weighting
 - Is it ethical or appropriate?
- Societal ‘value’ of disease changes
 - Societal value may be influenced by other factors

The Quality Adjusted Life Year (QALY)

- Measures the value of health outcomes by applying the concept of “health utility”
- Combines duration of life with quality of life into a single index
- Used to assess combinations of illnesses or life states
- Facilitates comparison of effectiveness of interventions applied in different disease areas

Limitations of the QALY

- “Subjective” preferences or utilities
 - Societal values
 - Change over time
 - Multiple domains of health
- Does not incorporate age-weighting function
 - Disease/disability affecting very young is viewed in same manner as very old

DALY vs. QALY

QALY

- Combines quality and quantity elements of health into one indicator
- Measure of health gain – number of years with full health
- Combines life years gained as a result of health interventions with a judgment about the quality of these years
- Focus is on assessing individual preference for different health outcomes that might result from a specific intervention

DALY

- Also combines information on quality and quantity of life
- Measure of health loss – number of healthy life years lost due to premature mortality or morbidity for particular diseases
- Developed primarily to compare relative burdens among different diseases and among different populations

TYPES OF ECONOMIC EVALUATION

Costs and Cost Analysis

Costs

- Measure the value of the resources required to deliver a medical service or public health intervention
 - Direct Cost – expenditures
 - Indirect Cost – opportunity costs

Cost Analysis

- The systematic collection, categorization, and analysis of costs associated with a disease or an intervention and its outcomes, to inform decisions

Cost Analysis

- How much does it cost?
 - Staff salary and benefits
 - Physical resources (building and maintenance)
 - Supplies and equipment (medical, office, computers)
- Can the cost fit in the budget?
- What other endeavors could be accomplished for that cost?

Uses of Cost Analysis

- Accountability
 - How are available resources being used?
- Assessing efficiency
 - Are outputs appropriate for the level of inputs?
- Assessing priorities
 - Examine how resource use reflects health priorities
- Assessing equity
 - Examine how health resources are distributed across the population (e.g., rural/urban expenditures per capita)

Uses of Cost Analysis (cont)

- Planning and projecting costs
 - What resources are needed to achieve public health objectives?
- Burden of disease estimation
 - What is the cost of doing nothing?
- Basis for a full economic evaluation
 - Combine with effectiveness measures

Example: Cost Analysis

- Direct cost of operating a cancer registry
- Estimate costs associated with various registry activities
- Evaluate factors that may affect the efficiency of registry operations
- As cancer registries continue to be developed in LMIC it is important to understand the resources required for their operation

Economic Analyses

- Cost-effectiveness analyses (CEA)
 - Different interventions – common health outcome
 - Health outcomes are in ‘naturally occurring’ units (costs of preventing a case or death)
- Cost-utility analyses (CUA)
 - A type of CEA
 - Different interventions – different effects on health
 - Health outcomes as quality adjusted life years (QALY)
- Cost-benefit analyses (CBA)
 - Different interventions – different effects (on health or others) in monetary terms
 - Health outcomes as monetary values

Cost-Effectiveness Analysis (CEA)

Cost of
Intervention 1

Health outcome
(e.g., number of
cases or deaths
prevented)

vs.

Cost of
Intervention 2

Health outcome
(e.g., number of
cases or deaths
prevented)

Example: CEA

- Colorectal screening for cancer detection in Asia
- Evaluated the cost-effectiveness of faecal occult blood testing (FOBT), flexible sigmoidoscopy, and colonoscopy
- Cost-effectiveness ratios compared with no screening
 - FOBT: \$6,222 per life year saved
 - Flexible sigmoidoscopy: \$8,044 per life year saved
 - Colonoscopy: \$7,211 per life year saved
- FOBT was determined to be the most cost-effective compared with flexible sigmoidoscopy and colonoscopy

Tsoi K, Ng S, Leund M, Sung J. CEA on screening for colorectal neoplasm and management of colorectal cancer in Asia. *Aliment Pharmacol Thera.* 2008;28:353-363.

Cost per Outcome is a Tool

Economic evaluations are ratios:

- Express cost of a desired outcome over that outcome

What economic evaluations are not:

- Cost to “buy” an outcome
- Cost to establish a program or intervention

Cost-Utility Analysis (CUA)

- Specific type of CEA
 - Aims to measure quality of life rather than simply the years of life gained or cases averted
- Incorporates measure of “quality” by comparing the “utility” associated with various outcomes
 - Value measured in QALYs

Example 1: CUA

- Compare QALYs among newly diagnosed diabetics using aspirin with those not using aspirin
- Aspirin users gained 0.19 QALYs over a lifetime compared with non-users
- Cost-effective ratio of \$8,801 per QALY gained
- Aspirin use determined to be cost effective by authors

Li R, Zhang P, Barker LE, Hoerger TJ. Cost-effectiveness of aspirin use among persons with newly diagnosed type 2 diabetes. *Diabetes Care*. 2010;33(6):1193-1199.

Example 2: CUA

- Compare QALYs across various cervical cancer prevention and control efforts in Thailand
- All screening strategies showed benefits (increased QALYs) due to a decreased number of women developing cervical cancer versus “no intervention”
- Combination of visual inspection with acetic acid (VIA) and pap smear is most cost-effective option in Thailand
- Compared to doing nothing, the results were:
 - 0.01 QALY gained, with a cost savings of Bt 800
- HPV vaccination not cost-effective when compared with current national policy (Bt 181,000 per QALY gained)

Praditsithikorn N, et al. Economic evaluation of policy options for prevention and control of cervical cancer in Thailand. *Pharmacoeconomics*. 2011;29(9):781-806.

Cost-Effectiveness Thresholds

What constitutes a cost-effective intervention?

- Canadian Panel
 - Interventions costing less than \$20,000 per QALY are generally considered cost-effective
- United States Panel
 - Interventions costing less than \$50,000 - \$100,000 per QALY are generally considered cost-effective
- United Kingdom Panel
 - Interventions costing less than approximately \$47,000 per QALY are generally considered cost-effective

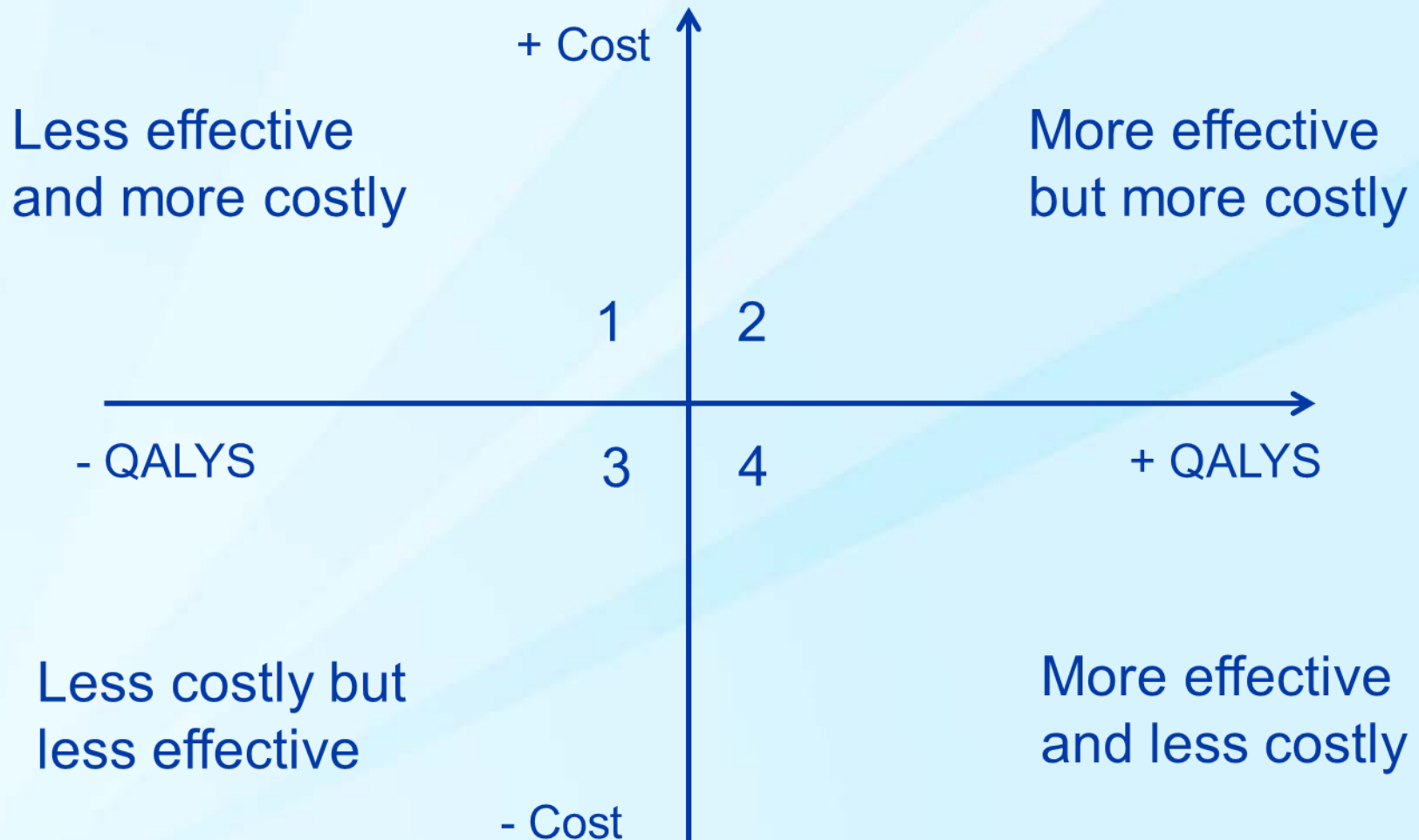
Cost-Effectiveness Thresholds (con't)

World Health Organization (WHO-CHOICE)

- Country specific Gross Domestic Product (GDP) is used as an indicator of cost-effectiveness

| Cost Effectiveness | GDP per capita |
|-----------------------|-------------------|
| Highly cost-effective | Less than 1 times |
| Cost effective | Between 1-3 times |
| Not cost-effective | More than 3 times |

Cost-Effectiveness Plane



Cost-Benefit Analysis

- Standardizes benefits and costs in monetary terms
- Provides list of all costs and benefits for specified time period
- Does not require that health outcomes be the same
- Measures
 - Benefit-cost ratio (BCR)
 - Net-present value (NPV)

Example: Cost-Benefit Analysis

- Evaluated nutrition education program effectiveness for delay or prevention of chronic diseases
 - Costs: Program operating costs
 - Benefits: Monetary value benefits (delay or avoidance of chronic disease)
- Calculated benefit-to-cost ratio (USD):

$$\frac{\textit{Total Benefit}}{\textit{Total Cost}} = \frac{\$18,223,985}{\$1,713,081} = 10.64$$

- Concluded that nutritional education is an important component of chronic disease prevention

Rajgopal R, Cox R, Lambur M, Lewis E. Cost-benefit analysis indicates the positive economic benefits of the expanded food and nutrition education program related to chronic disease prevention. *J Nutri Educ Behav.* 2002;34(1):26-37.

Q1: CEA, CUA, Or CBA?

1. A study finds that the cost of operating an intervention is \$1,000, and the benefit derived from the intervention is \$2,000.

Q2: CEA, CUA, Or CBA?

1. A study finds that the cost of operating an intervention is \$1,000, and the benefit derived from the intervention is \$2,000.
2. Two interventions are compared to assess the cost of the intervention vs. the reduction in the disease-specific mortality rate.

Q3: CEA, CUA, Or CBA?

1. A study finds that the cost of operating an intervention is \$1,000, and the benefit derived from the intervention is \$2,000.
2. Two interventions are compared to assess the cost of the intervention vs. the reduction in the disease-specific mortality rate.
3. An intervention is evaluated for the cost per QALY gained.

COMPONENTS OF CBA

I. What is Included in CBA?

Costs: Monetary values of all resources

- Cost of interventions or programs
- Cost of illness



II. What is Included in CBA?

Costs: Monetary values of all resources

- Cost of interventions or programs
- Cost of illness



Benefits: Monetary values of desirable consequences

- Direct
- Indirect
- Intangible

III. What is Included in CBA?

Costs: Monetary values of all resources

- Cost of interventions or programs
- Cost of illness

?



Benefits: Monetary values of desirable consequences

- Direct
- Indirect
- Intangible

?

Intervention outcomes

Question

1. Think of examples of health outcomes, non-health outcomes and intangible outcomes
2. Would you classify these as a cost or a benefit?



How to Interpret CBA Findings

1. Compare net-present value (NPV) of each alternative
 - Used in finance to assess long-term investments
 - The present value of all benefits over a period of time
 - High NPV is desirable
2. Compare health outcomes of each alternative
3. Determine whether each alternative meets budget constraints

Best Scenario (Easiest Decision)



Intervention

1

- + Most desirable health outcome
- + Highest NPV
- + Fits within budget



Intervention

2

- Less desirable health outcome
- Lower NPV
- May or may not fit budget

Typical Scenario

Intervention

1

- + Most desirable health outcome
- Lower NPV
- Exceeds budget

Intervention

2

- Positive but less desirable health outcome
- + Higher NPV
- Exceeds budget

ECONOMIC ANALYSIS IN DECISION MAKING

Using CBA for Decision-Making

- Who is the group affected?
- What are the programs/interventions/policies being studied?
- What is the desired outcome?
- Who will pay for it?

School-Based Health Centers (SBHC) in Cincinnati, Ohio

- Compare health care costs between children in schools with and without SBHC
 - Health care costs are a proxy for health care utilization
- Question: Does the cost of having SBHC produce a valuable increase in health care utilization among racial minorities?



Guo JJ, Wade TJ, Pan W, Keller KN. School-based health centers: cost-benefit analysis and impact on health care disparities. *Am J Public Health*. 2010;100:1617-1623.

I. Information for Decisions: SBHC

- Group affected:
- Intervention being studied:
- Desired outcome:
- Outcome measure:
- Who pays:

II. Information for Decisions: SBHC

- Group affected: **School-aged children**
- Intervention being studied: **SBHC**
- Desired outcome: **Increase in health care utilization among racial minorities**
- Outcome measure: **Health care cost per student (proxy for health care utilization)**
- Who pays: **Government-sponsored insurance**

Decision: SBHC

- Presence of SBHC's were associated with higher levels of health care costs among racial minorities
 - Total costs = \$2.0 million
 - Total benefits = \$3.4 million
 - NPV = \$1.4 million
- SBHC's could save government insurance about \$35 per student per year

Worksite Oral Health in Japan

- Compare 3 levels of a worksite oral health intervention at one company
 - Male employees classified into 4 groups

| Level | Number of dental visits |
|--------|-------------------------|
| Light | 1 dental visit |
| Medium | 2-4 dental visits |
| Heavy | 5-6 dental visits |



- Costs were direct (salary to dentist and hygienists) and indirect (time required to participate) and paid by employer
- Question: How much investment in dental care produces good dental health among employees?

Ichikashi T, Muto T, Shibuya K. Cost-benefit analysis of a worksite oral-health promotion program. *Industrial Health*. 2007;45:32-36.

I. Information for Decisions: Worksite Oral Health

- Group affected:
- Intervention being studied:
- Desired outcome:
- Outcome measure:
- Who pays:

II. Information for Decisions: Worksite Oral Health

- Group affected: **Male employees of a single company**
- Intervention being studied: **Worksite oral health program**
- Desired outcome: **Improved dental health among employees**
- Outcome measure: **Reduction in total dental care costs during project period**
- Who pays: **Employer**

Decision: Worksite Oral Health

- Results (Benefit-cost Ratio)

| | |
|--------|-------|
| Light | 2.5:1 |
| Medium | 1.5:1 |
| Heavy | 0.7:1 |

- Authors found that the intervention with the medium frequency of dental visits was cost-beneficial.

Folic Acid Fortification in the United States

- Assess costs and benefits associated with fortifying grain with folic acid
- Compare high, low, and no fortification
- Question: Does the cost of fortifying grains with folic acid produce a valuable decrease in the prevalence of congenital spina bifida and anencephaly?



Romano PS, Waitzman NJ, Scheffler RM, Pi RD. Folic acid fortification of grain. *Am J Public Health.* 1995;85:667-676.

I. Information for Decisions: Folic Acid Fortification

- Group affected:
- Intervention being studied:
- Desired outcome:
- Outcome measure:
- Who pays:

II. Information for Decisions: Folic Acid Fortification

- Group affected: **Mothers and their unborn babies**
- Intervention being studied: **Fortification of grains with folic acid**
- Desired outcome: **Reduction in neural tube defects (spina bifida and anencephaly)**
- Outcome measure: **Prevalence of spina bifida and anencephaly**
- Who pays: **Food suppliers (all consumers)**

Decision: Folic Acid Fortification

- Fortification was estimated to yield a net economic benefit of \$94 million at the low level and \$252 million at the high level
- Benefit-to-cost ratios were as follows:
 - Low = 4.3:1
 - High = 6.1:1

Perspective on Costs and Benefits

- Individual family
- Third Party Payer (Insurance)
- Society
- Others
 - Industry, Health System, Ministry of Health

CONSIDERATIONS FOR IMPLEMENTING INTERVENTIONS OF GREATEST VALUE

Economic Considerations

- Current budget
 - An intervention may be cost-effective but unaffordable
- Funding sustainability

Practical Considerations

- Capacity to implement
 - Human resources (number of skilled persons available)
 - Physical infrastructure and resources
- Time required for full implementation

Social and Political Considerations

- Acceptability of the intervention
 - Funders
 - Participants
 - Workers
- “Popularity” of alternatives being replaced
- Expected longevity of intervention

Summary

- Economic evaluation can be used to analyze how resources should be allocated to maximize public health impact
- Economic analyses can measure outcomes in terms of disease, utility, or monetary values
- CBA converts all outcomes to monetary values
- Choosing an intervention depends on who is affected, the desired health outcome, the intervention, and who pays
- Implementing an intervention has economic, practical, and social considerations

Skill Assessment

- Instructions
 - Work individually or in small groups
 - Read the scenario and answer the questions that follow
 - Be prepared to share your responses with the class
 - Estimated Time: 1 hour, 15 minutes

References

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