



Methods for Conducting Economic Evaluation for Tobacco Control and Prevention

Ketra Rice, PhD, MS

Health Economist

Office on Smoking and Health

Evaluator's Network Webinar Series
January 26, 2017

Disclaimer

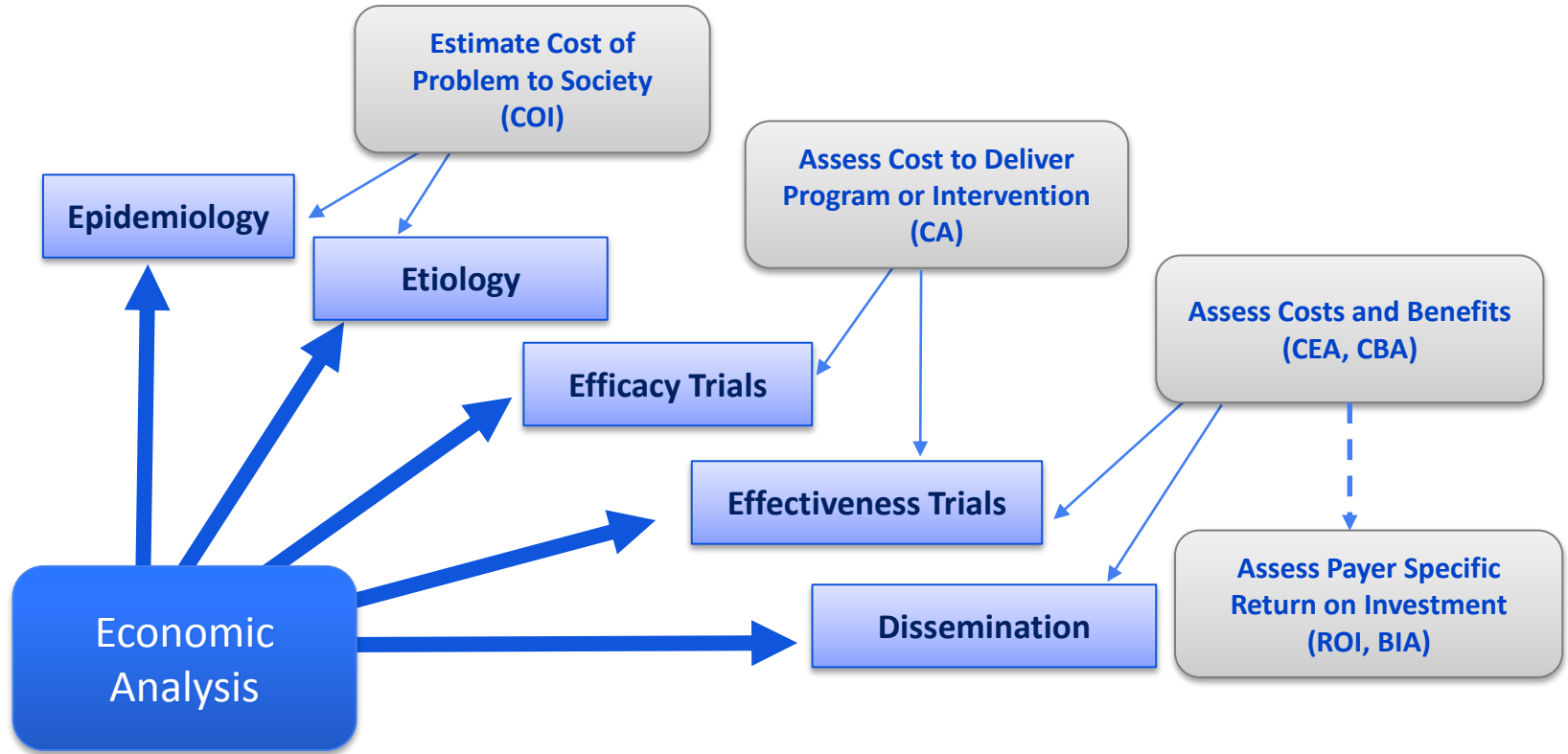
The findings and conclusions in this presentation are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

OBJECTIVES FOR TODAY

- Demonstrate the role of economic evaluation in tobacco control and prevention
- Differentiate the types of economic methods and data and understand when each method should be used given specific evaluation questions
- Provide an overview of Return on Investment (ROI) and its relationship to other economic evaluation methods
- Illustrate examples to help you become more comfortable with concepts and terms

The Role of Economic Evaluation in Tobacco Control and Prevention

Where Economic Evaluation Fits in Public Health



Source: CDC Policy Roundtable Presentation (2014) "The Real World Messiness of Evaluating Policy: How Evaluating Policies is Different (and Trickier) than Evaluating Programs!" Presented by Phaedra Corso, Director, Economic Evaluation Research Group, College of Public Health, UGA

Purpose of Economic Evaluation (EE)

- Designed to inform decision making regarding both the economic costs and (health, education, environmental) consequences of various possible actions
- However, CANNOT tell you what is the “correct” choice
- Decisions involve many issues other than “bang-for-buck”
 - Equity
 - Social justice
 - Legal responsibilities

Methods for Economic Evaluation

Methods for Economic Evaluation

Partial evaluation – costs only

- Cost analysis (CA) – program costing
- Economic impact analyses or Economic burden estimates
 - Cost of illness (COI) analysis in health

Full evaluation – costs and benefits

- Cost-effectiveness analysis (CEA)
- Cost-benefit analysis (CBA)

Other Methods

- Budget Impact Analysis (BIA)

Cost Analysis (CA)

Cost analysis is an economic evaluation technique that involves the systematic collection, categorization and analysis of program costs.

- Costs are placed in different categories based on their function and characteristics
- Involves the valuation of all resources used for the program

Questions Programs Can Answer With CA

1. What are the start-up costs for the program (i.e., costs before key program activities are initiated)?
2. How much funding is expended annually by the program?
3. What is the distribution of costs among the key program activities for the program?
4. What is the average cost per person served by the program?

How Do We Define Costs?

- Costs are the value of all resources (people, equipment, supplies, buildings, vehicles) used for the program
 - Value implies what something is worth, whether money is exchanged or not
- Cost analysis (with origins in economics) makes a distinction between explicit and implicit costs

Explicit Costs

- Direct payment for resources required to implement the program – based on market prices
- Examples:
 - Salaries for project personnel
 - Supply costs
 - Travel expenses
 - Cost of educational materials

Implicit Costs

- Measure the value of the opportunity costs because the resource is not available for its next best use
- Examples:
 - Volunteer time
 - Donated space (e.g., from a university)
- Shadow prices used when price does not reflect the actual value of a good or no market price exists to accurately reflect the value of the good.

Sources for Measuring Costs

- Primary data collection
 - Accounting and payroll systems
 - Records
 - Questionnaires
- Published sources

Steps to Conduct a Cost Analysis

1. Define the Program
2. Determine the Study Perspective
3. Define a Time Frame and Analytic Horizon
4. Evaluate Program Costs

Example Program

Consider a smoking cessation program in a free health clinic. This program primarily uses nicotine replacement to aid patients who express a desire to quit smoking. The patients are referred from health care providers and are seen on a monthly basis in the health clinic to receive medication, clinical monitoring and counseling.

1. Defining the Program

Example Program:

Consider a smoking cessation program in a free health clinic. This program primarily uses nicotine replacement to aid patients who express a desire to quit smoking. The patients are referred from health care providers and are seen on a monthly basis in the health clinic to receive medication, clinical monitoring and counseling.

- What is the nature of the program?
- What is the target population?
- What is the delivery site?
- Who are the people delivering the program?
- What types of equipment are needed?
- What are the requirements from program participants?

1. Defining the Program...answers

- What is the nature of the program?
 - Smoking cessation via pharmacotherapy
- Who is the target population?
 - Smokers referred by their health care providers
- What is the delivery site?
 - Free health clinic
- Who are the people delivering the program?
 - Nurses, Counselors, and/or physicians
- What types of equipment are needed?
 - Medication, laboratory tests and other supplies for clinical monitoring, other supplies specific to the clinic
- What are the requirements from program participants?
 - Time, transportation

2. Determine the Study Perspective

- Provider
- Payer
- Patient
- Government
- Societal

What costs would be included with each perspective?

Example Program:

Consider a smoking cessation program in a free health clinic. This program primary uses nicotine replacement to aid patients who express a desire to quit smoking. The patients are referred from health care providers and are seen on a monthly basis in the health clinic to receive medication, clinical monitoring and counseling.

Study Perspectives:

- Provider
- Payer
- Patient
- Government
- Societal

What costs would be included with each perspective?...answers

- Provider or institution
 - Physician/nurse salary, physician/nurse time, medical supplies (lab equipment and medication), administrative staff salaries and time

- Payer
 - No public or private insurers involved in this example, but govt. may be the payer since it's a free health clinic

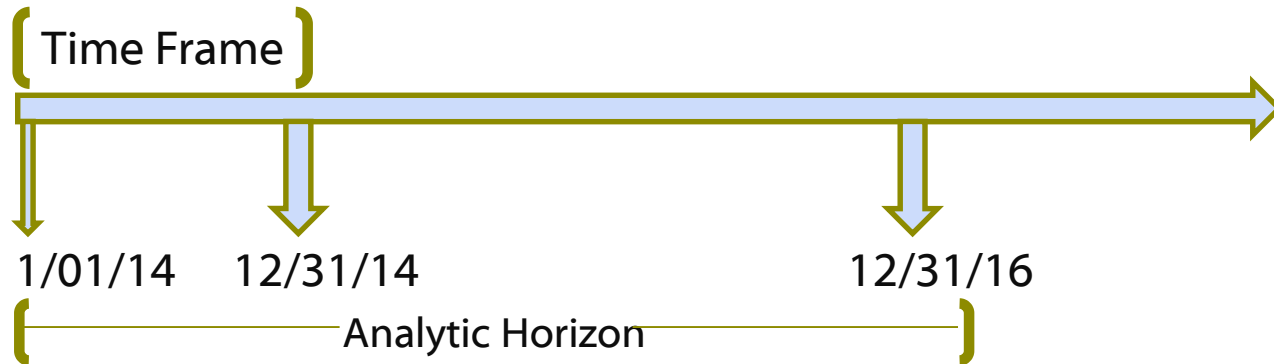
- Patient
 - Patient time (time for travel, wait time in clinic, etc.)

- Government
 - Who pays for the free clinic? State Govt., Federal Govt.?

- Societal
 - All

3. Define a Time Frame and Analytic Horizon

- Time Frame: The period of time during which the program or intervention is delivered.
- Analytic Horizon: The time period used for measuring the costs (and benefits).



4. Evaluate Program Costs

- Create a cost inventory
 - Classify costs
 - By line item
 - By activity
 - By funding source
 - Measure quantities of each resource used and assign a monetary value to resources (micro-costing method)
 - Discount when necessary

Example Cost Inventory Worksheets

WORKSHEET FOR ESTIMATING PERSONNEL COSTS - CLINIC A				
Type of Personnel	Number (A)	Average Annual Salary/Earnings (including benefits) (B)	% Time Spent on Activity (C)	Annual Cost of Personnel, in \$ (A)x (B)x (C)
<u>Salaried (List Position and associated degrees/licenses)</u>				
Ex. Senior Nurse, RN	1	\$80,000.00	50.00%	\$40,000.00
a)				
b)				\$0.00
c)				\$0.00
d)				\$0.00
e)				\$0.00
				\$0.00
Subtotal				\$0.00
<u>Hourly (List Position)</u>				
a)				\$0.00
b)				\$0.00
c)				\$0.00
d)				\$0.00
e)				\$0.00
				\$0.00
Subtotal				\$0.00
<u>Volunteers (List Position)</u>				
a)				\$0.00
b)				\$0.00
c)				\$0.00
d)				\$0.00
e)				\$0.00
				\$0.00
Subtotal				\$0.00
TOTAL COST				\$0.00

WORKSHEET FOR ESTIMATING SUPPLY COSTS - Clinic A

Supply Type	Amount	Cost per unit	Total
<u>Office Equipment and Supplies (List Separately)</u>			
Ex. Dell Laptops	2	\$1,200.00	\$2,400.00
a)			\$0.00
b)			\$0.00
c)			\$0.00
d)			\$0.00
e)			\$0.00
f)			\$0.00
g)			\$0.00
Subtotal			\$0.00
<u>Patient Printed Materials (List separately, if not included in office equipment and supplies)</u>			
Ex. Printed patient instructions	400	0.25	\$100.00
a)			\$0.00
b)			\$0.00
c)			\$0.00
d)			\$0.00
e)			\$0.00
f)			\$0.00
g)			\$0.00
			\$0.00
Subtotal			\$0.00
<u>Other supplies (List separately)</u>			
Ex. Postage	500	0.44	\$220.00
a)			\$0.00
b)			\$0.00
c)			\$0.00
d)			\$0.00
e)			\$0.00
Subtotal			\$0.00
TOTAL COST			\$0.00

WORKSHEET FOR RECORDING INTERVENTION COSTS BY RESOURCE CATEGORY				
Resource Category	(Annual \$ value) Donated/In-kind Contributions	(Annual \$) Actual Expenditures	Time Spent (% of Time on Training)	Total
START-UP COSTS				
Equipment (List Separately)			N/A	\$0.00
a)				\$0.00
b)				\$0.00
c)				\$0.00
d)				\$0.00
e)				\$0.00
f)				\$0.00
g)				\$0.00
Building/Office Space				\$0.00
Training (Initial)				\$0.00
Time/expense for establishing program (setting up partnerships, etc.)				\$0.00
Other start-up costs (List Separately)				\$0.00
a)				\$0.00
b)				\$0.00
c)				\$0.00
d)				\$0.00
e)				\$0.00
f)				\$0.00
g)				\$0.00
Subtotal				\$0.00
OPERATIONS COSTS				
Personnel (Calculated from personnel costs worksheet)	Automatically Calculated From Personnel Worksheet			\$0.00
Supplies (Calculated from supplies worksheet)	Automatically Calculated From Supply Worksheet			\$0.00
Buildings (Operation and Maintenance)			N/A	\$0.00
Training (Recurrent)				\$0.00
Other Operating Inputs				\$0.00
Subtotal				\$0.00
TOTAL				\$0.00

WORKSHEET FOR RECORDING THE VALUE OF NON-MARKET RESOURCES

Donated Resources (List Separately)	Approach to Determining Value	Value
Materials		\$
Ex. 5 HP Desktop computers	Market value @ \$400 each	\$2,000.00
a)		
b)		
c)		
d)		
e)		
f)		
g)		
Time		
Ex. Student intern @ 240 hours	Wage rate (based on age, gender, education, and years of experience)	\$16,000
a)		
b)		
c)		
d)		
e)		
f)		
g)		

Summary of Cost Analysis (CA)

- Cost analysis is the first step in economic evaluation.
- Cost analysis involves the valuation of all resources used for the program.
- The perspective of the study helps to determine which costs to include.
- A cost inventory is important to help organize costs.

CA Tools and References

State Tobacco Prevention Programs:

- CDC, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. STATE (State Tobacco Activities Tracking & Evaluation System). Available at: <http://www.cdc.gov/statesystem>
- Huang J, Walton K, Gerzoff RB, King BA, Chaloupka FJ. State Tobacco Control Program Spending—United States, 2011. *MMWR Morb Mortal Wkly Rep.* 2015 Jun 26;64(24):673-8.
- Robert Wood Johnson Foundation. *Broken Promises to Our Children: a State-by-State Look at the 1998 State Tobacco Settlement 18 Years Later.* A report on the states' allocation of the tobacco settlement dollars. Princeton, NJ: Robert Wood Johnson Foundation; 2016. Available at: http://www.tobaccofreekids.org/microsites/statereport2017/pdf/StateReport_FY2017.pdf

Cost Analysis Example in Cancer Prevention:

- Ekwueme DU, Subramanian S, Trogdon JG, Miller JW, Royalty JE, Li C, Guy GP, Crouse W, Thompson H, Gardner JG. Cost of services provided by the National Breast and Cervical Cancer Early Detection Program. *Cancer.* 2014 Aug 15;120(S16):2604-11.

Cost of Illness (COI) Analysis

Cost-of-illness analysis measures the economic burden of a disease and estimates the maximum amount that could potentially be saved or gained if a disease were to be eradicated.

- Not just illness; also injury, disability, or risk factors (e.g. cigarette smoking)

Questions Programs Can Answer With COI

1. What is the economic burden of this disease/condition on society?
 - What is the burden in my state?
 - What direct and indirect costs result from premature death, disability, and injury due to this disease/condition?
2. What are the potential benefits of a health care intervention if it can eradicate this disease/condition?

Categories of Costs in COI

- **Direct costs**
 - Medical and non-medical costs associated with the diagnosis, treatment, and rehabilitation associated with the disease or condition
- **Indirect or productivity costs**
 - Lost economic productivity of an affected person due to morbidity or mortality
 - Not to be confused with indirect or overhead accounting costs
- **Intangible costs**
 - Pain and suffering
 - Usually excluded from cost analyses

Cost Included in COI Analysis by Perspective

	Direct Costs		Indirect Costs	
Perspective	Medical	Non-Medical	Morbidity	Mortality
Payer	Covered Costs	—	—	Covered Cost
Patient	Out of pocket costs	Out of pocket costs	Lost wages/Household production	Lost wages/Household production
Businesses	Covered costs (self-insured)	—	Lost productivity (presenteeism/absenteeism)	Lost productivity
Government	Covered (Medicare, Medicaid)	Criminal justice costs	—	—
Societal	All Costs	All Costs	All Costs	All Costs

Source: Luce BR, Manning WG, Siegel JE, and Lipscomb J, Estimating Costs in Cost-Effectiveness Analysis. In: Gold MR, Siegel JE, Russell LB, et al., eds., Cost-effectiveness in Health and Medicine. New York: Oxford University Press, 1996.

Ways to Get Direct Costs

- **Directly**

- Micro-costing
 - Calculate quantities of labor time, equipment, supplies, etc.
 - Apply unit costs to calculate total costs

- **Indirectly (used for clinical services)**

- Charges
 - Hospital charges (may be 2-5 times higher than actual cost.)
 - Cost-to-charge ratios can be used to estimate average cost (costs may be underestimated because of exclusion of professional fees.)
- Fee schedule – Medicare or state-specific Medicaid
- Average payment– claims data

Cost Estimation Approaches

- **Treatment approach**

- Estimate expenditures associated with condition-specific tests, procedures, and drugs
 - Empirical approach – classify services used as disease-related or not
 - Excludes costs of complications and sequelae

- **Net cost approach**

- Difference in average expenditures
- May overstate costs because no control for confounding

- **Regression approach**

- Statistical analysis in which diagnoses are included along with other predictors of expenditures
- This controls for presence of other chronic disease and risk factors

Ways to Get Indirect Costs

- **Long-term disability and death**
 - Gross human capital approach is standard in US
 - Calculate individual output as gross earnings, including benefits and payroll taxes
 - Value of household work as the opportunity cost of hiring a replacement from the labor market
 - Net human capital approach used by forensic economists
 - Subtract value of personal consumption from earnings to estimate external loss to rest of society
- **Short-term disability easy to assess**
 - Loss of work days times daily earnings

Prevalence and Incidence-based Cost Estimates

- **Prevalence-based COI estimates**
 - How much do we spend in one year to take care of individuals with condition X?
 - Lost productivity from prevalent cases (disability) and deaths in current year due to previous exposures
 - Cannot be used to predict cost savings through prevention
- **Incidence-based COI estimates**
 - Calculate present value of lifetime costs of a newly incident case
 - Can be used as input in cost-effectiveness analysis to predict averted costs from prevention
- **Hybrid analyses**
 - Current year direct costs and present value of indirect costs

Incremental Per-Patient Costs

- **Economic calculation requires incremental cost – counterfactual to estimate benefit of prevention**
 - Simplest approach is to subtract mean costs of care for affected persons from demographically similar persons without disease
 - Important to control for comorbid conditions
 - Usually impossible to control for lifestyle, environmental, and genetic factors

Discounting Costs

- Discounting adjusts future costs and outcomes to their present value.
- Discounting allows us to calculate the present value of costs that occur in the future.
- Discounting is relevant in COI due to direct and indirect costs that may accrue past the first year.
- Standard is 3% in COI studies.

Reporting of Cost Estimates

- **Median cost**
 - Cost for “typical” affected person
 - Per person cost per year
 - Can also include interquartile range
- **Mean or average cost** (required for aggregate estimates)
 - Number of affected persons times mean cost is total aggregate cost to society
 - Can also report 95th percentile

Sources of Health Care Cost Data

- **National Surveys/Administrative Data**
 - Medical Expenditure Panel Survey (MEPS)
 - Medicare Current Beneficiary Survey (MCBS)
 - National Hospital Ambulatory Medical Care Survey (NHAMCS)
 - National Ambulatory Medical Care Survey (NAMCS)
 - Health Care Utilization Project (HCUP)
- **Claims Data**
 - Public – Medicare and Medicaid
 - Proprietary
 - MarketScan (Truven Health Analytics, Inc.)
 - Health Care Cost Institute (HCCI), non-profit – multiple insurers
 - State All Payers Claims Databases

CDC Health Care Data Sources

- **OSH Surveys**
 - National Youth Tobacco Survey (NYTS)
 - National Adult Tobacco Survey (2009-2014)
 - Global Tobacco Surveillance System
 - Global Adult Tobacco Survey (GATS)
 - Global Youth Tobacco Survey (GYTS)

- **Other CDC surveys leveraged**
 - National Health Interview Survey (NHIS)
 - National Health and Nutrition Examination Survey (NHANES)
 - Behavioral Risk Factor Surveillance System (BRFSS)
 - Youth Risk Behavior Survey (YRBS)

Health Care Data Sources: Pros

- **Hospital discharge data**
 - Covers all payers, representative of population
- **Claims data**
 - Very large numbers of observations
 - Actual expenditures, not prices
 - Detailed data on procedures, drugs, etc.

Health Care Data Sources: Cons

- **Hospital discharge data**
 - Hospital charges are crude, even with cost-to-charge ratios
 - Excludes professional fees (~20% of hospital costs on average)
 - Hospital costs are small minority of all health care costs
- **Claims data**
 - Not representative of total population
- **Survey data**
 - Useful for common, chronic conditions, not for uncommon ones

Summary of Cost-of-Illness (COI) Analysis

- A comprehensive cost-of-illness study includes both direct and indirect costs to estimate total costs incurred because of a disease or condition.
- The societal perspective is the most comprehensive.
- If the costs extend past one year, incidence-based estimates provide information about the cost of averting a case, whereas prevalence-based estimates provide a snapshot of current costs.
- COI can aid in cost-effectiveness analysis and cost-benefit analysis by providing the baseline costs of an illness without an intervention.
- A 3-percent discount rate is recommended.

COI Tools and References

- Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) - Smoking-Attributable Expenditures (SAE) . SAM estimates available at: http://www.cdc.gov/tobacco/data_statistics/oshdata/
- Xu, X, Bishop, EE, Kennedy, SM, Simpson, SA, Pechacek, TF. Annual healthcare spending attributable to cigarette smoking: an update. *Am. J. Prev. Med.* 2015; 48:326–33.
- Maciosek MV, Xu X, Butani AL, Pechacek TF. Smoking-attributable medical expenditures by age, sex, and smoking status estimated using a relative risk approach. *Preventive medicine.* 2015; 77:162-167.
- Adhikari B, Kahende J, Malarcher A, Pechacek T, Tong V. "Annual Smoking-attributable mortality, years of potential life lost, and productivity losses--United States, 2000-2004." *MMWR. Morbidity and mortality weekly report* 2008;57(45):1226–28.
- Bunn WBI, Stave GM, Downs KE, Alvir J, Dirani R. Effect of smoking status on productivity loss. *J Occup Environ Med.* 2006; 48(10):1099–1108. <http://dx.doi.org/10.1097/01.jom.0000243406.08419.74>.
- Halpern MT, Shikiar R, Rentz AM, Khan ZM. Impact of smoking status on workplace absenteeism and productivity. *Tobacco Control* 2001; 10(3):233–38.

Cost-effectiveness Analysis (CEA)

- Estimates incremental costs and outcomes of interventions
- Compares results from one or multiple interventions with other interventions (or no intervention) affecting the same outcome
- Expresses outcomes in natural health units
 - Number of cases prevented
 - Number of lives saved

Questions Programs Can Answer With CEA

1. Which of a number of alternative interventions represent the best value for the money?
 - What is the most cost-effective strategy, from various interventions, to reduce tobacco consumption?
2. What strategies/interventions are dominated by other strategies/interventions?

Measures for Cost-Effectiveness Analysis

$$\text{Cost-Effectiveness Ratio (CER)} = \frac{\text{Total Cost (C)}}{\text{Units of Effectiveness (E)}}$$

Incremental cost-effectiveness ratio (ICER)

$$= \frac{\Delta C}{\Delta E} = \frac{\text{Cost new treatment} - \text{cost current treatment}}{\text{Effect new treatment} - \text{effect current treatment}}$$

Example of CEA Ratios

Smoking Cessation Intervention

Program	Costs	Effects	C/E	$\Delta C/\Delta E$
A	110	20	$110/20 = 5.50$	
B	120	29	$120/29 = 4.14$	
C	150	50	$150/50 = 3.00$	
D	190	60	$190/60 = 3.17$	
E	240	70	$240/70 = 3.43$	

$$\text{Average Cost-Effectiveness Ratio} = \frac{\text{Cost (C)}}{\text{Units of Effectiveness (E)}}$$

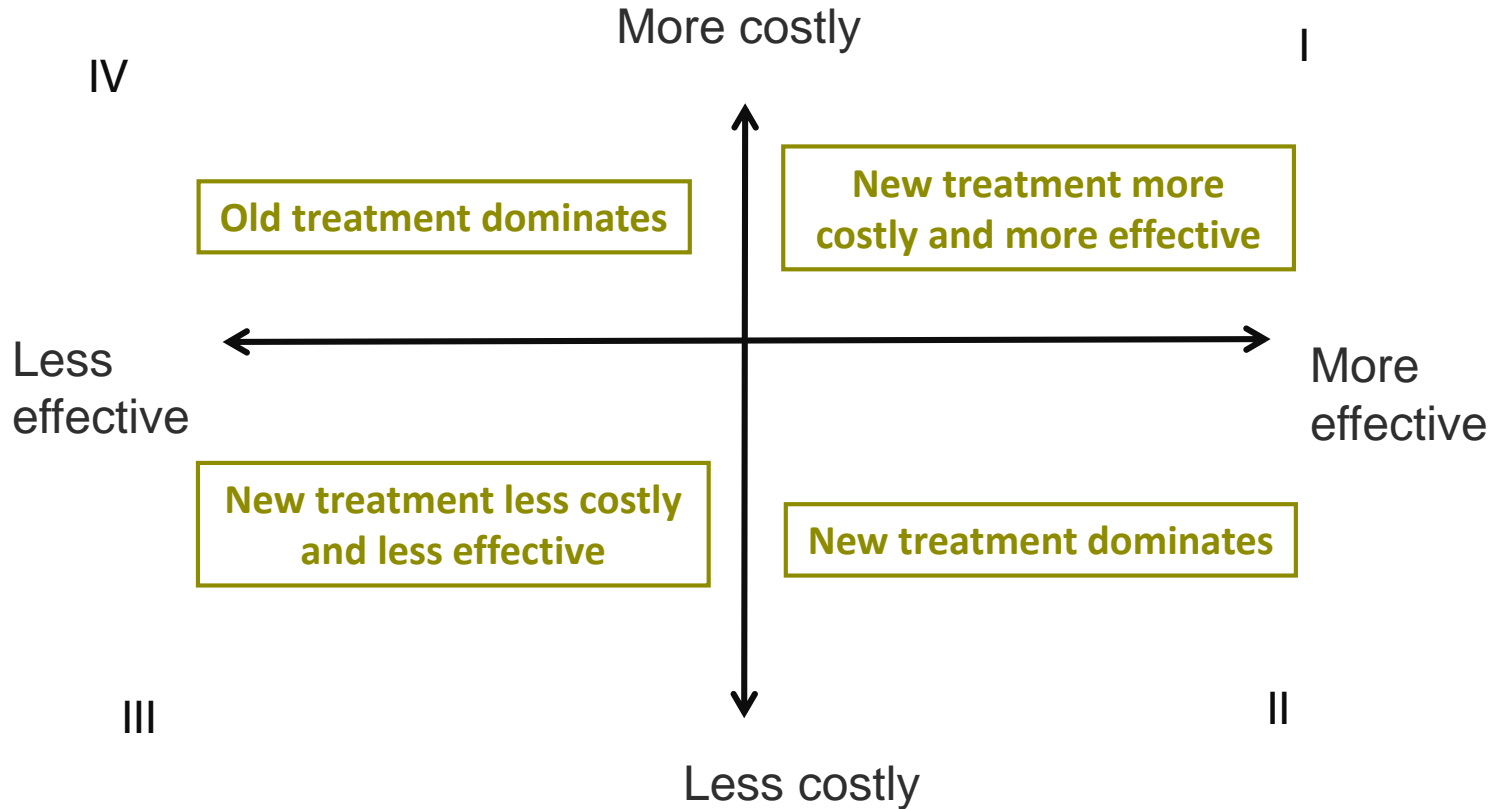
Example of CEA Ratios

Smoking Cessation Intervention

Program	Costs	Effects	C/E	$\Delta C/\Delta E$
A	110	20	5.50	-
B	120	29	4.14	1.11
C	150	50	3.00	1.43
D	190	60	3.17	4.00
E	240	70	3.43	5.00

$$\text{ICER} = \frac{\text{Difference in Cost}}{\text{Difference in Effectiveness}} = \frac{\Delta C}{\Delta E} = \frac{\text{Cost new treatment} - \text{cost current treatment}}{\text{Effect new treatment} - \text{effect current treatment}}$$

Incremental Cost-effectiveness Plane

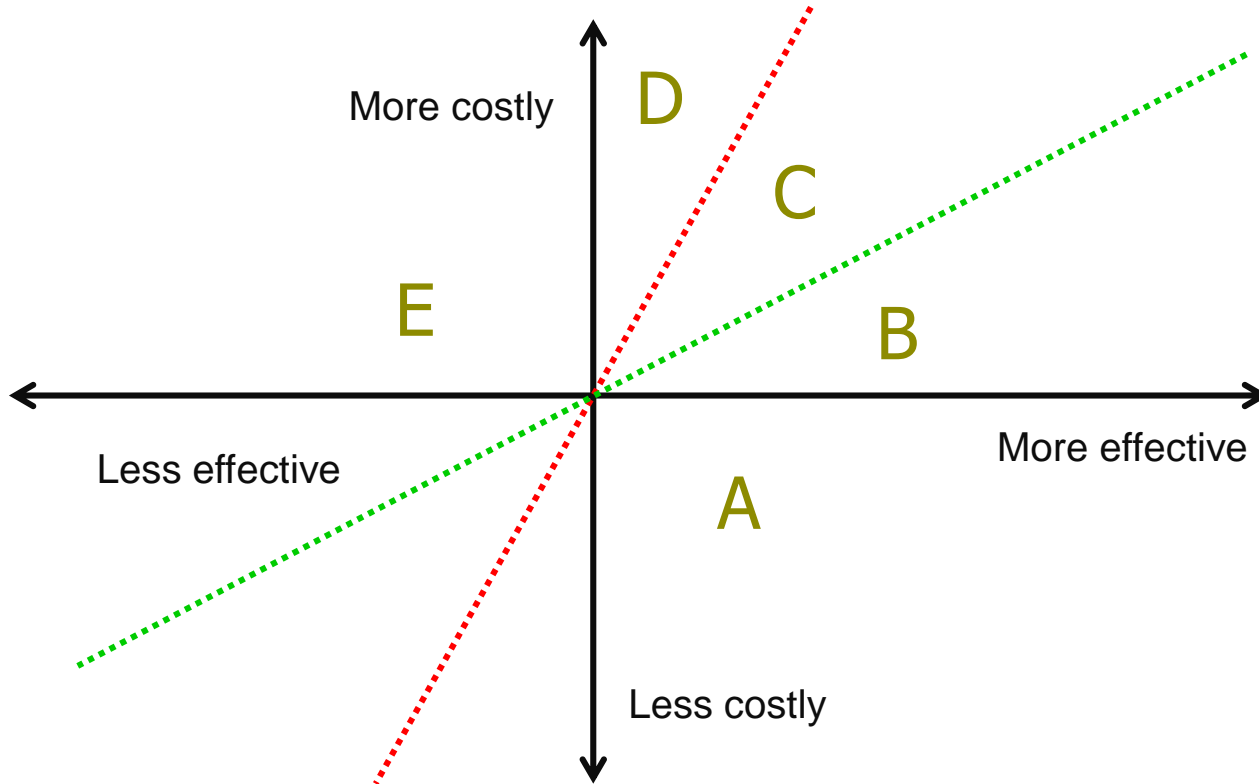


Choosing the Right Alternative Using ICER

$$\text{ICER} = \frac{\Delta \text{ Costs}}{\Delta \text{ Effects}} < \lambda$$

λ = willingness to pay

Which Treatment Makes the Grade?



CEA References

- Leao, TA, Kunst, E, Perelman, J. Adolescent smoking: a systematic review of cost-effectiveness of preventive policies and programs. *The European Journal of Public Health* 2016; 26(1): 165-012.
- Xu X, Alexander A, Simpson SA, Goates S, Nonnemaker JM, Davis KC, McAfee T. A cost-effectiveness analysis of the first federally funded antismoking campaign. *Am J Prev Med* 2015; (48)3:318-325.
- Miller LS, Max W, Sung H-Y, Rice D, Zaretsky M. Evaluation of the economic impact of California's Tobacco Control Program: a dynamic model approach. *Tobacco Control* 2010; 19(Suppl 1):i68-i76.
- Villanti A. Smoking Cessation Interventions for US Adults and Young Adults: Evaluating Effects and Cost-effectiveness: Johns Hopkins University; 2010.
- Farrelly MC, Hussin A, Bauer UE. Effectiveness and cost effectiveness of television, radio and print advertisements in promoting the New York smokers' quitline. *Tobacco Control* 2007;16(Suppl 1):i21-i3.
- Fellows JL, Bush T, McAfee T, Dickerson J. Cost effectiveness of the Oregon quitline "free patch initiative". *Tobacco Control* 2007; 16(Suppl 1):i47-i52.
- Secker-Walker, RH, Worden JK, Holland, RR, Flynn, BS, Detsky AS. A mass media programme to prevent smoking among adolescents: costs and cost-effectiveness. *Tobacco Control* 1997; 6:207-212.

A Complementary Tool to CEA

Budget Impact Analysis (BIA)

- A tool to understand the potential impact that implementing a prevention program will have on the payer's budget.
- Estimates the financial consequences of adopting a new intervention for local, regional, and national budgets (usually in addition to CEA)
 - New public health interventions may require an increase in public or private health care expenditures
 - New interventions may result in reduced condition costs because of reduced number or severity of cases
 - Reduced condition costs may partially or totally offset the increase in public or private health care expenditures

Budget Impact Analysis (BIA)...cont.

- BIA identifies the size of the population affected by the intervention and the effect of implementation on costs over the short-term.
- Focuses on the direct costs of specific resources needed to put the intervention into effect, such as supplies, equipment, and staff.
- Assessed from the payer's perspective, uses a short-term time horizon, does not use discounting or long-term modeling, and does not include overhead costs.
- Difficulty rests in;
 - Generalizing results (don't)
 - Programs accessing accurate and up to date financial information

BIA References

- Sullivan SD, Mauskopf JA, Augustovski, F, et al. Budget Impact Analysis—Principles of Good Practice: Report of the ISPOR 2012 Budget Impact Analysis Good Practice II Task Force, *Value in Health*, 2014, 17/1; <http://www.sciencedirect.com/science/article/pii/S1098301513042356>
- Mauskopf J. Budget-Impact Analysis. In: Anthony J. Culyer (ed.), *Encyclopedia of Health Economics*, Vol 1. San Diego: Elsevier; 2014. pp. 98-107.
- Principles of Good Practice for Budget Impact Analysis II- Good Practices for Outcomes Research Webinar Series <https://www.ispor.org/education/Webinars/Budget-Impact-Analysis-092014.aspx>

Cost – Benefit Analysis (CBA)

- A method used to compare costs and benefits of an intervention where all the costs and benefits are standardized or valued in monetary terms
- Used to compare different programs with different units of outcomes (health and non-health)
- Estimates full costs and benefits of interventions
- Outcomes expressed in a single \$ value (*net benefits*)
- Used for choosing across policy options

Cost – Benefit Analysis (CBA)...cont.

- When can CBA be used?
 - In deciding whether to implement a program.
 - If $NB > 0$, implement.
 - When choosing among competing options.
 - Implement program with highest NB.
 - For setting priorities when budgets are limited.

- Most useful for marketing the ROI in public health.

Classifying Benefits

- **Direct benefits**
 - Expenditures saved for prevention, detection, treatment, rehab, professional services, drugs, medical supplies, etc.
- **Indirect benefits**
 - Potential increased earnings or productivity gains as a result of an intervention
 - Usually calculated as the avoidance of earnings and productivity losses (morbidity and mortality) without the intervention
- **Intangible benefits**
 - Psychological benefits of health, satisfaction of life

Quantifying Benefits

- Human Capital or Cost-of-Illness (COI) approach
 - Typically includes medical costs and productivity losses averted
- Willingness-to-Pay (WTP) or Contingent-valuation approach
 - How much is society *willing to pay* to reduce the annual mortality risk associated with secondary smoke?

An Example: CBA for household health

Evaluation of the costs and benefits of household energy and health interventions at global and regional levels ~ WHO, 2006

- **Costs**
 - Stove costs, costs for the distribution of cleaner fuels or improved stoves, research and development investments and accompanying educational measures
- **Direct Benefits:**
 - reduced health-related expenditures as a result of less illness
 - acute lower respiratory infections (ALRI) in children younger than 5 years,
 - chronic obstructive pulmonary disease (COPD) in adults older than 30 years, and
 - lung cancer in adults older than 30 years
- **Indirect Benefits:**
 - Productivity gains
 - Time savings due to the shorter time spent on fuel collection and cooking
 - Environmental benefits

The net benefit to society was between US\$ 77 billion and US\$ 139 billion per year at global level, and this range was based on high and low estimates of costs and benefits.

Source: Hutton G, Rehfuss E, Tediosi F, Weiss S. Evaluation of the costs and benefits of household energy and health interventions at global and regional levels. WHO; 2006.

CBA References

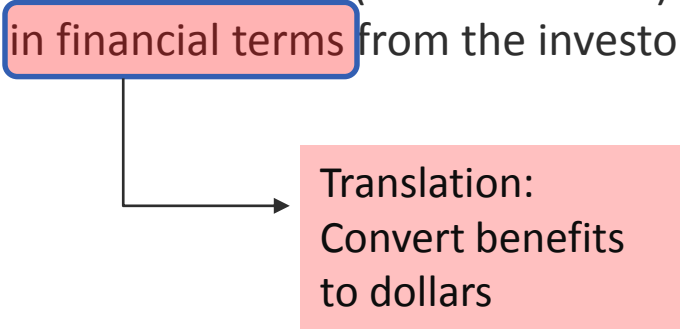
- Boardman AE, Greenberg DH, Vining AR, Weimer DL. Cost-benefit analysis: concepts and practice. Upper Saddle River, NJ: Prentice Hall; 2006.
- Chattopadhyay S, Pieper DR. Does spending more on tobacco control programs make economic sense? An incremental benefit-cost analysis using panel data. *Contemporary Economic Policy* 2012;30(3):430-47.
- Richard P, West K, Ku L. The Return on Investment of a Medicaid Tobacco Cessation Program in Massachusetts. *PLOS ONE* 2012;7(1): e29665. doi: 10.1371/journal.pone.0029665
- Dilley J, Harris J, Boysun M, Reid T. Program, policy, and price interventions for tobacco control: quantifying the return on investment of a state tobacco control program. *AJPH* 2012;102(2):e22-e8.
- Bartlett EE. Cost-benefit analysis of patient education. *Patient education and counseling* 1995;26(1):87-91.

What Do We Really Mean by ROI?

Defining ROI

A return on investment (ROI) measures the amount of return on an investment relative to the investment's cost.

In public health, it is a tool to compare the costs of an intervention (i.e. investment) with its health or economic benefits (i.e. returns) **in financial terms** from the investor's perspective.



The diagram consists of a red rounded rectangle with a blue border containing the text 'in financial terms'. A black line extends from the bottom of this box, turns left, and then down, ending in an arrowhead pointing to a larger red rectangle containing the text 'Translation: Convert benefits to dollars'.

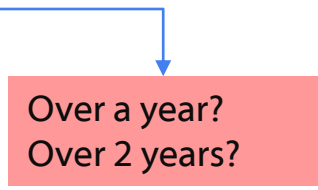
Translation:
Convert benefits
to dollars

ROI Makes a Business Case for a Program

- **ROI helps answer these types of questions:**

- What bang are we getting for our buck?
- What is the return on spending money **over time?**
- When will the investment be 'worth it'?

over time?



- **ROI helps with communication**

- *“Show us the financial value of your program.”*
- *“Is there a financial return for investing in this program?”*

Perspective and Time Frame for ROI Studies

- **Perspective of analysis matters**
 - Who is the investor? (provider, patient, public health department, payers, government, society?)
- **Timeframe is shorter than for other economic evaluation methods**
 - In the range of 1-3 years
 - Other economic evaluation methods can range 10+ years

The ROI Formula

- $ROI = \frac{\text{Return}}{\text{Investment}}$

....or....

- $ROI = \frac{\text{Value of the program's } \text{NET benefits}}{\text{Total program costs}}$

Net = Benefits - Costs

The diagram consists of a blue L-shaped arrow pointing from a pink rounded rectangle containing the text 'NET benefits' to a larger pink rectangle containing the text 'Net = Benefits - Costs'.

Trying out the Formula

- **Example: Stock Market**
 - Buy 20 shares of stock for \$10/share
 - Then sell those shares for \$250

- **What's the ROI?**

$$ROI = \frac{\textit{Return}}{\textit{Investment}} * 100\%$$

- Investment = Cost of buying shares = 20 shares * \$10 = \$200
- Return = Benefits received from selling shares = \$250 – Cost of buying shares

$$ROI = \frac{250-200}{200} * 100\% = 25\%$$

Example: ROI in Public Health

Example: Asthma Educational Program

Perspective	Cost of Program per patient (Investment)	Emergency room cost saved per patient (Return)	ROI
Public Health Department (PHD)	\$500	\$0	0% (0/\$500)
Payer (PHD pays for the program)	\$0	\$1,500	ROI can't be calculated because there is no payer investment
State Health Programs (PHD and Medicaid)	\$500	\$1,500	200% ($\$1,500 - \500) / $\$500 =$
Payer (Payer pays for the program)	\$500	\$1,500	200% ($\$1,500 - \500) / $\$500 =$
Societal (PHD pays for the program)	\$500	\$1,500	ROI can't be calculated without additional information on benefits

Limitations of ROI in Public Health

- ROI can have multiple meanings
- The interests of investors in public health are different than those that invest to generate profits
- ROI is only one piece of information
- Might not be the right method to answer your questions
- Other economic evaluation methods can help make the “ROI-like” case

Comparison of Methods

<i>Economic Evaluation Method</i>	<i>Comparison</i>	<i>Measurement of Effects</i>	<i>Economic Summary Measure</i>
Cost Analysis	Used to compare costs of implementing a program/intervention	Dollars	Cost of program
Cost of Illness Analysis	Used to measure the economic burden of a disease	Dollars	Cost of illness
Cost-Effectiveness Analysis	Used to compare interventions that produce a common health outcome	Health outcomes, measured in natural units	Incremental Cost-effectiveness ratio (ICER) Cost per case averted Cost per life-year saved
Cost-Benefit Analysis	Used to compare different programs with different units of outcomes (health and non-health)	Dollars	Net benefit or cost Benefit to cost ratio
Budget Impact Analysis	Used to estimate the financial consequences of adopting a new intervention for local, regional, and national budgets	Dollars	Annual change in resource use Annual change in cases of condition and associated resource use and costs
Return on Investment	A financial analysis from the perspective of the investor	Dollars	Net financial cost over dollars invested

Summary

- Economic evaluation (EE) methods can be useful for informing public health policy, planning, and practice.
- Programs must understand which method is appropriate for answering the questions they are asking.

General Public Health Economics Resources

- Drummond MF, Sculpher MJ, Claxton K, Stoddart GL, Torrance GW. Methods for the economic evaluation of health care programmes. Oxford University Press; 2015.
- Haddix AC, Teutsch SM, Corso PS. Prevention effectiveness: a guide to decision analysis and economic evaluation. Oxford University Press; 2003.
- Five Part Webcast on Economic Evaluation. Available at:
https://www.cdc.gov/dhdsp/programs/spha/economic_evaluation/index.htm
- Understanding and Using Economic Evidence, the Guide to Community Preventive Services (Chapter 11). Available at:
<https://www.thecommunityguide.org/sites/default/files/publications/Ch11-Economics.pdf>
- OSTLTS Gateway – Public Health Economics and Tools. Available at:
<https://www.cdc.gov/stltpublichealth/pheconomics/index.html>

THANK YOU!

CONTACT INFORMATION:

Ketra Rice, PhD, MS

Health Economist

Office on Smoking and Health

National Center for Chronic Disease Prevention & Health Promotion

Centers for Disease Control and Prevention

4770 Buford Highway, NE, MS F-79

Atlanta, GA 30341

Office: 770-488-4241

Email: klrice@cdc.gov



For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

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