

# Economic Evaluation: Making the case for diabetes self- management education

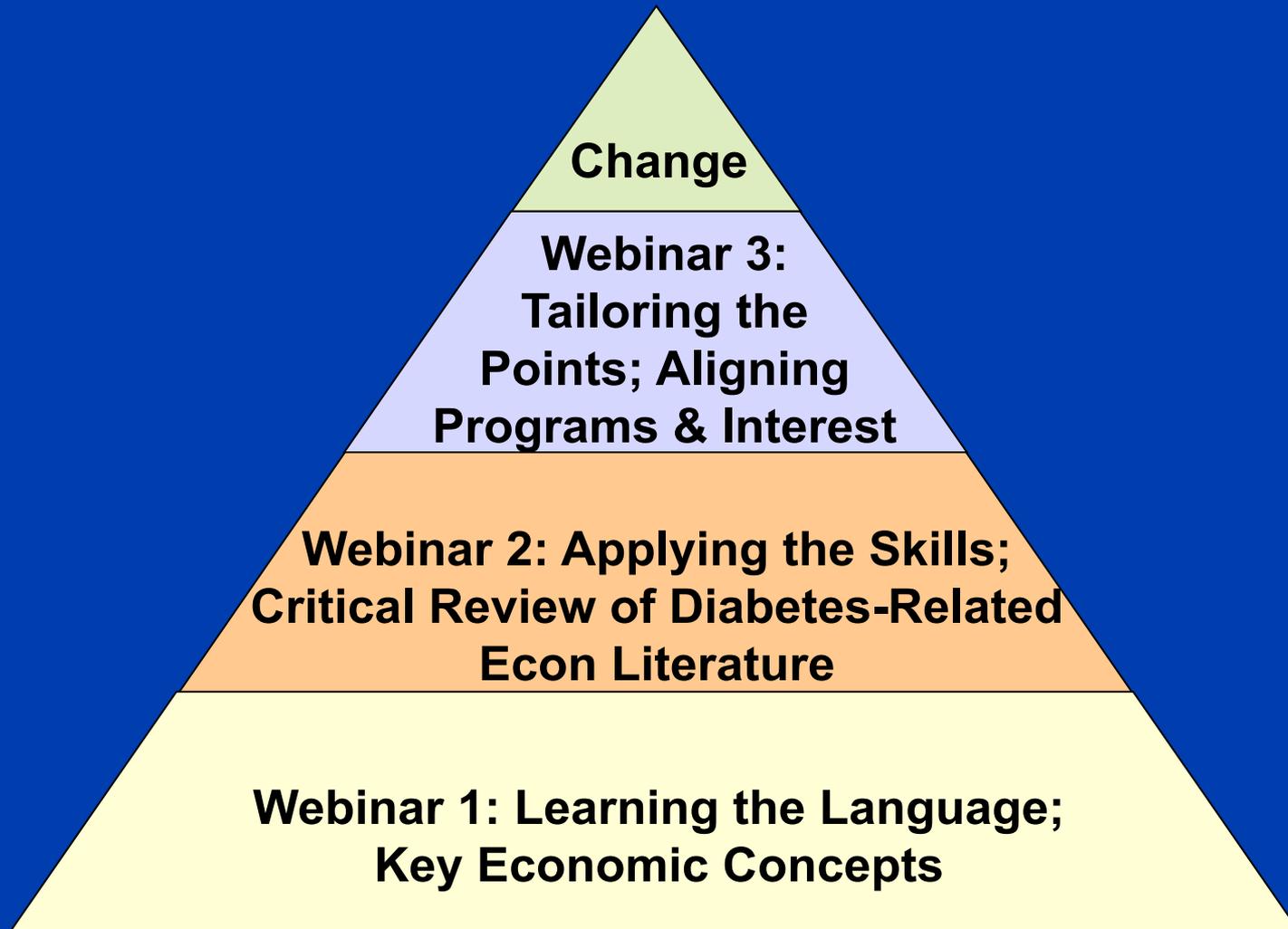
**NACDD Webinar**  
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Carsten Baumann, MA



NATIONAL ASSOCIATION OF  
**CHRONIC DISEASE DIRECTORS**  
Promoting Health. Preventing Disease.

# DSME Webinar Series Blueprint



# Economic Evaluation: Overview

- Part 1: Introduction
- Part 2: Main types of economic evaluation
- Part 3: Key concepts
  - Cost calculations (direct, indirect, opportunity)
  - Benefits (money, life years, etc.)
  - Perspectives (individual, group, society)
  - Time horizon (discounting)
  - Uncertainty
- Homework exercise: critical review of economic evaluations of DSME

# Marooned on a Desert Island

- A physicist, an architect and an economist are marooned on a desert island with a can of beans
- How will they get the can open?



# Learning Objectives

- Know the differences between types of economic evaluations: cost-inclusive, cost-benefit (return on investment), cost-effectiveness and cost-utility analysis
- Understand key terms in economic analysis
- Be able to use economic evaluation studies to justify and prioritize prevention and treatment strategies

# Part 1: Introduction

- Selecting a program
  - Lowest cost; highest effectiveness
  - Allocating the budget
- What is economic evaluation?
- Why do it?
- What can it tell us?
- Is it evidence?

# Which Program Has Greatest Benefit?

Benefit – only

- Physical Activity (PA) Program:  
20 years of life gained
- Nutrition (Nutri) Program:  
25 years gained
- Smoking Cessation Program:  
15 years gained

# Which Program Has Lowest Cost?

Cost – only

- Physical Activity (PA) Program:  
\$400,000 per year
- Nutrition (Nutri) Program:  
\$800,000 per year
- Smoking Cessation Program:  
\$350,000 per year

# Which Program to Implement? Lowest Cost or Greatest Benefit

## Cost – only

- Physical Activity Program = \$400,000
- Nutrition Program = \$800,000
- Smoking Cessation Program = \$350,000

## Benefit – only

- Physical Activity = 20 years of life gained
- Nutrition = 25 years of life gained
- Cessation = 15 years of life gained

# Which Program to Implement?

## Ranked Interventions

## Cost/Benefit ratio

1. Physical activity (\$400k)	\$20,000/ YOL gained
2. Smoking cessation (\$350k)	\$23,333/ YOL gained
3. Nutrition (\$800k)	\$32,000/ YOL gained

- If we wanted lowest cost intervention?
- If targeted C/B ratio is: \$25,000/ YOL gained
- If targeted C/B ratio is: \$20,000/ YOL gained
- If we had \$800,000 budget?

# What is Economic Evaluation (EE)?

## Definition:

- EE compares the outcomes (benefits) and costs of alternative interventions to inform decisions about the allocation of scarce resources using an established set of economic tools
- It is **one** decision-making tool
- It compares a new alternative vs. the base case (current approach; business as usual)

# Why Use Economic Evaluation in Public Health Interventions?

- To determine whether an intervention alternative is both effective and efficient
- To make population-based decisions that take into account various cost perspective
- To prevent waste of public resources
- To justify spending on public health interventions to funding agencies and policymakers

# What are possible EE results?

<b>Increased Costs</b>	A: Costs more; Worsens health relative to control	B: Costs more; No health difference	C: Costs more; Improves health relative to control
<b>No Change</b>	D: Costs the same; Worsens health relative to control	E: Costs the same; No health difference	F: Costs the same; Improves health relative to control
<b>Cost Savings</b>	G: Costs less; Worsens health relative to control	H: Costs less; No health difference	I: Costs less; Improves health relative to control

**Worse  
Outcomes**

**No Change**

**Improved  
Outcomes**

# Should intervention be adopted?

<b>Increased Costs</b>	Definitely reject new alternative (base case preferred)		Decision: Are the benefits worth the costs?
<b>No Change</b>		Indifferent	
<b>Cost Savings</b>	Decision: Is the health loss worth the savings?		Definitely accept new alternative (base case rejected)
	<b>Worse Outcomes</b>	<b>No Change</b>	<b>Improved Outcomes</b>

# Need for Evidence

- Without proven strategies, we do not know whether our planned intervention will work
  - If not effective, cannot be cost-effective
- ***Must do research to find out whether:***
  - A) An unproven intervention is effective
  - B) An effective intervention is cost effective
- ➔ In case it got lost: If something is not effective, it cannot be cost-effective!

# Part 2: Main Types of Economic Evaluation

- Cost-inclusive evaluation (CIE) 
- Cost-benefit analysis (CBA) 
  - Cost-minimization 
- Cost-effectiveness analysis (CEA) 
  - Cost-utility analysis (CUA) 



# Cost-Inclusive Evaluation

- Definition: Any evaluation that looks at both effectiveness (intended outcomes) and costs
- Outcomes: Monetary & non-monetary units
- Answers: Did it work and at what cost?
- Decision: Accept if effectiveness is better or cost is lower than alternative

# Previewing EE Types

Type of Analysis	Outcome (Benefit)	Measurement of Benefits
Cost Minimization (CMA) 	Identical, but costs are different <i>Can we do it for less?</i>	None (or kept constant)
Cost Effectiveness (CEA) 	Single common benefit (or outcome) <i>Are the (natural) outcomes worth the cost?</i>	Natural units e.g. life years gained, A1C levels, blood pressure, improved nutrition/physical activity
Cost Utility (CUA) 	1 or more benefits (outcomes) standardized into a single value <i>Are standardized outcomes worth the cost?</i>	QALYS DALYS (discounted)
Cost Benefit (CBA) 	Single, or multiple benefits (outcomes) standardized into a single monetary value (in present dollars) <i>Do we save more than we spend?</i>	Present value of \$\$; Monetary value of a YOLS or QALY



# Cost-Benefit Analysis

- Definition: CBA compares the costs and benefits of the same (or different) program using monetary outcomes
  - Outcomes: Monetary units
  - Answers: Are the net benefits greater than net costs?
  - Decision: Accept if the effects are worth more than the cost; select the intervention that has a cost/benefit ratio  $< 1$
- Most common form of EE in business:
- AKA return-on-investment (ROI) analysis



# Cost-Minimization (Saving) Analysis

- Definition: CMA compares the costs of different programs that produce the same health related outcomes (cell H)
- Outcomes: Monetary units\*
- Answers: While keeping outcomes constant, are the costs lower?
- Decision: Select the effective intervention with the lower cost (cost saving strategy)



# Cost-Minimization Analysis: Example

A. Participants walk 4 days per week

- Lowers Cardiovascular Disease (CVD) risk by 10%
- Costs \$3000 per participant per year

B. Participants reduce fat from 40% to 30% of calories

- Lowers CVD risk by 10%
- Costs \$2500 per participant per year

Outcome: Compare data on outcome only

- Both equally effective in lowering CVD risk

Analysis: Compare data on costs only

- Reduced fat intake intervention costs less

Decision: Choose the fat reduction intervention

- Cost saving strategy

*Note: these examples are fictitious*



# Cost-Effectiveness Analysis

- Definition: CEA compares the costs and benefits of different programs using the same outcome measure
- Outcomes: Non-monetary, natural units
- Answers: Are the net effects worth the net costs?
- Decision: Accept if effects are worth the cost; select the intervention that has a lowest cost/benefit ratio
- ➔ Most common form of EE in health:
  - Cells C, F, and I

# Which Program to Implement?

## Ranked Interventions

## Cost/Benefit ratio

1. Physical activity (\$400k)	\$20,000/ YOL gained
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- If we had \$800,000 budget?

# Question on Part 2: Main Types of Economic Evaluation

Any questions on what was covered so far:

● Cost-inclusive evaluation (CIE) 

● Cost-benefit analysis (CBA) 

– Cost-minimization 

● Cost-effectiveness analysis (CEA) 

– Cost-utility analysis (CUA) 

# Part 3: Key Concepts

- Cost (direct, indirect, opportunity\*)
- Benefits (money, life years, etc.)
- Perspectives (individual, group, society)
- Time horizon (discounting)
- Uncertainty (sensitivity)

# Key Concept: Cost Types

- Intervention program (or direct) costs
- Indirect program costs on client and others
- Averted health care costs
  - A negative cost (i.e. a benefit?)
- Averted productivity losses
  - A negative cost (i.e. a benefit?)
- Future health costs incurred due to increased longevity from intervention
  - Controversial cost

# Key Concept: Program (Direct) Costs

Direct Costs (costs attributable to program)

- Variable Costs

- Costs that vary with number of participants
  - Labor
  - Supplies
  - Some variable costs (labor) may be fixed, especially within a budget cycle

- Fixed Costs

- Cost that do not change with number of participants
  - Management
  - Equipment, rent

# Key Concept: Indirect Costs

- Costs to participants
  - Time costs (lost wages)
  - Travel costs
  - Supplies and equipment client buys
- Costs borne by external agents
  - Other family members, individuals, agencies
  - Value of any free or donated inputs
- Opportunity costs

# Down the Rabbit Hole: Costs





# Plus Costs of Treating Adverse Side Effects

- If the intervention has potential adverse health side effects, the cost of treating these must be included
  - Vaccine-related illness
  - Smoking cessation and weight gain
  - Vigorous exercise and injury
  - Spraying for mosquitoes and health risk
- Most public health interventions have low risk of adverse side effects



# Beneficial Side Effects?

- If the intervention has potential positive health side effects, those cost savings should be included if they can be estimated
- Smoking cessation program reduces cancer and CVD risk to smoker and to others who are no longer exposed to secondhand smoke
  - Not always included in averted treatment costs
  - Analysis will understate the cost effectiveness of the program



# Averted Treatment Costs

- Reduced health care treatment costs due to successful diabetes self-management program
  - A negative cost rather than a benefit
    - Subtracted from total costs of intervention
  - Lowers the total health care budget for individual/payer/society in the short (or long) run.



# Increased Life Expectancy = Added Health Care Costs?

- “The cost of additional healthcare caused by extended years of life should NOT be included in the costs of preventive services...

**Note:** Although there is no clear consensus in the field on this point, these additional costs should not be included for comparative purposes only.”

--The Community Guide

# Key Concept: Benefits (Health Outcomes)

In monetary units (currency)

- Monetary value of years of life saved (gained)

In physical units – global health outcomes

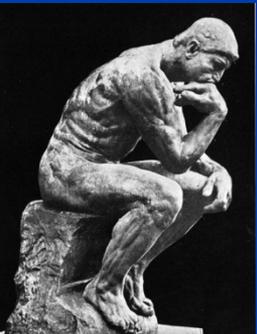
- Years of life saved (YOLS)
- Health Related Quality of Life (HRQL) Units
- Quality Adjusted Life Years Saved (QALYS)

In physical units - intermediate outcomes

- % lowered blood pressure, cholesterol
- Increased hours of exercise
- Smoking cessation

# Societal Decisions

- Goal: Balance spending on different health programs to maximize net benefits to society as a whole.
  - Who benefits from the intervention? Is it equitable?
- Investments based on societal values
  - Political system determines whose values are represented in the outcome chosen
    - e.g. Diabetes self-management education vs. well baby visits



# Use of Intermediate Outcomes (Benefits)

Prevention poses special problems:

- It may take a long time for benefits to be felt
- Annual benefits may be small and cumulative
- The benefits may be complex and interrelated
  - Some benefits may be omitted or overlooked
- So often focus on intermediate outcomes

# Intermediate Outcomes in CEA

- Intermediate outcomes (CEA)
  - Reduced A1c among targeted group
  - Lower BMI among targeted group
  - Increased hours of weekly exercise
  - Number of target group that stops smoking
- Related to final outcomes (CEA)
  - If A1c maintained in normal range, then less likely to have complications
  - If normal BMI maintained, then XX years of life gained
  - Outcomes depend on validity of assumptions
  - Expected outcomes

# What are Expected Outcomes?

## *Create a Decision Tree*

- % of population targeted for intervention
- Adjust for % who participate
- Adjust for % effectively treated
  - % adherence to intervention, relapse
- Adjust for % with improved health status from intervention
- Expected benefit from successful intervention
  - Number of years of life gained \* successful cases

# What are Expected Outcomes?

## *Create a Decision Tree*

- Percentage population targeted for intervention (17%)
  - 250,000 people living in Lincoln, NE and 17% smoke = 42,500
- Adjusted for percentage who participate (10%) = 4,250
- Adjusted for percentage effectively treated (15%) = 638
  - Adherence to intervention versus relapse
- →  $250,000 (.17) (.10) (.15) = 638$  successful participants
- Assumed benefit: Increase life expectancy by 40 years on average if new behavior is maintained over lifetime
- Years of life saved =  $40 * 638 = 25,520$  YOLS
  - Note YOLS based only on those who succeed, not larger groups

# Cost Utility Analysis Outcomes

- When is CUA used?
  - When quality of life is important
  - When the program affects both morbidity and mortality of participants
  - When the programs being compared have a wide range of outcomes but all have an effect on healthy years of life
    - Diabetes self-management education versus violence prevention
    - Reducing secondhand smoke exposure versus increasing prenatal care

# Down the Rabbit Hole: QALYS





# Adjust YOLS for Quality of Life (QALYS)

- QALYS take into account morbidity occurring in additional years of life
- Time spent in a particular health state multiplied by a **preference weight** for that state
- Q of L adjustment to YOLS ranges from 0 – 1
  - 0 = dead
  - 1 = perfect health
- If Q of L adjustment is .80 (80 percent)
  - 5 years (in poor health) = .8(5)
  - 5 years (in poor health) = 4 years in good health



# Problems With QALYs

- Subjective and difficult to measure
- Whose QALY values should be used?
  - A representative sample of the population
  - The affected group only
- QALY scales will differ depending upon:
  - Age group represented
  - Health status represented
- Limited applicability in primary prevention, high applicability in secondary & tertiary prevention
  - Captures disease progression

# Cost/Benefit: Depends on Perspective

**LOST**



**Human; no hair; 6' 0"**  
**Responds to "Bark, bark"**



# Key Concept: Perspective of Analysis

- Narrow: Includes benefits and costs to the individual
- Intermediate: Includes benefits and costs to
  - Public Health Agency
  - Medical Care Provider
  - Payer: Health Plan or Government
  - Consumer Group
- Broad (Societal): Includes the benefits and costs to the entire population

# Optional Exercise on Perspectives:

Based on the different costs identified earlier when we talked about direct & indirect costs:

- Which fall into costs borne by the individual?
- By an intermediary or organization?
- By society?

# Key Concept: Time Horizon

- Over what period will you observe and include outcomes and costs of intervention?
- Benefits and costs from the intervention
  - Short term (1 year or less)
  - Longer term (more than 1 year)
  - Lifetime benefits or costs
- The longer the time horizon the greater the uncertainty about outcome and cost
- The preference is for something now



# Discount Rate Used

- If you include costs and benefits over more than one year, you must discount them to their present values
  - Otherwise adding apples and oranges
- Use Low Social Rate of Discount: 3%-5%
- Benefits and costs are lower in present value the further in the future they occur



# Discounting Common Monetary Units

- \$60,000 in benefits received (or expenses paid) in one year at 5% rate
  - $\$60,000 / (1.05)^1 = \$57,142.86$
- \$60,000 in benefits received (or expenses paid) in 50 years at 5% rate.
  - $\$60,000 / (1.05)^{50} = \$5,232.22$
- → Present value is lower the farther in the future the benefits or costs occur

# Key Concept: Uncertainty

- Effect of intervention on outcomes and costs is not known with certainty
  - We make assumptions
    - We can manage participant enrollment, adherence
    - Avoided costs (side effects) are correct
    - We have used the proper discount rate
    - Our budgeted costs are correct
- How to deal with uncertainty?
  - Sensitivity analysis (best, base and worst case scenarios)



# Accounting for Uncertainty: Sensitivity Analysis

- Identifies critical variables
- Variables in sensitivity analysis
  - Risk of disease or injury
  - Discount rate (0-5%)
  - Direct costs of program
  - Value of estimated benefits
  - Patient compliance, adherence
    - Successful quitters = 5% or 50% of participants

# Summarizing EE Types

Type of Analysis	Outcome (Benefit)	Measurement of Benefits
Cost Minimization (CMA) 	Identical, but costs are different <i>Can we do it for less?</i>	None (or kept constant)
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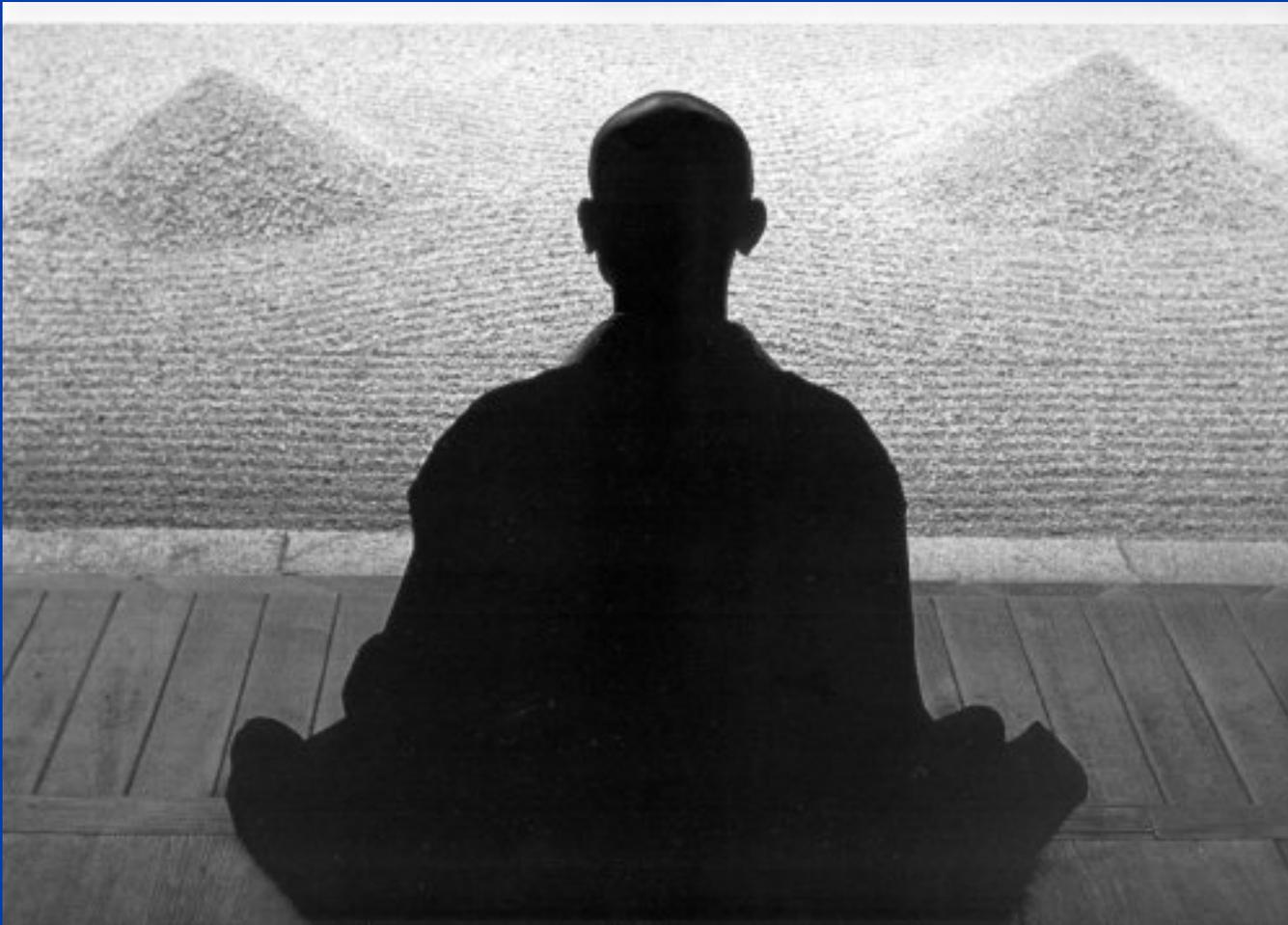
# Summary

- Economic evaluation is the comparison of costs and benefits of alternative interventions to determine the most efficient and effective allocation of scarce resources
- Economic evaluation provides information for rational decision-making by public health professionals and policy makers

# Key Take Away: Match EE Type with Question of Interest

- Do we know all our costs?
- What outcomes are we comparing?
- What is the time horizon for incurring both costs and benefits?
- What level of (or perspective on)
  - Cost, benefits, effectiveness do we need?

# Reflection



# Articles for Review

- 1) What was the intervention/program?
- 2) In what setting? What population?
- 3) What type of economic analysis?
- 4) From whose perspective?
- 5) What were the cost & types of costs?
- 6) What were the benefits?
- 7) How do findings support case for DSME?

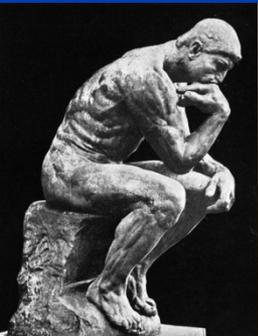
# More Economic Evaluation Slides; Drinking from the Fire Hose



Photo source: Massachusetts Institute of Technology, Alumni Newsletter;  
<http://alum.mit.edu/news/QuickTake/Archive/200908/>

# Key Concept: Opportunity Cost

- Opportunity Cost of a decision:
  - The value (net benefit) of what is given up to produce more health.
    - Net benefit lost from more health versus producing more education, better roads and streets, national defense, law enforcement
  - To produce more chronic disease prevention programs, what other public health programs (and other public programs) must be given up and at what cost to society when we do so?



# Lowest Opportunity Cost: Example

Cost per year of life saved (C/B ratio):

- Pneumonia vaccine
  - \$2 million/100 YOLS = \$20,000
- Influenza vaccine
  - \$2 million/ 11,100 YOLS = \$180
- Which has lower C/B ratio?

# Lowest Opportunity Cost: Example

Same Resource Cost: Budget = \$2 Million

Same Population Served: Denver citizens

## INTERVENTION

Pneumonia vaccine

Influenza vaccine

## NET BENEFITS

100 life-years gained

11,100 life-years gained

- What is opportunity cost of influenza vaccinations?

**100 LIFE YEARS**

- What is the opportunity cost of pneumonia vaccination?

**11,100 LIFE YEARS**

- Which has the higher opportunity cost?

**PNEUMONIA VACCINE**



# Averted Productivity Losses

- Present value of higher future wages earned because of disease prevention
  - Intervention increases worker life expectancy
  - Intervention reduces disability so can earn more
- Benefits to employers/society
  - Intervention makes workers more productive
  - Produce more output; pay more taxes
- Not used in cost-utility analyses (CUA)
  - Utility measure implicitly includes the value of additional working life years gained



# Comparing QALYS: Example

- Intervention A:
  - Saves 5 years of life but with disability
  - Quality adjustment for disability = .7
  - QALY:  $.7 \times 5 = 3.5$  QALYs
- Intervention B:
  - Saves 4 years of life with no disability
  - Quality adjustment: 1.0
  - QALY:  $1 \times 4 = 4$  QALYs
- Intervention B is preferred to A



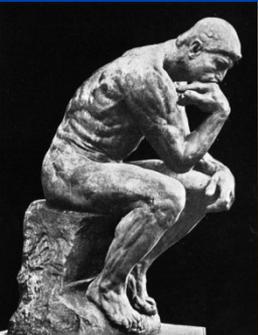
# Alternative to QALYs: DALYs

- Disability Adjusted Years of Life
- DALYs are a cost or burden to society
- Definition: Years of healthy life lost through premature death and disability
  
- DALYS and QALYS not comparable
- Goal: reduce DALYs; increase QALYs



# Converting QALYs to Dollars

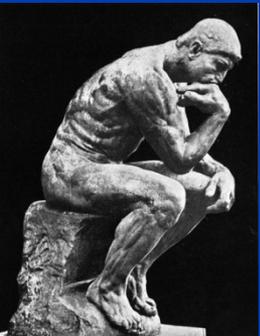
- Monetary Valuation (Human Capital Approach)
- Value of a year of life saved based on average annual (hourly) earnings
  - Average worker earns \$50,000 per year, working 40 hours per week
  - Value of a year of life saved = \$ 50,000
- What is the value if person does not work?
  - What if the person is a doctor or a farmer?





# Discounting Benefits: YOLS and QALYs

- Is an added year of life less valuable to you, the further into the future that it is received and enjoyed?
  - Do younger people value increased years of life more or less than older people who are closer to the end of life?
  - Discounting reflects this difference in the value of an additional year of life by age





# Converting to Common Temporal Monetary Units

- Future Benefits (and Costs) measured in monetary units must be discounted to reflect

## PRESENT VALUES

- Money received tomorrow is worth less than money received today
  - $10.00/(1.10)^1 = \$9.09 = \text{value today @ } 10\%$
  - Future Value of year of life in 20 yrs = \$ 50,000
  - Present Value of a year of life \$ 27,683
    - $\$50,000/(1.03)^{20}$



# Sensitivity Analysis

- Vary the values of key variables over a given range, e.g., adherence from 5% to 50%
- Use these values to calculate different costs and/or benefits
- Variables with the greatest impact on C/B and C/E ratios create greatest risk to program success
- These need to be monitored and well managed