An Introduction to Economic Evaluation

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What is Economic Evaluation (EE)?

Applied analytic methods to:

Identify,

Measure,

Value, and

Compare

the costs and consequences of

interventions, policies, strategies.

Why Care About Economics within the Context of Evaluating Interventions?

Maximizing outcomes is important.

Minimizing costs is important too.

Resources are limited, so hard (resource allocation) decisions must be made.

Demonstrates the value provided from the resources expended (return on investment).

Economic Evaluation ≠ Economics

- Economics seeks to explain choices and behaviors by individuals

- Economic evaluation (EE) seeks to inform choices made by public policy makers, health care payers

Purpose of EE

- Designed to inform decision making regarding both the economic and public health (or other) consequences of various possible actions

- CANNOT tell you what is the “correct” choice: it provides analysis of the consequences of each

Purpose of EE (what it is designed to do)

- Fundamental role of EE is to inform how much you get for what you pay (bang for buck)
- Programmatic choices occur at many levels
  - National Health Policy
    - what to cover in Medicare
    - how to allocate organs
  - Industry/Employers
    - How many plans to offer
    - what coverage options to provide
  - Schools
    - what teacher/student ratio is appropriate
    - Math curricula

Purpose of EE (what it isn't designed to do)

- However, from a social and political standpoint, decisions involve many issues other than "bang-for-buck"
  - Equity
  - Social justice
  - Legal responsibilities
  - Public/patient/client opinion

EE as a Solution

- Rational system for distributing scarce resources
  - a fundamental assumption is that we cannot spend an infinite amount of resources on health care
  - therefore, use what we have wisely

- Opportunity Costs
  - Every $ spent on one use is a $ that CAN'T be spent on another
    - $ spent on cancer can’t be spent on violence prevention
    - $ spent on health can’t be spent on education

EE as a Solution

- Contention is that the most *efficient* distribution of resources is one that favors more cost-effective strategies

- Society should not waste it's resources….but
  - what is "waste" to one group is an "absolute necessity" to another

EE as a Solution

- Therefore:
  - The ***methodology*** of EE is derived from basic economic theory which relies on understanding optimal consumption as the interaction of a set of consumer preferences making decisions under budget constraints
  - The ***application*** of EE to a particular problem (health care or otherwise) is derived from social theory and a political process and political or social agendas

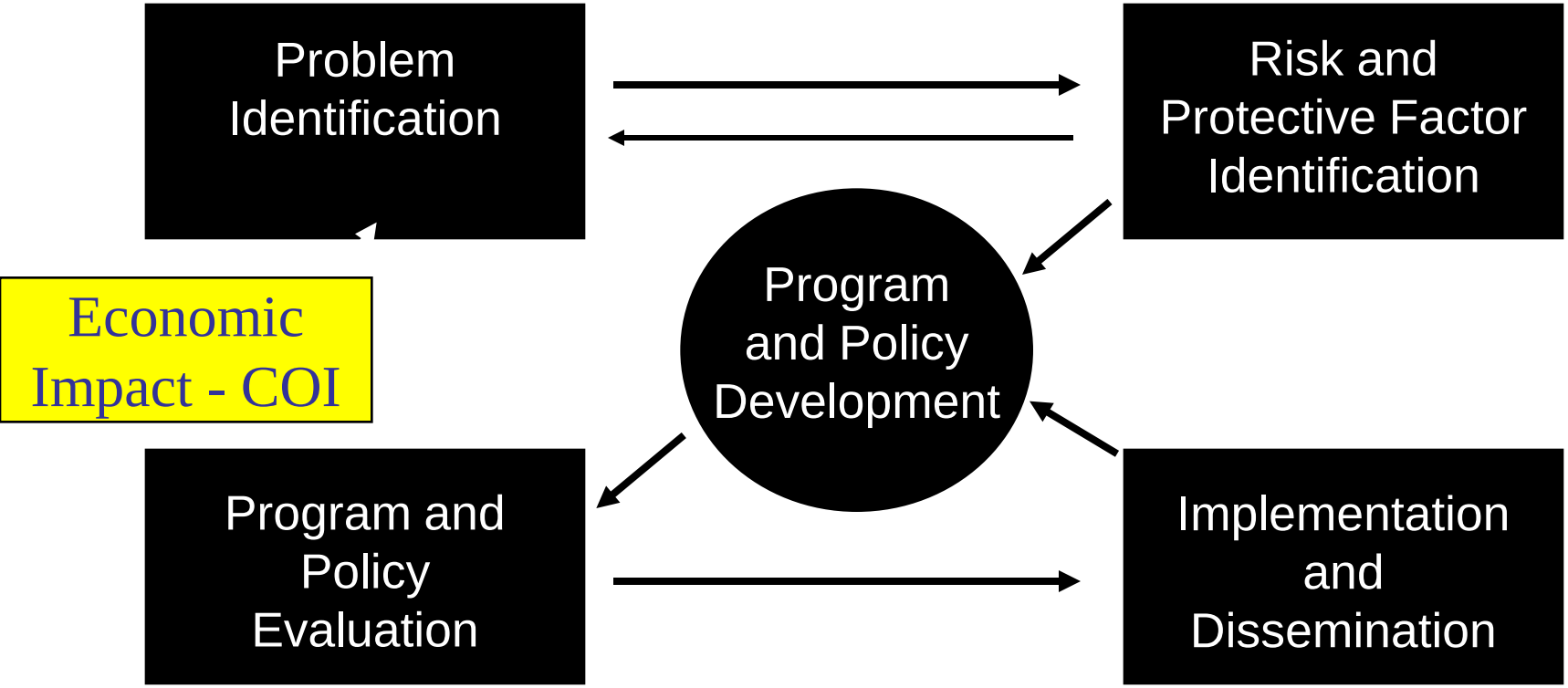
EE as a Solution

- Examples:
  - Society is often willing to spend very large sums to save a single life
    - baby Jessica in the well
  - Society may balk at spending “efficiently”
    - Sex education programs
    - Needle exchange programs
  - Many programs spend very different amounts to save the same “statistical life”
    - highway safety
    - eradicating certain contaminates from the workplace

EE Methods

- Partial evaluation – costs only
  - Economic impact analyses
    - Cost of illness (COI) analysis in health
  - Cost analysis (program costs)

- Full evaluation – costs and outcomes
  - Cost-benefit analysis (CBA)
  - Cost-effectiveness analysis (CEA)
    - Cost-utility analysis (CUA)


Problem Identification
Risk and Protective Factor Identification
Program and Policy Development
Economic Impact - COI
Program and Policy Evaluation
Implementation and Dissemination

Economic Impact Analyses
or
Cost of Illness (COI) Analysis for Health Outcomes

- Estimates total costs to society bc of a condition (crime, obesity)
  - Direct costs of resources required to deal with (treat) condition
    - Medical and non-medical
  - Indirect costs of resources
    - Loss in workplace, household productivity

Economic Impact Analysis Reporting

- Prevalence-based.
  - Amount spent each year to deal with (or care for) a person with a condition.
- Incidence-based.
  - Amount spent over a person's lifetime for a condition first occurring within a particular time period.

COI Methods

- All medical costs.
- Only diagnosis-specific medical costs.
  - Add attributable fraction.
- Incremental cost approach.
  - Match against control.
  - Regression.
  - Attributable fraction.

Sum of All Medical Costs

- Provides average utilization and costs of illness.

Pros	Cons
Good for relative comparisons.	Possible inaccuracies in gauging costs.

Diagnosis-Specific

- Total of related medical costs for all patients with a given diagnosis.
- Best for assessing specific costs of the disease or condition.

Pros	Cons
▪ Represents lower-bound actual costs. ▪ Good for incidence-based models.	▪ May underestimate costs.

Attributable Fraction

- The indirect health expenditures associated with a given diagnosis, through other diseases or conditions.
- The attributable fraction is added to the total costs.

Example 1: Attributable Costs

- $108.8 billion in health care spending attributable to hypertension in 1998.
  - $22.8 billion for hypertension as primary diagnosis.
  - Other costs attributable to hypertension:
    - $29.7 billion — cardiovascular complications.
    - $56.4 billion — other diagnoses.

Hodgson & Cai. Medical care expenditures for hypertension, its complications, and its comorbidities. *Medical Care* 2001;39(6):599–615.

Matched Control

- Shows incremental costs by calculating the difference in costs between those patients with and those without a given disease or condition.
- Must match controls.

Pros	Cons
▪ More accurate results.	▪ Possibility of overestimating due to factors not accounted for in matching.

Regression Methods

- Statistical modeling that can account for confounding variables.

Example 2: Regression Analyses

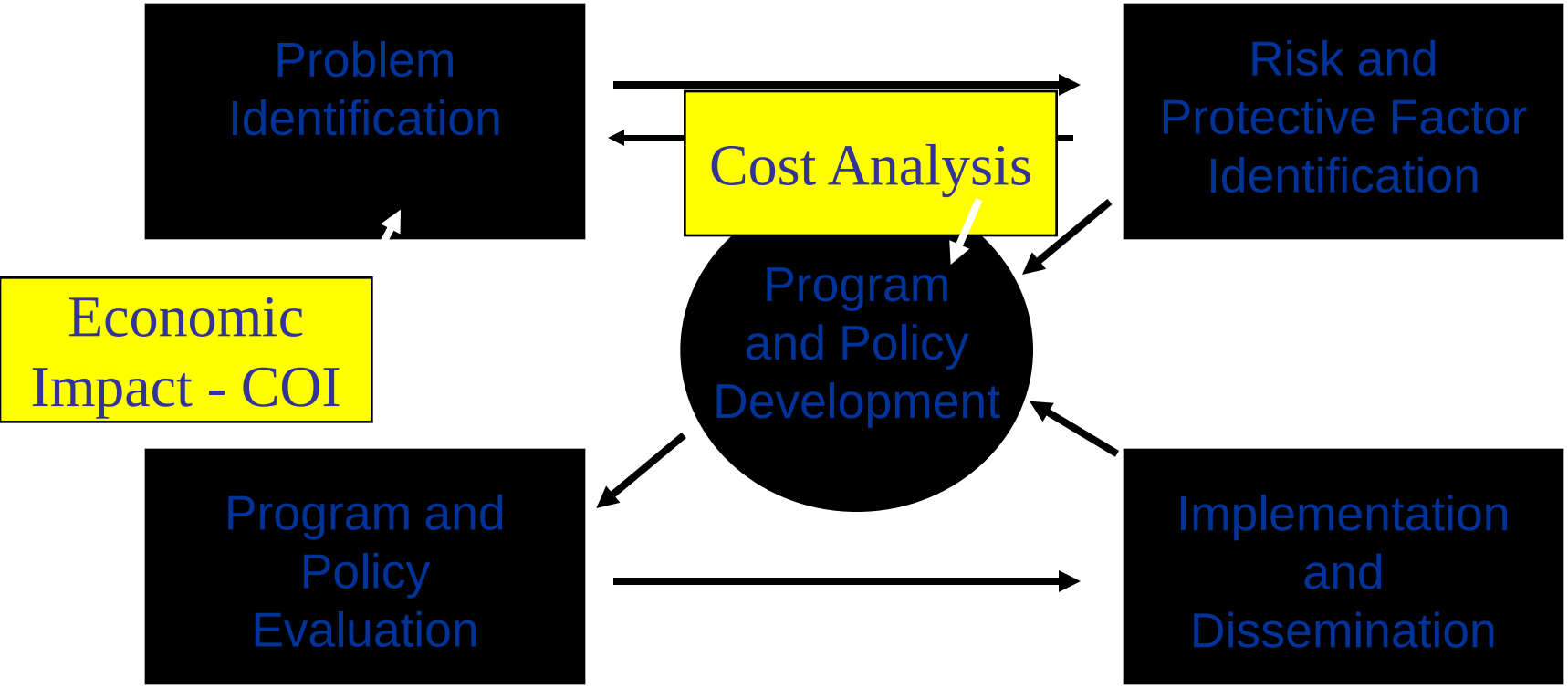
- Balu & Thomas. Incremental expenditure of treating hypertension in the United States. *American Journal of Hypertension* 2006;19:810–816.
- Compared population of persons with one or more hypertension diagnoses to a population with no hypertension diagnoses.
- Controlled for other factors using Charlson co-morbidity index.
- Did not include attributable fraction.

Results

- **Conclusion:** Annual incremental expenditures for hypertensives were $1,130.70 more than for non-hypertensives.
- **Implication:** Hypertension alone costs more than $55 billion per year.

So What?

- Economic burden estimates
  - Provide the needed data to lobby for more prevention resources.
  - Illustrate the potential savings (or costs avoided) if effective interventions are implemented
  - Represent the potential ***returns on investment*** for prevention.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Cost Analysis (CA)

- Estimates total costs of running a program
  - Costs are the value of the resources (people, building, equipment and supplies) used to produce a good or a service
- Important for realizing costs from varying perspectives
  - e.g., incurred by program, incurred by participant
- Important for budget justification, decision making, and forecasting.
- Also called: cost consequence or cost identification analysis
- Provides the first step of a full economic evaluation
- Includes not just **financial**, but also **economic** costs.

Financial Costs

- Financial Costs
  - Monetary expenditures for resources required to implement the program – based on market prices
  - Typically found in the budget proposal
  - Typically used to conduct a *cost-neutrality analysis*
  - A convenient, but sometimes incomplete, way to measure costs

- Examples:
  - Salaries for project personnel
  - Supply costs
  - Computer purchases
  - Cost of curriculum materials

Economic Costs

- Economic Costs
  - (Or opportunity cost): The value of the forgone benefit because the resource is not available for its next best use.
  - Economists argue that a resource's cost is the sacrifice necessary to obtain goods or services.

- Examples:
  - Volunteer time
  - Donated space (e.g., from a University)

Programmatic Cost Analysis of the *Family Connections* Program

(*Protecting Children, 2009*)

P. Corso, University of Georgia
J. Filene, James Bell Associates

Study Design

- Micro-costing approach
- Costs included: personnel, space, materials/supplies, travel
- Aggregate pre-implementation costs
- A comparison of aggregate costs from year 1 to year 3

Defining Cost Categories

**Type of Activity	***Activity Description
(D) Direct: Client-focused, face-to-face activity	a. Advocate b. Assess c. Counseling/support d. Court representation e. Assist/provide f. Plan g. Refer h. Schedule i. Teach j. Transport
(I) Indirect: Collateral activities on behalf of client systems	a. Advocate b. Clinical documentation c. Research d. Preparation for court e. Testify in court f. Consult/Collaborate g. Locate resources h. Team meeting i. Risk management meeting j. Clinical Interdisciplinary team mtng k. I&R referral
(AC) Administrative-Client: Related to client activities	a. Gives supervision b. Receives supervision c. etc
(AP) Administrative-Program: Related to programmatic/management activities	Etc.

Aggregating Costs Across Sites

Year 3, *Family Connections* Implementation Costs for N=8 Sites

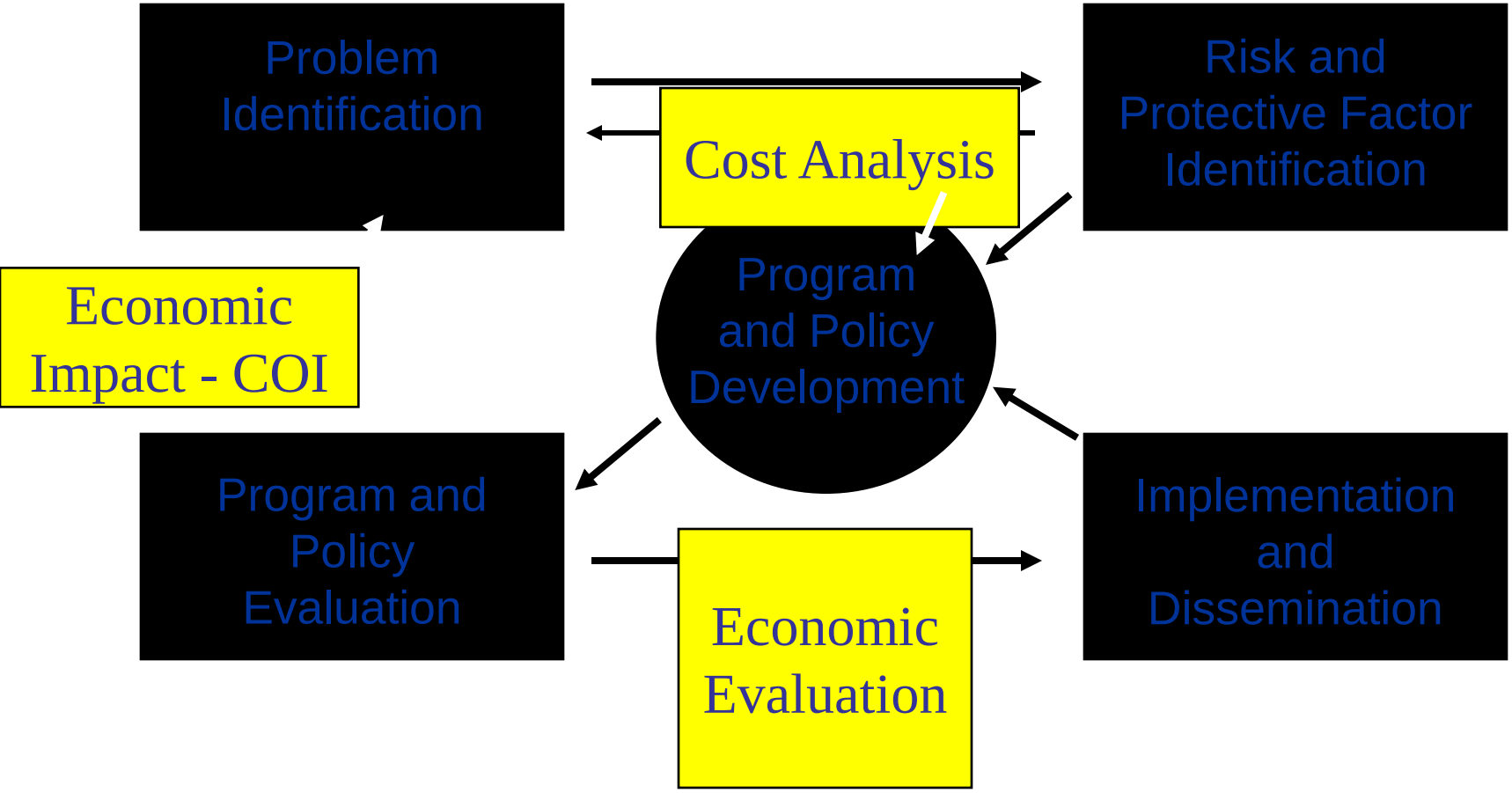
Cost category	Site						
	B	C	D	E	F	G	H

Final Results

Implementation Phase	Total Costs	Average Costs	Median Costs	Range

Lessons Learned

- Prospective vs retrospective cost collection
- The benefits of time diaries vs the cons of interventionist burn-out
- Consistency of cost collectors
- Benefits of collecting costs from multiple sites
- Cons of multiple sites and the ability to aggregate;
  - Fidelity to the model
  - Participant-level, provider-level, program-level, and community-level factors that may impact costs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Economic Evaluation Methods

- What is Economic Evaluation?
  - Applied analytic methods used to identify, measure, value and compare the costs and consequences of treatment and prevention programs, interventions, and policies.
- What are the Methods?
  - BCA – benefit-cost analysis
  - CEA – cost-effectiveness analysis
    - CUA – Cost-utility analysis

Benefit-Cost Analysis (BCA)

- Compares costs and benefits of an intervention.
  - Standardizes all costs and benefits in monetary terms.

- Lists **all** costs and benefits over time:
  - Can have different time lines for costs and benefits.
  - Can include health and non-health benefits.

- Used primarily in regulatory policy analyses.
  - Clean Water Act, Clean Air Act.

- Increasingly applied to public health.

BCA — Summary Measures

- Benefit-cost ratio (B/C).
  - Very popular with stakeholders.
  - “For every dollar spent on X, you will save Y dollars.”
  - Implement if B/C ratio > 1.
  - Often misleading.
    - Easy to manipulate costs to get higher ratios.
- Net benefit (B – C).
  - Subtract costs from benefits.
  - Implement if net benefit > 0.
  - Less easily manipulated.

When Is BCA 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.

Assessing Dollar Value of Benefits

Benefits can be direct, indirect, or intangible.

- Direct benefits:
  - Medical expenditures saved for other purposes.
- Indirect benefits:
  - Potential increased earnings or productivity gains.
- Intangible benefits:
  - Psychological benefits of health, satisfaction with life.

Valuation of Indirect/Intangible Benefits

- Human capital approach.
- Friction cost method.
- Revealed preference.
- Stated preference.

Human Capital Approach

Theory of investment:

- Views the human being as a capital investment.
- A person’s sole purpose is economically productive output.
- Value is measured by earnings generated and value of household productivity.

Human Capital Approach

- Assumes worker's value equals earnings, because fair-market workplace will not pay a worker more than the additional value he/she contributes.
- Lost productivity = lost earnings.
  - Uses gross earnings and fringe benefits.
  - Adjusts value for non-market labor, such as household productivity.
  - May subtract future consumption of goods and services.

Example

- Estimating benefits of a hypertension health promotion program:
  - Before program, participants missed 20 days of work per year on average.
  - After program, missed 7 days of work per year.
  - Average income = $40,000 + $10,000 benefits.
  - Average earnings = $200/day.
  - 13 days of productivity gained X $200 = $2,600.

From Corso et al, *AJPM* 2007

- Homicide
  - $1.3 million in lost productivity
  - $4,906 in medical costs.
- Non-fatal assault resulting in hospitalization
  - $57,209 in lost productivity
  - $24,353 in medical costs.
- Suicide
  - $1 million lost productivity
  - $2,596 in medical costs.
- Non-fatal self inflicted injury
  - $9,726 in lost productivity

Limitations of Using the COI as a Benefits Measure

- Human capital approach undervalues women, children, and the elderly

- Does not include other major costs to society associated with CM:
  - Costs of decreased educational outcomes
  - Costs associated with criminal justice system, child welfare
  - Losses in quality of life, pain and suffering
  - Etc., etc., etc.

Alternative Approach for Quantifying Benefits in a BCA

- Stated Preference Approach
- Contingent Valuation Surveys
  - Use of survey Qs to elicit people's preferences for (public) goods/services by finding out what they would be willing to pay for them
  - Present respondents with hypothetical scenarios and ask them to reveal the maximum they would be willing to pay for such a program/benefit
    - Or amount willing to be compensated for the program not to occur
  - Willingness-to-Pay (WTP) values are contingent upon the hypothetical market described to the respondent
  - WTP to prevent mortality risk leads to Value of Statistical Life (VSL)

Use in BCAs – Value of Statistical Life

- If average WTP is $50 for a reduction in fatality from 2 in 100,000 to 1 in 100,000
  - Average VSL = 100,000 x $50 = $5 million
- VSL in US range from $1 million to $20 million
  - Depending on method
    - HC lowest, Stated Preference, (Revealed Preference)
- VSLs vary by age of target group, income, type of risk, and risk level

The Benefits of Preventing a CM Death: Evidence from Willingness to Pay Survey Data

Corso, Fang, Mercy

Revise and Resubmit, *AJPH*

Methods

- Respondents selected by random-digit dial in the state of Georgia in the Fall of 2008.
- Double-bounded contingent valuation model used to ask WTP for a certain risk reduction associated with CM
- Initial bid values ranged from $25 to $250 to control for starting point bias.

Methods (cont.)

- In a split sample, respondents were asked to state their WTP to reduce the risk by 50% of
  - homicide associated with CM (a 1 in 100,000 risk reduction), or
  - physical, sexual, emotional abuse, or neglect (a 7 in 100 risk reduction).

- Respondents were also asked in a split sample about their WTP by either (1) increased taxes or (2) charitable donations.

- The maximum likelihood function was estimated using the interval regression command in STATA. Bootstrap standard errors were used to calculate the 95% confidence intervals on the mean and median WTP.

Sample Population (N=425)

	Mortality Taxes	Mortality Donation	Morbidity Taxes	Morbidity Donation	FULL SAMPLE
Average Age	47.2	49.9	52.9	54.3	**50.9**
% Female	70.9	67.6	59.6	68.1	**66.5**
% White	60.2	69.0	72.3	80.0	**69.9**
% OwnHome	77.2	77.0	83.6	93.3	**82.4**
% Married	57.6	56.7	57.7	54.6	**56.6**
% HS+	75.3	71.8	73.1	73.3	**73.4**
% $50K+	63.9	62.6	61.0	60.4	**61.9**

	Morbidity		Mortality	
	N=176		N=199	
	LR chi2(17)=33.38		LR chi2(17)=34.18	
	Log likelihood = -232.11066		Log likelihood = -265.61981	
	Prob > chi2=0.0101		Prob > chi2=0.00080	
	Coefficient	p-value	Coefficient	p-value
Age	-3.379485	0.533	2.19662	0.685
Age^2	.0110811	0.830	-.0134851	0.802
White	58.91067	0.176	-3.03023	0.926
Female	31.20838	0.375	-32.53265	0.300
OwnHome	105.1563	0.058	-61.87553	0.119
HxCM	-8.674912	0.831	-28.90957	0.384
Taxes	86.2269	**0.016**	120.66	**0.000**
Politics_Rep	-84.09037	**0.033**	-40.68805	0.237
Politics_Indep	-60.5638	0.167	-46.19087	0.262
Politics_Other	-156.6723	0.063	-128.7396	**0.017**
CMRisk>	-106.3852	0.041	24.77823	0.544
CMRisk=	-7.186702	0.859	-16.08892	0.633
CMRisk_Miss	-95.20274	0.101	4.514504	0.944
Inc$20-$49K	2.848877	0.969	99.57298	0.060
Inc$50-$74K	3.867972	0.962	78.57215	0.186
Inc$75K+	-45.95815	0.513	38.8271	0.502
Inc_Missing	-118.7853	0.088	108.0162	0.051
_cons	220.7916	0.147	59.79685	0.634

Implications for Benefits Estimate

- WTP for a 50% reduction in the risk of a child being maltreated
  - Mean: $149 ($121 to $176, 95% CI)
  - Median: $152 ($120 to $186, 95% CI).

- WTP for a 50% reduction in the risk of homicide associated with CM
  - Mean: $137 ($90 to $175, 95% CI)
  - Median: $141 ($97 to $178, 95% CI).

- Therefore, these preliminary pilot results suggest that the societal value of preventing a CM homicide may be more than **$14 million** and the value of preventing a case of CM may be valued at approximately **$2,000**.

Study Limitations and Next Steps

- Small sample
- Non-representative sample
- Scope tests on % risk reduction not conducted
- Hypothetical description of child maltreatment limited

- **Next steps:** conduct with other state samples and eventually with a large representative national sample

Cost-Effectiveness Analysis (CEA)

- Estimates costs and outcomes of interventions.
- Expresses outcomes in natural units.
  - e.g., cases prevented, lives saved.
- Compares results with other interventions affecting the same outcome.

CEA — Summary Measures

Average Cost-Effectiveness Ratio	Incremental Cost-Effectiveness Ratio
$\frac{\text{Net Costs\_A}}{\text{Net Effects\_A}}$	$\frac{(\text{Net Costs\_B} - \text{Net Costs\_A})}{(\text{Net Effects\_B} - \text{Net Effects\_A})}$

Where Net Costs = Program Costs_A – COI Averted

Quantify Outcomes — CEA

- Intermediate outcomes:
  - Increased physical activity.
  - Decreased blood pressure.
- Final outcomes:
  - Heart disease cases prevented.
  - Lives or life years saved.

CEA Caveat

- Outcomes cannot be combined; they must be considered separately. Consider one or two of the most important measures.
- Number of summary measures depends on number of outcomes chosen.
  - If A and B are the most important, then:
    - Cost/outcome A.
    - Cost/outcome B.
    - Translation for policy-makers can be difficult.

CEA of *Family Connections*

(DePanfilis et al., *Child Abuse & Neglect* 2008)

Table 2
Total and average monthly cost per family, by intervention group

	Total costs (column 1)	Cost per FC3 family (27 families) (column 2)	Cost per FC9 family (27 families) (column 3)
Staff salary and fringe	$13,923	$294	$222
Intern salary and fringe	$13,206	$279	$210
Rent and utilities	$722	$13	$13
Supplies and copying	$298	$6	$6
Transportation	$163	$3	$3
Client family expenditures	$643	$12	$12
Monthly total	$28,955	$607	$466
Total cost		$1,821	$4,194

Table 3
Child Behavior Checklist—total raw scores by intervention group

	CBCL total raw scores (*SD*)		
	Baseline	Follow-up	Change
FC3 raw score mean, (*SD*)	43.5 (33.1)	38.1 (29.2)	5.4*
FC9 raw score mean (*SD*)	45.7 (28.6)	30.5 (24)	15.2**

*$p < .05$; **$p < .01$.

Average CE Ratios:

FC3 = $337/unit change in CBCL raw score

FC9 = $276/unit change in CBCL raw score

Incremental CE Ratio:

= $242/unit change in CBCL comparing FC9 to FC3

Cost-Utility Analysis — CUA

- Compares costs and benefits, where benefits = # of life years saved *adjusted* for loss of quality.
- Combines length and quality of life.
- Compares disparate outcomes in terms of utility.
  - Quality-adjusted life years (QALYs).
  - Disability-adjusted life years (DALYs).
- Derives a ratio of cost per health outcome.
  - $/QALY or $/DALY.

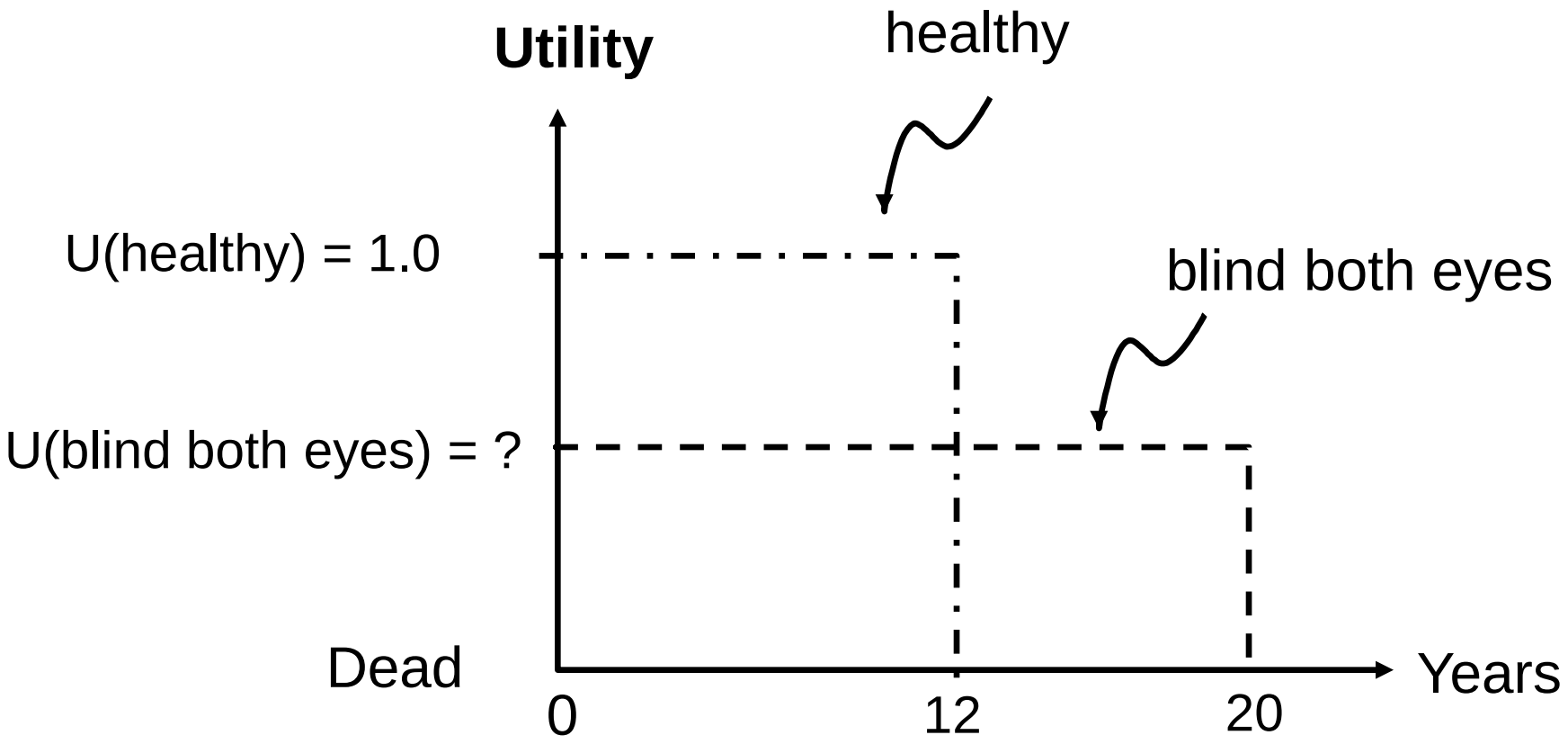
When Is CUA Used?

- When quality of life is ***the*** important outcome.
- When the program affects both morbidity and mortality.
- When programs being compared have a wide range of outcomes.
- When one of the programs being compared has already been evaluated using CUA.

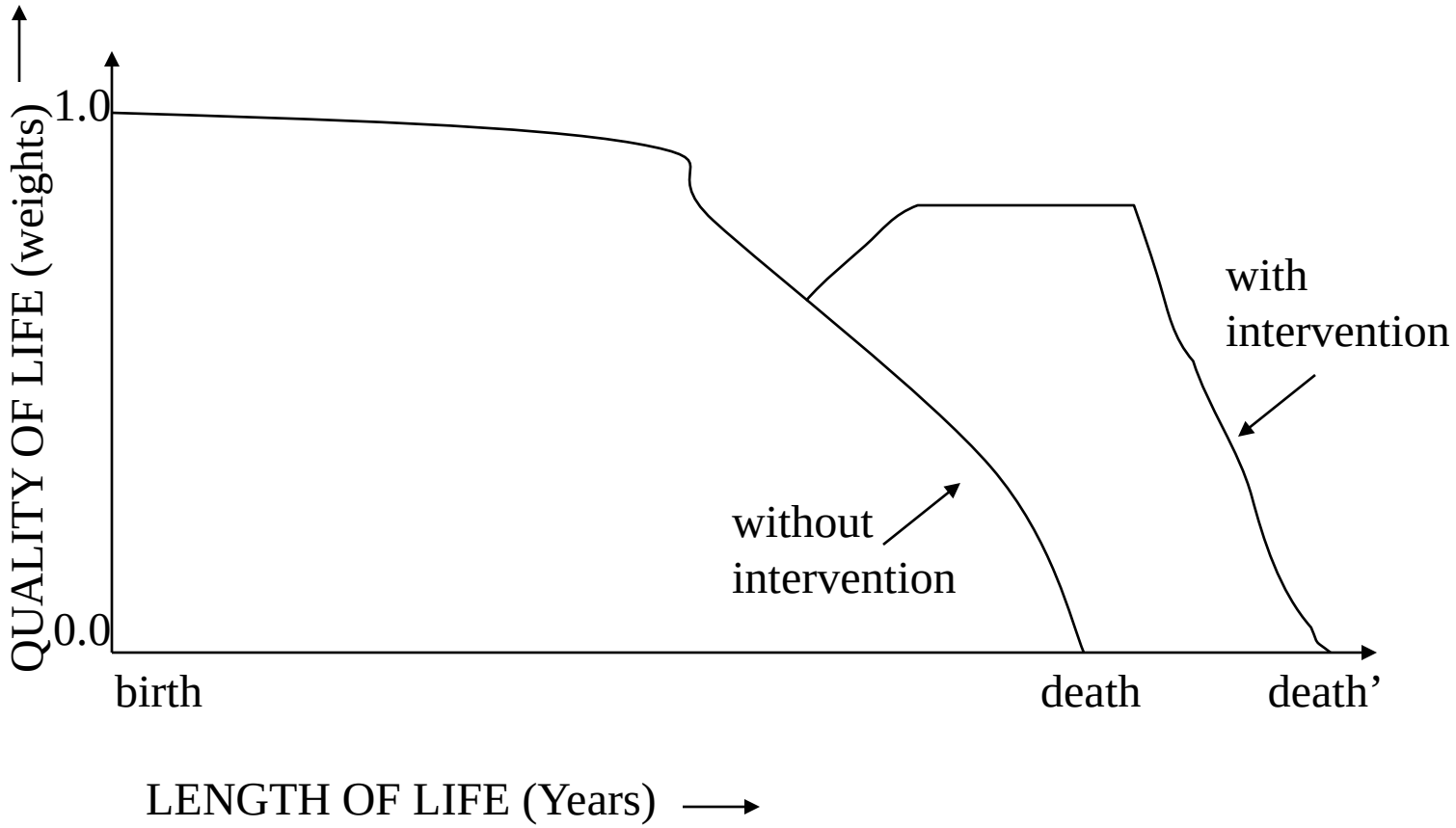
Quantify Benefits — CUA

- Utilities, or preference weights, are:
  - A quantitative approach for describing *preferences* for quality of life.
  - Typically based on a 0 to 1 scale, where:
    - 0 = death.
    - 1 = perfect health.

Time Trade-Off



Valuation of Benefits in a CEA:
Combining Length of Life with Quality of Life



Where to Get QALY Weights?

Source	Examples	Disadvantages
Literature	▪ Individual studies ▪ CUA databases	▪ Lack of comparability
Indirect measures	▪ Beaver Dam study, QWB ▪ Joint US-Canadian health survey included HUI ▪ MEPS included EQ-5D US	▪ Only common diseases ▪ No severity levels
Direct measures	▪ Expert panel ▪ Special sample survey	▪ Expense ▪ Time ▪ Representation

QALY Weights for Chronic Diseases

- Data from MEPS, 2000–2002.
- Regression methods used to estimate disutility for 95 ICD-9 codes, controlling for:
  - Age, gender, comorbidity, race/ethnicity, income, education.
- Results—Marginal disutilities:
  - 389 Hypertension -0.0250
  - 410 Acute MI -0.0409
  - 427 Dysrhythmia -0.0190
  - 428 Heart failure -0.0635

Sullivan & Ghushchyan, *Medical Decision Making* 2006.

Health-related quality of life in adults who experienced maltreatment during childhood

Corso, Edwards, Fang, Mercy

American J of Public Health, June 2008

Study Objective

- To estimate the long-term impact of CM on health-related quality of life (HRQoL)
- … for use in developing lifetime estimates of reductions in quality-adjusted life years (QALYs) associated with CM
- …for eventual application in assessing the cost-effectiveness of interventions designed to prevent CM

Unique properties of ACE dataset

- Adult HMO members (Kaiser, California) self-reporting different forms of maltreatment during childhood
- Age span of adults is expansive
- SF-36 data was collected in Wave 2
- Other variables that have been shown to be correlated with CM exist in the data set
  - Other ACEs – parental drugs, imprisonment, divorce
  - Other socio-economic variables

Study Sample

- N = 8,667 in second survey wave
  - N = 7,641 agreed to complete SF-36
    - N = 6,815 completed all questions
- N = 6,168 in final sample
  - N = 25 dropped b/c missing info on CM
  - N = 622 dropped b/c missing info on one of the covariates needed to develop propensity score
- Demographics
  - Average age – 55.4 years (SD=14.9)
  - 53% female
  - 76% White

Study Design

- Utilities derived from the SF-36 score for each individual in the sample
- Propensity score methods were used to match cases (any CM) to controls (no CM)
- Eleven covariates included in logit model to estimate propensity score
  - Age, sex, race, education of mother, # of moves during childhood, parents owning home during childhood
  - Adverse exposures: witnessing parental violence, substance abuse, mental health, family member in prison, divorce

Results: Predicted Utilities, by Sample Population

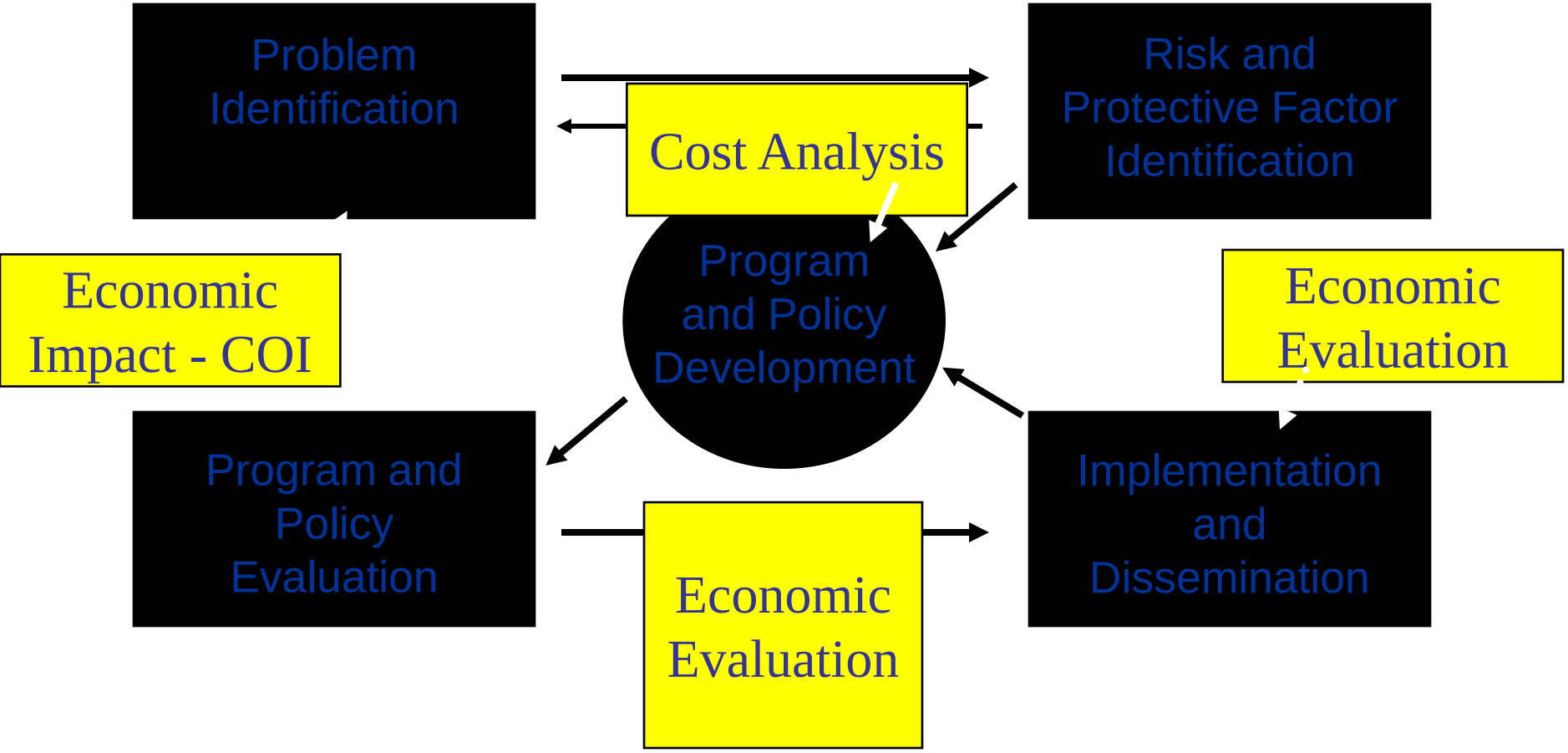
Age Group	No CM	CM	Difference in Utilities
19-39	.7990	.7575	**.042***
40-49	.7863	.7481	**.038***
50-59	.7873	.7642	**.023***
60-69	.7815	.7650	**.016***
70+	.7534	.7295	**.025***
ALL	.7813	.7534	**.028***

* Significant at $p < 0.05$

Predicted Utility Losses by Age Group and Type of CM

Age group	ALL	PA	SA	EA	PN	EN
19-39	.042*	.023*	.029*	.003	.018	.039*
40-49	.038*	.021*	.019*	.003	.011	.033*
50-59	.023*	.017*	.005	.007	.014	.015
60-69	.016*	.005	.018*	.004	.011	.028*
70+	.025*	.011	.013	**.051***	.027	.017
ALL	**.028***	**.015***	**.016***	**.010**	**.013**	**.026***

* Significant at $p < 0.05$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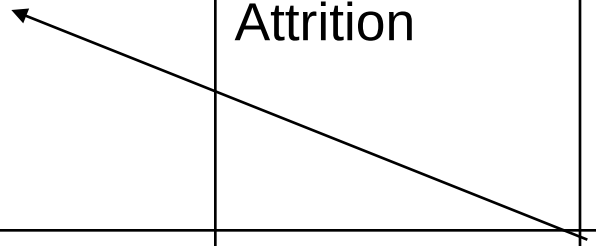
National Replication of Project SafeCare

Research Type	Population	Strategies	Intermed Outcomes	Final Outcomes
Evaluation Research	Participants	SafeCare	Participation Attrition	Decreased CM
Implement-ation Research	Providers	Implemen-tation Plan		Increased Fidelity

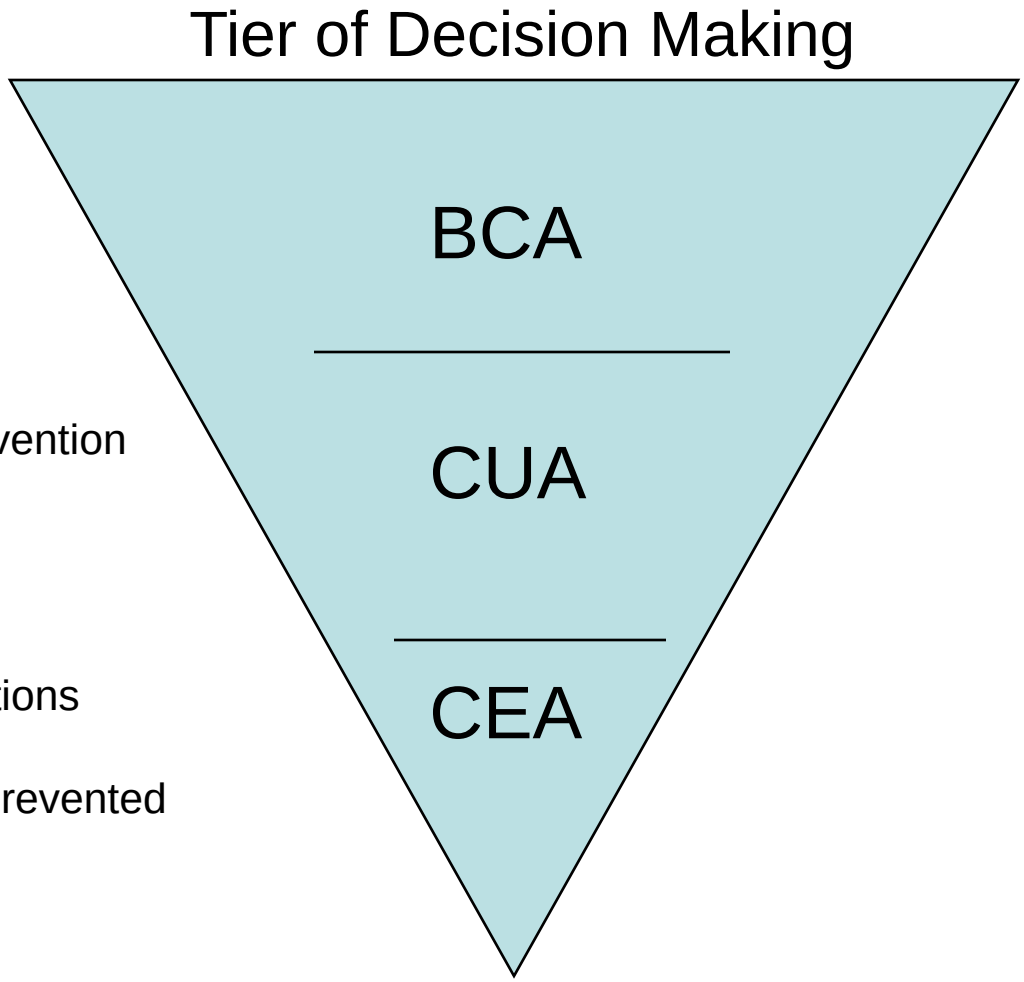


In Summary: Use of EE to Inform Prevention Policy

US Congress
Allocation decision between health, defense, and education.
Outcome comparator: $

Director of HHS
Allocation decision between violence prevention and cancer screening.
Outcome comparator: QALYs

Local HD
Allocation decision between two interventions designed to reduce child neglect.
Outcome comparator: Cases of neglect prevented



Final Comments

- Economic evaluation (EE) methods are valuable to decision making and for setting policy.

- For practitioners and evaluators, these skills are necessary because the DEMAND for these analyses is growing.

Resources

- Applying cost analysis to PH interventions (for sale at www.phf.org)

- Haddix, Teutsch, Corso – Prevention Effectiveness: A Guide to Economic Evaluation (Oxford University Press, 2003)

- Levin & McEwan. Cost-Effectiveness Analysis (Sage Publications, 2001)

Thank You!!

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