Webinar Content

- Overview of economic evaluation (EE) methods
- Cost of Illness (COI) analysis or economic impact analysis
- Programmatic cost analysis (CA)
What is Economic Evaluation (EE)?

Applied analytic methods to:
- Identify,
- Measure,
- Value, and
- Compare
the costs and consequences of
treatment* and prevention** 
strategies.

* Done a lot
** Done “not so much”
Why Care About EE?

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).
EE Methods

- Partial evaluation – costs only
  - Cost of illness (COI) analysis – Economic Impact Analyses
  - Cost analysis - programmatic cost analysis (CA)

- Full evaluation – costs and outcomes
  - Cost-benefit analysis (CBA); Benefit-cost analysis (BCA)
  - Cost-utility analysis (CUA)
  - Cost-effectiveness analysis (CEA)
Benefit-Cost Analysis (BCA)

- Standardizes both costs and outcomes in $
- Includes health *and* nonhealth outcomes
- Provides an objective summary measure
  - Net Benefits (B – C), Net present value (NPV)
  - Benefit-cost ratio (B / C)
Cost-Utility Analysis - CUA

- A method used to compare costs and benefits of interventions where benefits are expressed as the number of life years saved *adjusted* to account for loss of quality.

- Combines
  - Length of life (survival), 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
Cost-Effectiveness Analysis (CEA)

- Expresses outcomes in *natural* units.
  - (e.g., number of cases prevented or lives saved)
- Compares results with other interventions affecting the same outcome.
- Derives a *ratio* of cost per unit of outcome.
  - $/case prevented
  - $/life saved
  - $/life year saved
Cost-effective ≠ Cost-saving

Cost-effective

Cost-saving
What EE Method to Use?

Ex: Health vs. Defense
   Benefits = $
   \text{BCA}$

Ex: Violence vs. Obesity
   Benefits = QALYs
   \text{CUA}

Ex: Child Maltx vs. Child Maltx
   Benefits = Cases
   \text{CEA}
Economic Impact or Cost of Illness (COI) Analysis

• Estimates total costs incurred because of a disease or condition.
  – Costs of medical resources to treat disease/injury.
  – Costs of non-medical resources to treat disease/injury.
  – Losses in productivity due to disease.

• Uses:
  – To estimate economic burden of disease/injury
  – Benefits measure in BCA
  – In CUA, medical costs averted in numerator of CE ratio
  – In CEA, medical and productivity losses averted in numerator of CE ratio
Medical/Non-medical Costs

- Medical costs
  - Inpatient
  - Outpatient
  - MH
  - Rx

- Non-medical costs
  - Legal and justice system
  - Travel expenses to seek treatment
  - Childcare while seeking treatment
Productivity Losses – Human Capital Approach

• Assumes
  – Value of a worker’s productivity=earnings, bc a profit-maximizing employer will not pay a worker more than the additional value he/she contributes

• Valuation is simplest when an intervention affects mortality
  – Categorizes work loss (gain) by age, sex, occupation
  – Calculates the discounted value of expected labor
  – Uses gross earnings (before taxes) and includes fringe benefits
  – Imputes value for non-market labor such as household productivity
  – Occasionally subtracts future consumption of goods and services
HC Approach - Valuation of Morbidity

- Is more complicated than valuation of death
- Valuation may not simply be the number of work days lost, bc
  - Ability to return to work may be occupationally related
  - Returning to work doesn’t necessarily mean resuming the same level of productivity
  - The change in health status may necessitate job switching
COI Reporting

• Prevalence-based costs
  – Cross-sectional data
  – Includes all costs within a specific time period, regardless when event occurred
  – Useful for thinking about resources required for treatment within a given time period

• Incidence-based, or lifetime, costs
  – Longitudinal data
  – Includes lifetime costs for new events
  – Useful for thinking about potential savings from prevention
COI Methods

• All medical costs for the victims

• Only diagnosis-specific costs for the victims
  – Add attributable fraction

• Incremental cost approach
  – Match against control
  – Regression
  – Attributable fraction
Sum of All Medical Costs

- Prevalence-based, cross-sectional data
- Sum all annual medical costs comparing those reporting disease to those not reporting disease
- Pros: Good for relative comparisons and understanding of impact on the healthcare system
- Cons: Does not isolate the economic burden associated with the smoking, or understanding of co-morbidities
Sum only Diagnosis-Specific Costs

• Pros:
  – Represents lower-bound actual costs of disease
  – Good for incidence-based models

• Cons:
  – May underestimate costs, if co-morbid events are not included.
Attributable Fraction

- Also includes the indirect health expenditures associated with the behavior, through other diseases or conditions

- The attributable fraction is added to the total diagnosis-specific costs
Ruff, Volmer, Nowak, & Meyer
European Respiratory Journal
2000; 16: 385-390

THE ECONOMIC IMPACT OF SMOKING IN GERMANY
Methods

• Sources of information
  – Official German statistics
  – MEDLINE
  – German Institute for Medical Documentation and Information
  – Internet
  – Health insurance companies databases
  – German Federal Institute of Statistics
Methods

• Direct Costs
  – Healthcare resources: ambulatory care, drug treatment, hospital care, rehabilitation, long-term care
  – Resource units multiplied by unit costs

• Indirect Costs
  – Costs incurred from productivity losses, premature retirement, and premature mortality
  – Human Capital Approach
    • Life years lost before age 65 multiplied by gross annual income

• Intangible Costs (not included)
  – Patient’s quality of life (no reliable nationwide data)
## Methods

### Table 3. Diseases included in the calculation

<table>
<thead>
<tr>
<th>Disease category</th>
<th>ICD-9 code</th>
<th>Attributable risk %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral cavity and pharynx cancer</td>
<td>140–149</td>
<td>65</td>
</tr>
<tr>
<td>Larynx cancer</td>
<td>161</td>
<td>65</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>162</td>
<td>89</td>
</tr>
<tr>
<td>CHD</td>
<td>410–414</td>
<td>35</td>
</tr>
<tr>
<td>Stroke, CVD</td>
<td>433–438</td>
<td>28</td>
</tr>
<tr>
<td>AOD</td>
<td>440</td>
<td>28</td>
</tr>
<tr>
<td>COPD</td>
<td>490–491</td>
<td>73</td>
</tr>
</tbody>
</table>

CHD: coronary heart disease; CVD: cerebrovascular disease; AOD: atherosclerotic occulsive disease; COPD: chronic obstructive pulmonary disease.
# Results

Table 4. Smoking-attributable health care costs of smoking-related diseases

<table>
<thead>
<tr>
<th>Disease category</th>
<th>ICD-9 code</th>
<th>Direct</th>
<th>Total</th>
<th>Direct costs as % of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral cavity and pharynx cancer</td>
<td>140-149</td>
<td>124</td>
<td>771</td>
<td>16.0</td>
</tr>
<tr>
<td>Larynx cancer</td>
<td>161</td>
<td>47</td>
<td>226</td>
<td>20.7</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>162</td>
<td>559</td>
<td>2593</td>
<td>21.6</td>
</tr>
<tr>
<td>CHD</td>
<td>410-414</td>
<td>2692</td>
<td>4963</td>
<td>54.2</td>
</tr>
<tr>
<td>Stroke CVD</td>
<td>433-438</td>
<td>1162</td>
<td>1774</td>
<td>65.5</td>
</tr>
<tr>
<td>AOD</td>
<td>440</td>
<td>625</td>
<td>762</td>
<td>82.0</td>
</tr>
<tr>
<td>COPD</td>
<td>490-491</td>
<td>3269</td>
<td>5471</td>
<td>59.7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>8478</td>
<td>16561</td>
<td>51.1</td>
</tr>
</tbody>
</table>

Data represents costs in million EURO. CHD: coronary heart disease; CVD: cerebrovascular disease; AOD: atherosclerotic occlusive disease; COPD: chronic obstructive pulmonary disease.
Fig. 1. = Total costs made up of direct costs (□) and indirect costs (□) in million EURO by disease category. OPC: oral cavity and pharynx cancer; LXC: larynx cancer; LGC: lung cancer; CHD: coronary heart disease; CVD: cerebrovascular disease; AOD: atherosclerotic occlusive disease; COPD: chronic obstructive pulmonary disease.
Common Mistakes in COI Analyses

• Using cost estimates from different sources without converting into the same base year.
• Not adjusting market prices to reflect true costs.
• Combining reporting methods in same analysis
  – Annual vs lifetime costs
• Not using present value of future potential earnings.
So What?

- COI highlights the magnitude of the burden relative to other burdens.
- It provides data to argue for more resources to prevent the burden.
- Used with estimates of costs to prevent the burden, COI can provide policy-makers with return-on-investment information.
Programmatic Cost Analysis

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

- Costs are the **value of the resources** (people, buildings, equipment and supplies) used to produce a good or a service.
What are Resources?

Resources are the:

- People
- Places, and
- Things needed to carry out a task.

*Resources are what we spend our money on!*

*What they cost can be computed many different ways.*
Cost Analysis

• Typically the first step in economic evaluation.

• Estimates total costs of running a program.

• Important for realizing costs from varying perspectives.
  – e.g., incurred by program, incurred by participant

• Important for budget justification, decision making, and forecasting.

• Type of cost analysis warrants which costs are included.

• IMPORTANT: not focusing on program outcomes... yet.
Financial Costs

- Financial Costs
  - Monetary expenditures for resources required to implement the program – based on market prices
  - Typically found in the budget proposal
  - 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)

- **Shadow prices** used when market price does not accurately reflect the value of the good.
More Ways to Talk About “Costs”

• Direct costs
  – Those costs that are directly related to the project or intervention or the specific task at hand

• Indirect costs
  – Also called overhead costs – these are the “support” costs, including admin, accounting/finance management, office supplies, maybe utilities, etc....
Cost Analysis Terms

• Fixed Cost
  – Cost incurred only one time regardless of the number of times the intervention is conducted, i.e., the cost of staff training

• Variable Cost
  – Cost that varies with the number of times the intervention is conducted or with the number of clients covered, i.e., the amount of condoms per clients.
Total Costs (TC)

$$TC = (P_1 \times Q_1) + (P_2 \times Q_2) + \ldots + (P_n \times Q_n) = \sum_{i=1}^{n} (P_i \times Q_i)$$

where
- $P_1 = \text{Value of resource 1}$
- $Q_1 = \text{Quantity of resource 1 used}$
- $P_2 = \text{Value of resource 2}$
- $Q_2 = \text{Quantity of resource 2 used}$
- $\ldots$
- $P_n = \text{Value of resource n}$
- $Q_n = \text{Quantity of resource n used}$
Average Costs (AC)

- Total resource costs divided by total units of output.

\[ AC = \frac{TC}{Q} \]

Where

- TC = Total costs
- Q = Total units of output
Marginal Cost (MC)

- The marginal cost is the resource costs associated with producing one additional (or one less) unit of the same intervention.

\[ MC = \frac{(TC' - TC)}{(Q' - Q)} \]

Where
- \( TC \) = total costs at the current activity level
- \( TC' \) = total costs at the higher activity level
- \( Q \) = current output level
- \( Q' \) = higher output level
Average vs. Marginal Cost

• The marginal cost can be lower or higher than the average cost, depending on whether or not the program is operating at full capacity.

• When MC<AC, “economies of scale” are being realized.
  – This is the fixed versus variable costs issue
Additional Factors and Issues

- **Scaling**
  - How many times you do the intervention, or how many clients you serve, will affect your average cost – be careful!

- **Comparability**
  - Must count costs the same way for a valid comparison

- **Transferability**
  - Prices differ from market to market, and across time
Ritzwoller, Sukhanova, Gaglio & Glasgow
Annals of Behavioral Medicine
2009; 37(2): 218-227

COSTING BEHAVIORAL INTERVENTIONS: A PRACTICAL GUIDE TO ENHANCE TRANSLATION
Smoking Less, Living More Program

- Targeted adult smokers scheduled for surgery or diagnostic procedure
- Randomized to treatment or control arm of study
- 6-month intervention with telephone counseling, newsletters, and health education
- Completed a cost analysis of the intervention
Five-Step Process

1. Perspective of the Analysis
2. Identify Intervention Components
3. Capture Intervention Costs
4. Data Analysis
5. Sensitivity Analysis
Perspective of the Analysis

• Must consider decision maker
  – Medicare/Medicaid
  – Health plan
  – Community
  – Public health entity

• For future dissemination purposes include
  – Capital equipment
  – Prescription drugs
  – Technology used to deliver intervention
Identify Intervention Components

• Research
  – Removed from cost analysis
  – Examples
    • Grant administration, IRB approval, assessments and testing (not part of intervention), manuscript preparation

• Development
  – Necessary to differentiate those that would need to be replicated in the future and those that would not
  – Examples
    • Development of protocols and assessment, website design, telephone script production

• Implementation/Intervention
  – Recruitment
    • Include costs present in replication but exclude research specific such as informed consent
  – All Others
    • Labor, counseling, monitoring, supply, printing, and mailing costs
Capture Intervention Costs

- Prospective collection
- EXCEL-based templates collected on a monthly basis
- Personnel
  - Staff filled in time logs chronicling by hours or FTE
- Staff estimated to have spent 5-10 minutes per month recording resource use
<table>
<thead>
<tr>
<th>Project manager related activities</th>
<th>Sep 05</th>
<th>Oct 05</th>
<th>Nov 05</th>
<th>Dec 05</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Meetings</td>
<td></td>
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</tr>
<tr>
<td>Entire team</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Recruitment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol related</td>
<td>5</td>
<td></td>
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<tr>
<td>Conference calls</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Meeting preparation</td>
<td>6</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Human resources—hiring staff</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation and training for staff</td>
<td>12</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Grant Administration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budget</td>
<td>12</td>
<td>15</td>
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<td>15</td>
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<tr>
<td>IRB preparation</td>
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<td></td>
</tr>
<tr>
<td>Project related</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruitment scripts and materials</td>
<td></td>
<td></td>
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<tr>
<td>Baseline assessments</td>
<td>6</td>
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<tr>
<td>Travel to patient sample collections</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td></td>
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<tr>
<td>Mailing and/or administering follow-up assessments</td>
<td>2</td>
<td>15</td>
<td>14</td>
<td></td>
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<tr>
<td>Development of procedures for study tasks</td>
<td>21</td>
<td>10</td>
<td>12</td>
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<tr>
<td>Monitoring</td>
<td></td>
<td></td>
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<tr>
<td>Sample collection ( prep and administration)</td>
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<tr>
<td>Miscellaneous</td>
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<tr>
<td>E-mail correspondence</td>
<td></td>
<td></td>
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<tr>
<td>Data management</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Data collection</td>
<td>5</td>
<td>3</td>
<td>5</td>
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<tr>
<td>Database development</td>
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<tr>
<td>Data entry</td>
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<td>Other</td>
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<tr>
<td>Travel</td>
<td></td>
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<tr>
<td>Off-site commute</td>
<td>9</td>
<td>12</td>
<td>7</td>
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<tr>
<td>Scientific conferences</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mailing, stuffing envelopes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>82</td>
<td>74</td>
<td>79</td>
</tr>
</tbody>
</table>
Data Analysis

- Staff not asked to categorize resource use as research/development/implementation
  - Rather, researchers divvied the aggregated costs based on description of activity and knowledge of the intervention program
- Personnel time valued using salaries and benefit data of actual personnel
- Summarized as total intervention costs and cost per intervention participant
### Table 2: Intervention and Recruitment Cost Components

<table>
<thead>
<tr>
<th>Cost Element</th>
<th>Variable ($)</th>
<th>Fixed ($)</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recruitment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project staff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mailings</td>
<td>1,908</td>
<td></td>
<td>1,908</td>
</tr>
<tr>
<td>E-mail</td>
<td>3,990</td>
<td></td>
<td>3,990</td>
</tr>
<tr>
<td>Overhead*</td>
<td>24,912</td>
<td></td>
<td>24,912</td>
</tr>
<tr>
<td>Subject identification</td>
<td>1,470</td>
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<tr>
<td>Telephone interviewers</td>
<td></td>
<td></td>
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<tr>
<td>Training</td>
<td>3,046</td>
<td></td>
<td>3,046</td>
</tr>
<tr>
<td>Enrollment/eligibility calls</td>
<td>8,104</td>
<td></td>
<td>8,104</td>
</tr>
<tr>
<td>Supplies</td>
<td>776</td>
<td></td>
<td>776</td>
</tr>
<tr>
<td>Total recruitment</td>
<td>14,778</td>
<td>29,428</td>
<td>44,206</td>
</tr>
<tr>
<td><strong>Intervention components</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tailored newsletter</td>
<td>10,102</td>
<td></td>
<td>10,102</td>
</tr>
<tr>
<td>Interviewers training and supervision</td>
<td>23,865</td>
<td></td>
<td>23,865</td>
</tr>
<tr>
<td>Phone counseling/data management</td>
<td>11,872</td>
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<td>11,872</td>
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<tr>
<td>Project meetings and email</td>
<td>5,667</td>
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<td>5,667</td>
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<tr>
<td>Equipment and materials</td>
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<tr>
<td>Personnel management</td>
<td>9,643</td>
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<td>9,643</td>
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<tr>
<td>Overhead*</td>
<td>4,603</td>
<td></td>
<td>4,603</td>
</tr>
<tr>
<td>3-Month intervention</td>
<td>21,974</td>
<td>46,668</td>
<td>68,642</td>
</tr>
<tr>
<td>Total recruitment plus 3-month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>intervention</td>
<td></td>
<td></td>
<td>112,848</td>
</tr>
</tbody>
</table>

*Overhead includes office tasks as printing, copy making, unscheduled staff meetings, phone conversations, intervention preparation time, commute to the intervention site where calls are made, and newsletters are produced, etc.*
Scale Analysis

• Used fixed and variable costs to estimate how the total cost would vary depending upon the number of enrolled participants
Conclusion

• Cost analysis is an important first step in economic evaluation.

• Despite variation in data collected across sites, cost data provides important preliminary information on how much it may cost to replicate the program at hand.

• and more information about the relationship between outcomes and costs for future EEs.
Content of Part II Webinar

- Overview of BCA and CEA
- Measuring outcomes, QALYs, for use in CUAs
Thank You!

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