Economic Evaluation of the Environmental Burden of Disease

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Workshop on Environmental Burden of Disease
University of Ottawa
February 12th 2007

“The lack of quantification and valuation of EH hazards prevent any dialogue on the issue. It’s when you put a figure on the environmental health burden of disease that you can talk with decision-makers especially the Ministry of Finance. In addition, in the countries where we are working, EIAs are mainly used for donor-funded development projects with little attention to economic valuation. CEA and CBA are not used for health and environment-related projects. Both tools are complementary, and should be internalised in development work.”

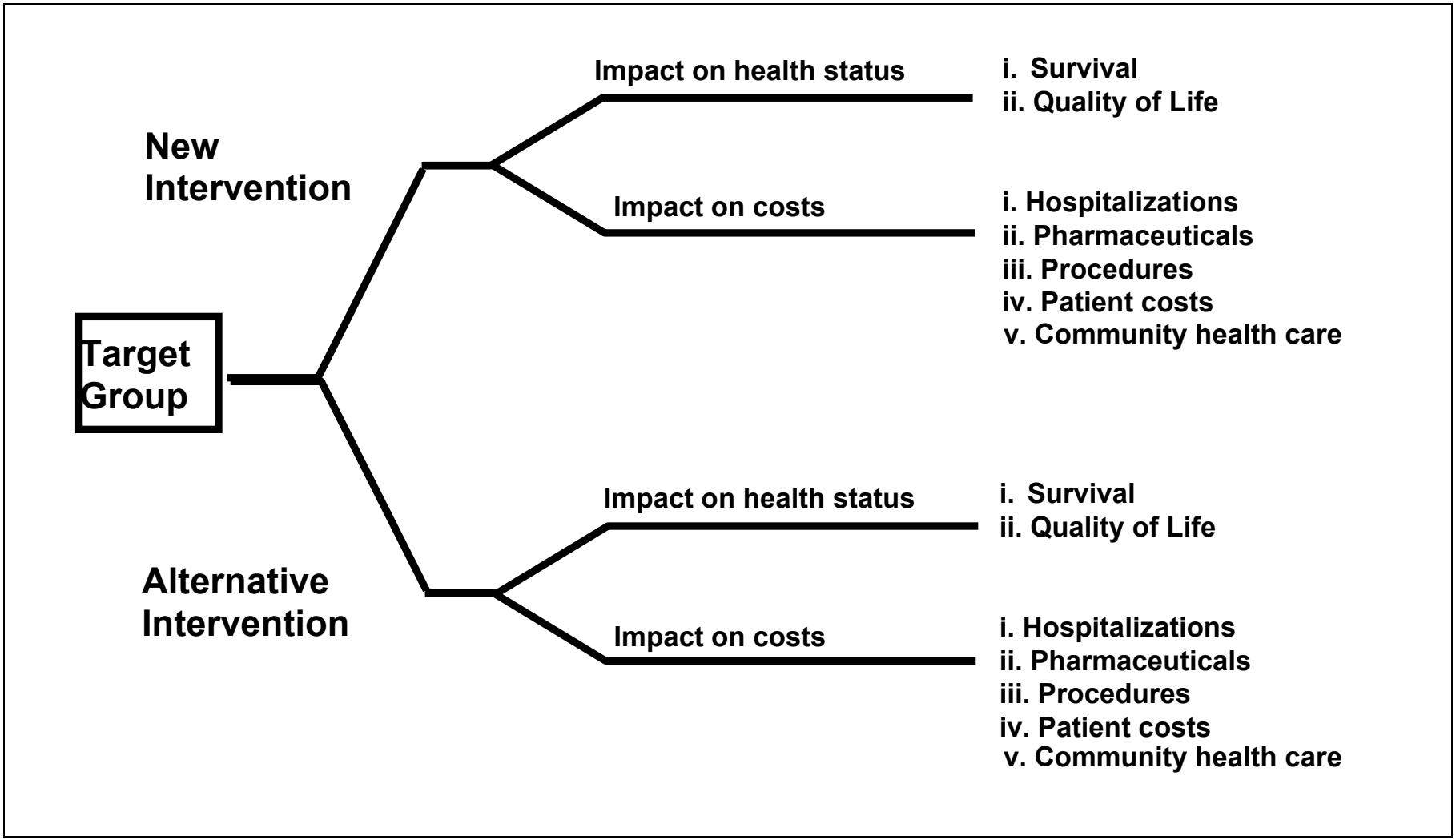
From the HELI review of environment and health decision-making in a developing country context

What are Economic Evaluations?

- A systematic framework to assess the relative costs and benefits of alternative interventions.

- By choosing to provide interventions that are deemed "cost-effective", public expenditure should be more efficient and societal benefits should increase

Nature of an Economic Evaluation



Types of Analysis

Form of Analysis	Measurement of Costs	Measurement of Benefit	Synthesis of Costs and Benefits
Cost Minimization Analysis	Dollars	None	Incremental cost
Cost Effectiveness Analysis	Dollars	Single dimension of effectiveness (e.g. life years gained)	Incremental cost effectiveness : incremental cost per unit gained
Cost Utility Analysis	Dollars	Utility gained (e.g. QALYs - quality adjusted life years)	Incremental cost-effectiveness: incremental cost per QALY gained
Cost Benefit Analysis	Dollars	Monetary value of benefits gained	Net benefit gained

Burden of Disease Studies

- Measure the disease impacts in terms of costs and health effects
  - Mortality from early death
    - Life years lost
    - Productivity losses
  - Morbidity from disease (long term chronic illness and short term effects)
    - Quality of life effects
    - Productivity losses
  - Costs
    - Costs of heath care associated with chronic and short term illness

Problems with Existing Studies

- Wide variation in estimates for the same disease
- Over estimates
  - Bloom study illustrated that sum of burdens twice health care expenditure
  - Use of human capital approach for indirect costs
- Greater focus on prevalence rather than incidence costs of disease

Cost of Illness Studies and Economic Evaluations

- Cost of illness studies are not economic studies
  - They measure the costs associated with the disease not the value of interventions or programs
  - Don’t help in resource allocation

Why Estimate Environmental Burden of Disease

- Estimates of the burden of disease can highlight the importance of the issue
- Burden of diseases provide a baseline from which to assess the impacts of programs designed to effect the epidemiology of disease
- Burden of disease estimates also provide a basis from which to assess the value of further research
- Potentially useful in analyzing trends

Components of Environmental Burden of Disease

- Mortality burden
- Morbidity burden

Mortality Burden

- Need to identify proportion of disease cases associated with environmental factors
  - Attributable fraction
- Assess impact of disease on life expectancy
  - Epidemiological modelling/decision analysis
- Estimate life years lost weighted by quality of life
  - Quality adjusted life years
- Estimate productivity losses due to early death

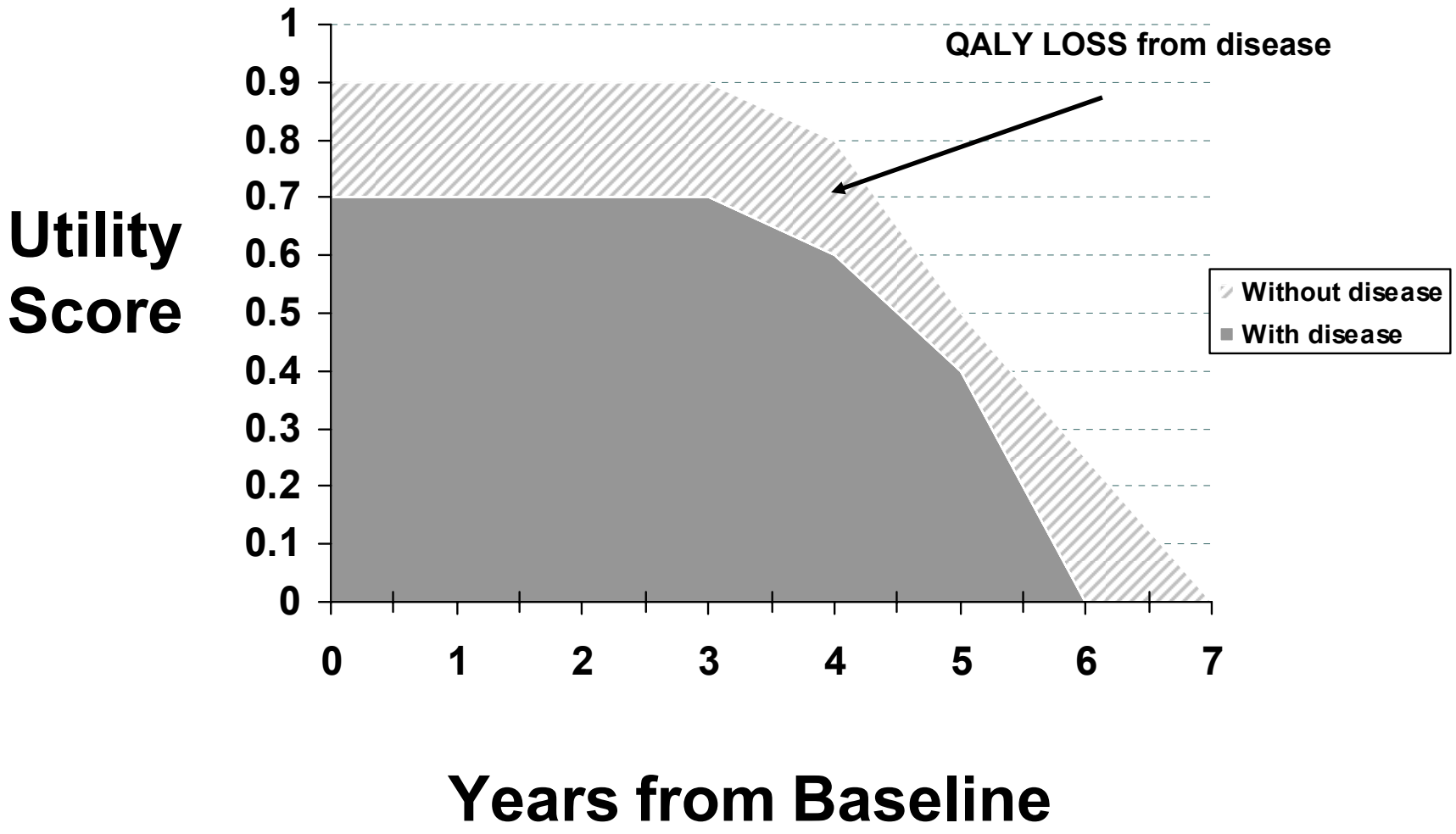
Morbidity Burden

- Again, need to identify proportion of disease cases associated with environmental factors
  - Attributable fraction
- Determine quality of life detriments due to illness
  - Disutility
- Determine productivity losses due to illness
- Determine health care costs associated with illness

Incorporating Quality of Life: Quality Adjusted Life Years

- Most common outcome measure in cost-utility analysis
- Method of placing a value on both mortality and morbidity to facilitate combination into one measure of benefit
- Life years weighted by patient's quality of life
- Quality of life expressed in terms of a utility score: score between 0 (= death) and 1 (= perfect health)
- Morbidity often greater effect on QALYs than mortality

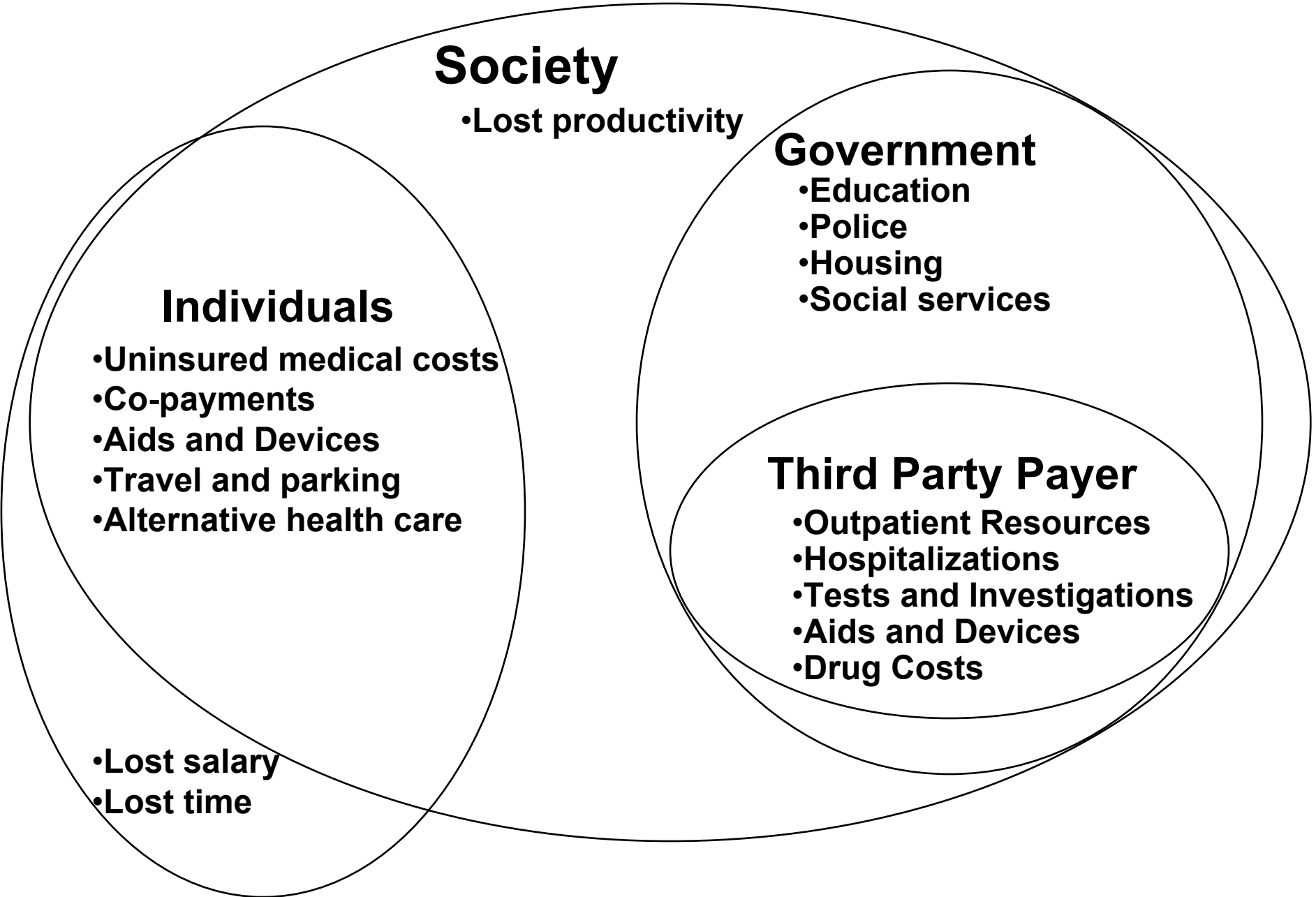
QALY Estimation



Coyle D, Stieb D, Burnett RT, DeCivita P, Krewski D, Chen Y, Thun MJ. Impact of particulate air pollution on quality-adjusted life expectancy in Canada. JToxicol Environ Health 2003.

- Quantified the effects of air pollution on mortality in terms of quality-adjusted life expectancy in Canada.
- Conducted using a decision analytic model using Monte Carlo simulation techniques.
- A one-unit reduction in sulfate air pollution would yield a mean annual increase in Quality-Adjusted Life Years (QALYs) of 20,960.
- Analysis suggests that an investment in Canada of over 1 billion dollars per annum would be an efficient use of resources if it could be demonstrated that this would reduce sulfate concentrations in ambient air by 1 microg/m^3

Range of Costs



Steps in Costing Health Care

- Identification of Resources
- Measurement of Resources
- Valuation of Resources

Costs in Economic Evaluations based on Environmental Burden

- Health care costs of disease caused by environmental factors
- Costs of programs/ policies to reduce environmental impact
- Costs of disease arising from increased life expectancy?

Productivity costs

- Short term absences from employment
- Long term absence
- Death

Alternate methods

- Human capital
  - All absences valued at wage rate
  - Highly inflated burdens of disease
- Friction cost method
  - Recognises that productivity losses limited by behaviour of the labour market
  - More realistic approach

Friction cost method

- Short term absences
  - Measured by income elasticity
- Long term absences/death
  - Measured by length of vacancies
- Reduced capacity
  - Measured through survey

RTI report to EPA on Costs of Illness for Environmentally Related Health Effects in Older Americans, 2005

- Estimated costs of six health conditions for which environmental exposure are known or suspected to be an important contributing factor.
  - chronic respiratory disease, lung cancer, heart disease, pneumonia, stroke, gastrointestinal illness
- Incorporated medical costs, nursing costs and lost productivity (human capital approach)
- Disease burdens ranged from $1 billion for GI and $50 billion for heart disease
- Analysis could not distinguish burden arising from environmental factors.

Generic Problems with Conducting Burden of Disease Studies

- Difficulties in developing epidemiological models of disease
  - Data availability
  - Changes in disease over time
- Difficulty in determining costs attributable to disease
  - Existence of co morbidities
  - Inclusion or exclusion of health care costs averted?
- Availability/acceptability of utility estimates

Specific Problems with Environmental Related Economic Evaluations

- Estimating the attributable fraction of disease

- Estimating the impact of interventions or policies

Problems: Attributable Fraction

"Unfortunately, the science and empirical evidence regarding the epidemiological links between environmental exposures and these health outcomes are not sufficiently advanced to reliably estimate this attributable fraction."

RTI report to EPA on Costs of Illness for Environmentally Related Health Effects in Older Americans, 2005

Problems: Impact of Programs

- Difficulties in forecasting long term impact of environmental programs/interventions
  - Uptake in programs
  - Effectiveness in programs
  - Impact on disease incidence and progression

Conclusions

- Estimates of the Environmental Burden of Disease can be used to model the impact of alternate policies or programs
- Need to incorporate effects of mortality and morbidity in terms of costs and quality of life
- Major limitations relate to lack of data on attributable fraction of disease and impact of potential programs