

Valuing Health Benefits of Air Pollution Reduction Policies: A Case Study of Asthma Related Impacts

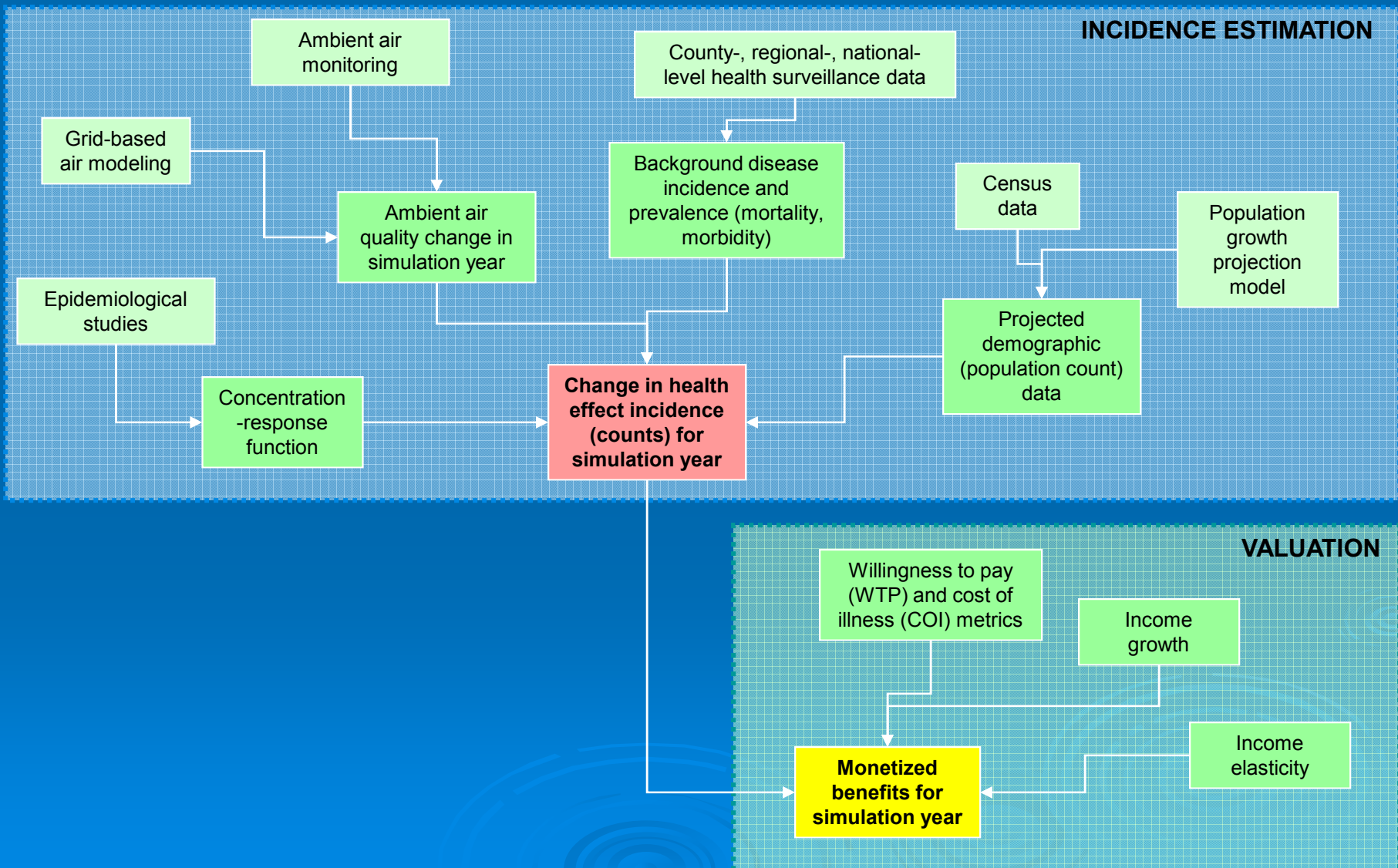
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How Do We Quantify and Monetize Benefits?



What are the asthma-related health impacts associated with air pollution?

➤ Clinical measures:

- Reduced FEV1

➤ Epidemiological outcomes:

- Increased symptoms and symptom severity
- Increased medication use
- Increased doctor visits
- Increased asthma ER visits
- Increased hospital admissions
- Lost work and school days
- Increased prevalence of asthma (no consensus on effect)

Economic Valuation of Asthma Impacts

- Multiple components
 - 1) Value of avoided averting behavior, e.g. reductions in restrictions on outdoor activity
 - 2) Value of avoided mitigating behavior, e.g. use of prophylactic steroids
 - 3) Value of lost work, lost school, and medical costs
 - 4) Value of avoided pain and suffering
- Where possible, it is best to use willingness to pay measures that capture all of the above components
- Often, only components 1 – 3 can be estimated.

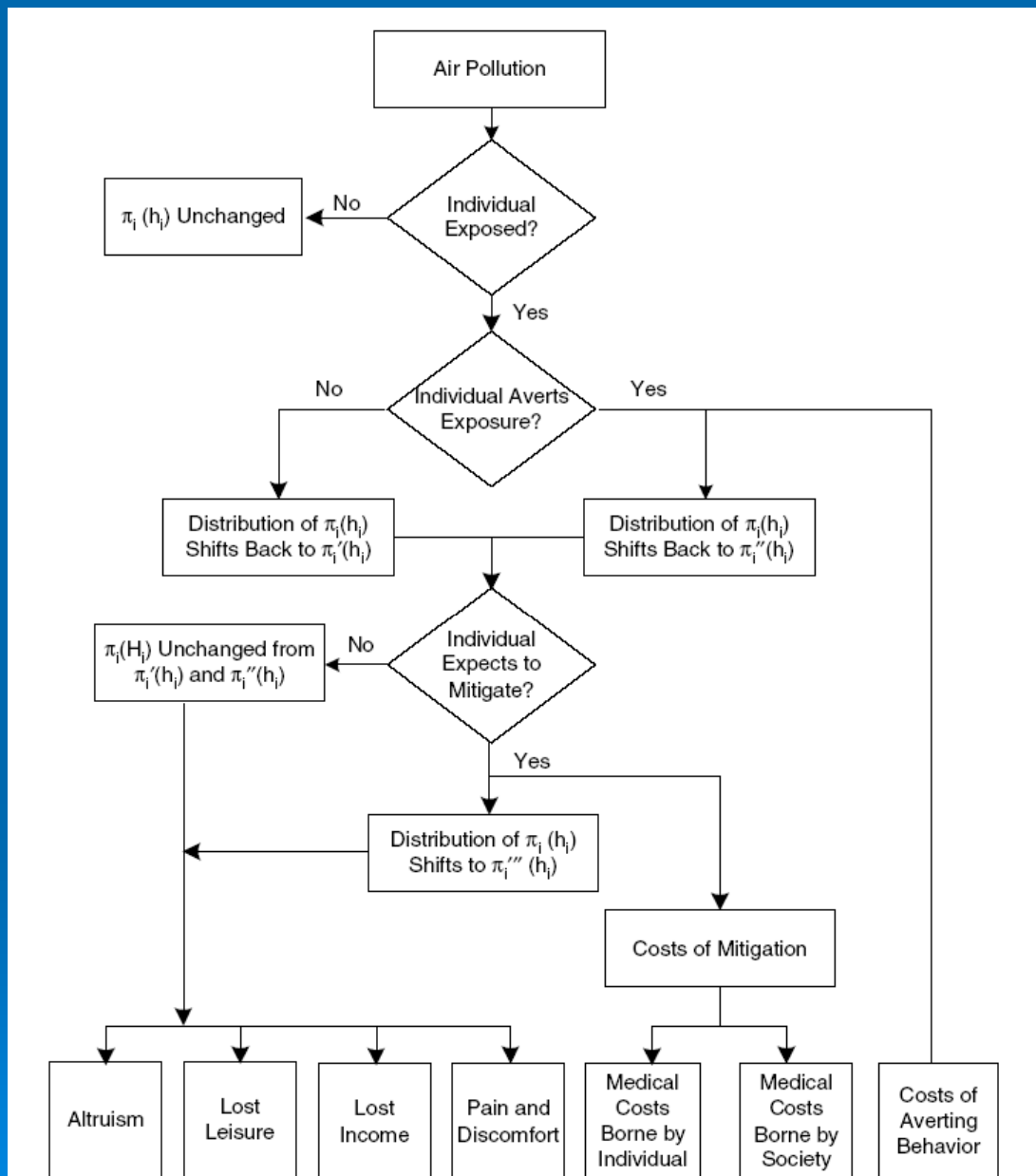


Figure 3-1. Social Costs of Air Pollution, Health Related
 Note: Reproduced from Desvousges, Johnson, and Banzhaf (1998), p. 131.

Issues with valuing asthma impacts

- No estimates available to measure value of averting and mitigating behavior – most epidemiology studies do not account for these factors
- Cost of illness estimates for ER visits and hospital admissions are likely substantial underestimates of willingness to pay

Issues with valuing asthma impacts

- Asthma exacerbations or “attacks” are not well defined endpoints and may have very different impacts depending on the underlying severity of asthma in the affected individuals
- Two key issues: Distribution of asthma severity in the population and distributions of severity of asthma episodes conditional on asthma severity
 - Some recent studies suggest air pollution increases the probability of a severe asthma attack relative to a less severe attack

Table 5-3. NHLBI Classification Scheme

	Symptoms ^a	Nighttime Symptoms
STEP 4: Severe Persistent	Continual symptoms Limited physical activity Frequent exacerbations	Frequent
STEP 3: Moderate Persistent	Daily symptoms Daily use of inhaled beta2-agonist Exacerbations affect activity Exacerbations ≥ 2 times/wk; may last days	≥ 1 time/week
STEP 2: Mild Persistent	Symptoms > 2 times/week but < 1 time/day Exacerbations may affect activity	> 2 times/month
STEP 1: Mild Intermittent	Symptoms ≤ 2 times/week Asymptomatic; normal PEF between exacerbations Exacerbations brief; intensity may vary	≤ 2 times/month

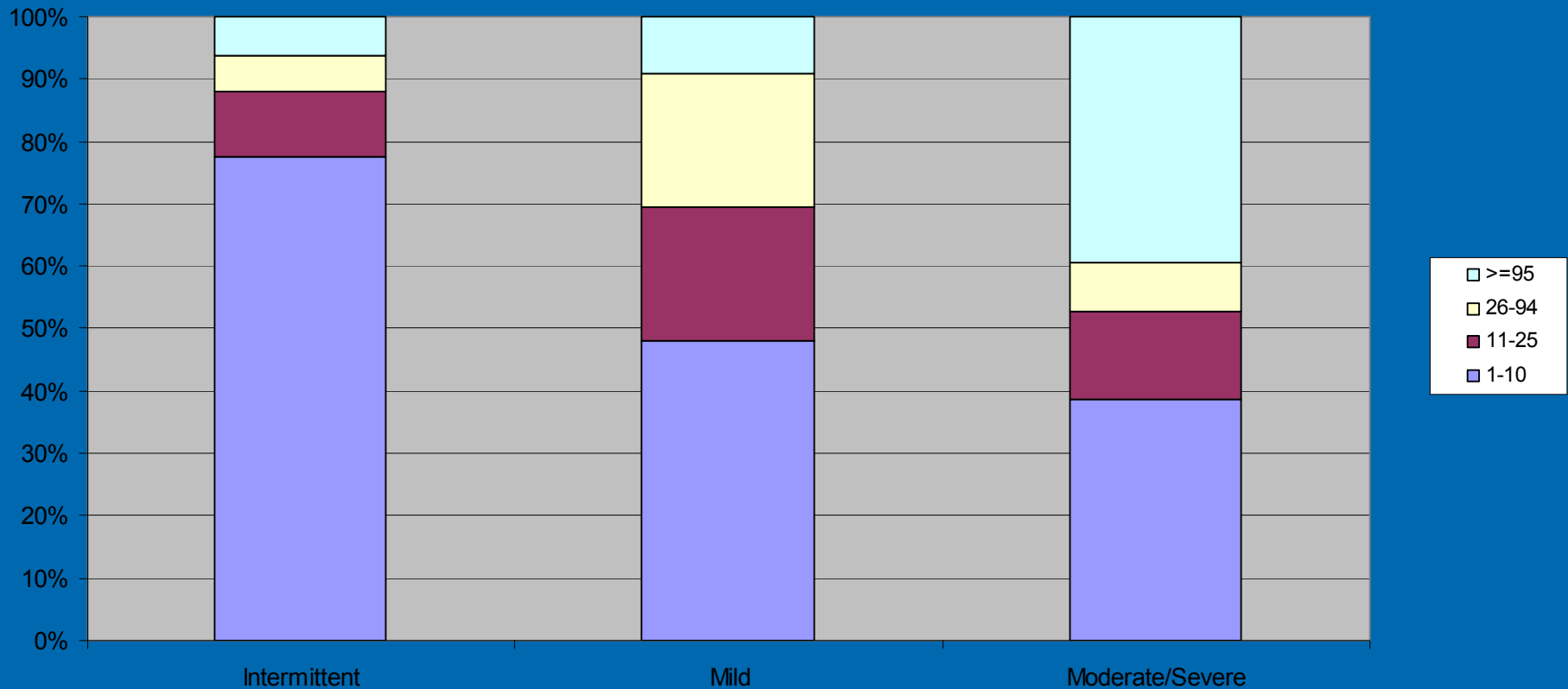
^a Patients at any level of severity can have mild, moderate, or severe exacerbations. Some patients with intermittent asthma experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms.

Source: Excerpted from National Heart, Lung, and Blood Institute (NHLBI) 1997. "Guidelines for Diagnosis and Management of Asthma." National Institutes of Health, National Heart, Lung, and Blood Institute.

Of the adult asthmatic respondents to the 1999 NHIS, 73% were classified as mild intermittent, 7% as mild persistent, and 20% as moderate or severe persistent.

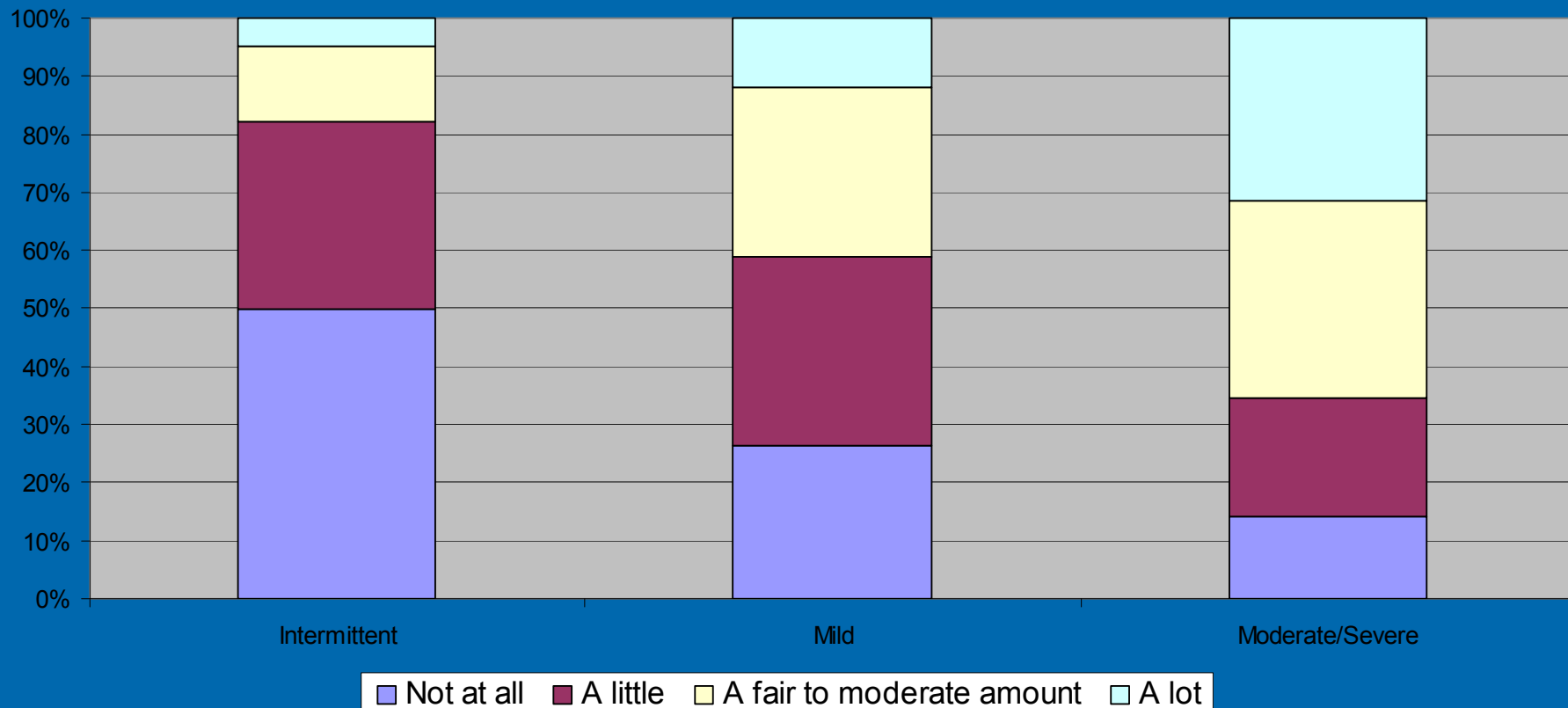
For asthmatic children, 78% were classified as mild intermittent, 8% were classified as mild persistent, and 14% were classified as moderate or severe persistent.

Adult Wheezing Attacks per Year By Asthma Severity (Based on 1999 NHIS)



Within the severity classifications, there was considerable variability in the number of asthma episodes. Some mild intermittent asthmatics had over 95 episodes in a year, while some moderate/severe asthmatics had only 1 episode in a year. However, the severity of these episodes varies.

**% of Asthmatic Sample Having to Restrict Activities Due to Wheezing Attacks in the Past 12 Months
(Based on 1999 NHIS)**



Most mild intermittent asthmatics indicated little to no activity restrictions, while most moderate/severe asthmatics indicated fair to moderate or a lot of activity restrictions due to their asthma episodes.

Implications for EPA's current methods

- Our current approach characterizes impacts of different severity, e.g. asthma exacerbations, ER visits, and hospitalizations, but does not differentiate asthma exacerbations by severity. The average willingness to pay for a moderate or worse asthma day is \$40, but this may not reflect the value to an asthmatic who is more likely to suffer an attack due to air pollution
- Recent research has found that perceptions and beliefs regarding asthma have as much or more impact than severity
- We are working to develop a more refined valuation approach that takes into account severity related probabilities of different outcomes

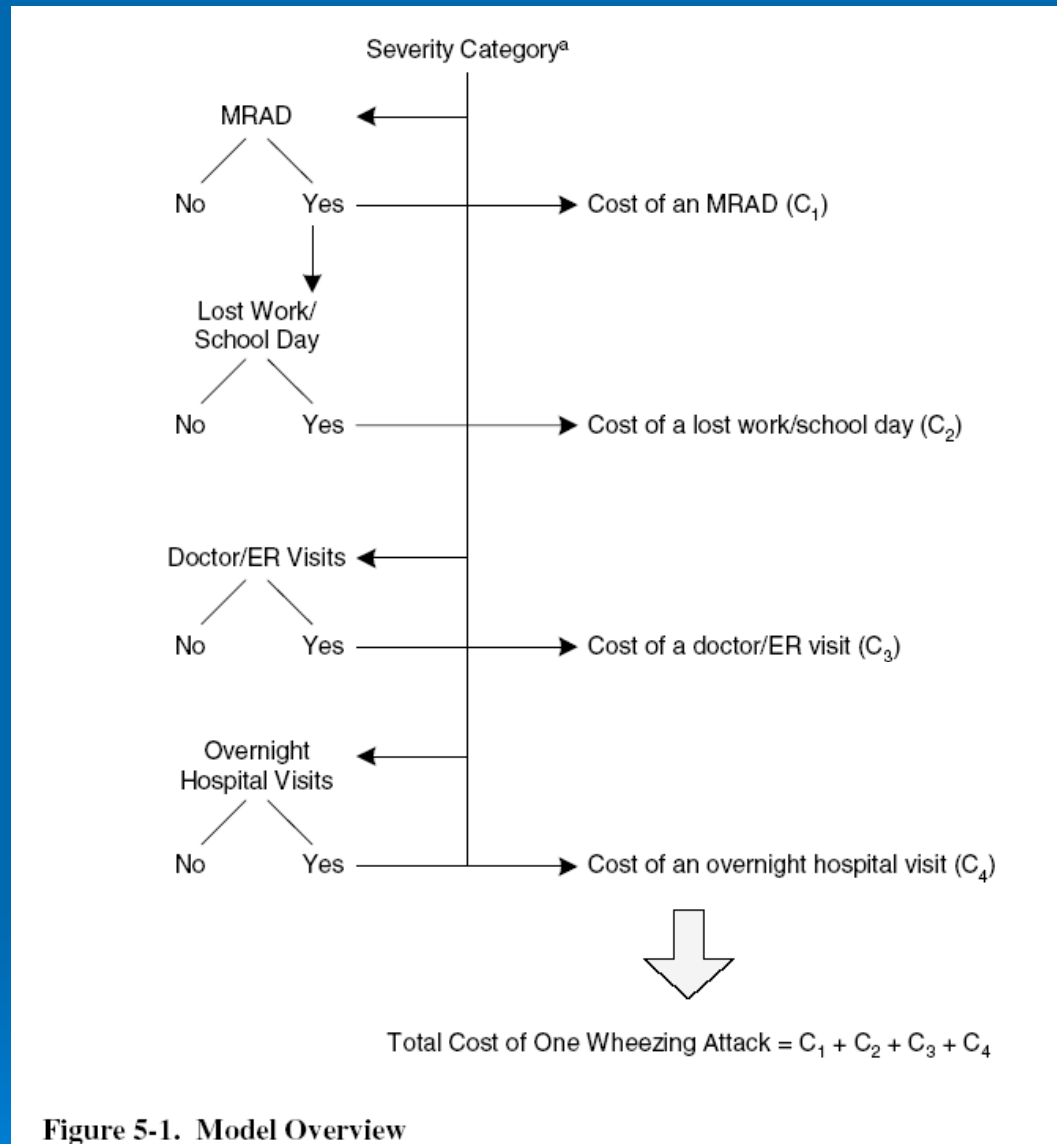


Figure 5-1. Model Overview

Example of a possible asthma impact valuation framework reflecting differences in severity of outcomes and underlying asthma severity

Conjoint Analysis Could Address Multidimensional Characterization of Asthma Attacks

- Swedish analyses by Johansson et al, 2003, 2004 estimated WTP for asthma treatments including attributes of asthma treatment options including type of maintenance treatment, additional reliever, time to onset and duration of reliever, number of symptom-free days (SFDs) per month, and out-of-pocket cost per month
- Walzer, 2007 looked at parents preferences for asthma treatment options in the U.S. including attributes of episode-free days, risk of exacerbation, information available for the long-term impact of the treatment, and out-of-pocket expenses
- DeShazo and Cameron (2004) evaluate WTP for illness profiles including asthma symptoms

Supplementary Slides



What Health Effects Do We Currently Quantify?

	PM	Ozone
Current		
Mortality	✓	✓
Chronic bronchitis	✓	
Nonfatal heart attacks	✓	
Hospital admissions	✓	✓
Asthma ER visits	✓	✓
Acute respiratory symptoms	✓	✓
Asthma attacks	✓	
Work loss days	✓	
Worker productivity		✓
School absence rates		✓

Emerging Public Health Impacts

- Infant mortality/low birth weight/pre-term births
- Decreased lung development
- Cancer
- Doctor visits
- New incidence of asthma
- Increased chronic heart disease – atherosclerosis
- Increased incidence of strokes

- Not quantified due to
 - Lack of appropriate baseline incidence rates
 - Not enough weight of evidence
 - Not easily monetized or characterized in terms of public health significance

How Do We Value Effects?

- Cost of illness (COI)
 - Hospital admissions
 - School absences
 - Work loss days
 - Worker productivity
 - Heart attacks
 - Stroke
- Willingness to Pay
 - Premature death
 - Chronic bronchitis
 - Respiratory symptoms



Cost of illness

- Captures the direct dollar savings to society of reducing a health effect
- Ignores the value to individuals of reduced pain and suffering
- Generally a lower bound when no WTP estimates are available
- Should include both immediate costs and long-term followup costs

Willingness to Pay

- Measures the complete value of avoiding a health outcome
- Relies on either revealed or stated preferences for risk reductions
 - Revealed preferences from labor market studies provide values for fatal risk reductions
 - Stated preferences from “contingent valuation” studies provide values for chronic illnesses and acute respiratory effects, as well for fatal risks
- Generally more uncertain than COI

Current mean values for health effects (2000 \$)

- Premature death: \$6.3 million (WTP)
- Chronic bronchitis: \$340,000 (WTP)
- Heart attacks \$67,000-\$141,000 (COI)
- Hospital admissions: \$7,000 - \$18,000 (COI)
- ER visits: \$300 (COI)
- Acute bronchitis \$360 (WTP)
- Respiratory symptoms \$15 - \$50 (WTP)
- Asthma attacks \$40 (WTP)
- Work loss days \$110 (COI)
- School loss days \$75 (COI)

Many of the Valuation Estimates We Have Are Quite Old

- Premature death: (VSL) 1992 to 2000
- Chronic bronchitis: 1991
- Heart attacks 1990 to 1998
- Hospital admissions: 2000
- ER visits: 1997 to 1999
- Acute bronchitis 1994
- Respiratory symptoms 1986
- Asthma attacks 1986
- Work loss days 2000
- School loss days 2000

Potential Updates

- EPA is developing an updated value for mortality risk reductions
- We are using the Medical Expenditure Panel Survey (Agency for Healthcare Research and Quality) to develop updated cost of illness profiles for a number of chronic conditions and illnesses
- We are evaluating a number of panel data sets to provide updated estimates of wage and earnings impacts of chronic diseases
- We are evaluating disease model approaches to improve estimates for diseases such as asthma and heart disease