The Health and Related Economic Benefits of Attaining Healthful Air in the San Joaquin Valley

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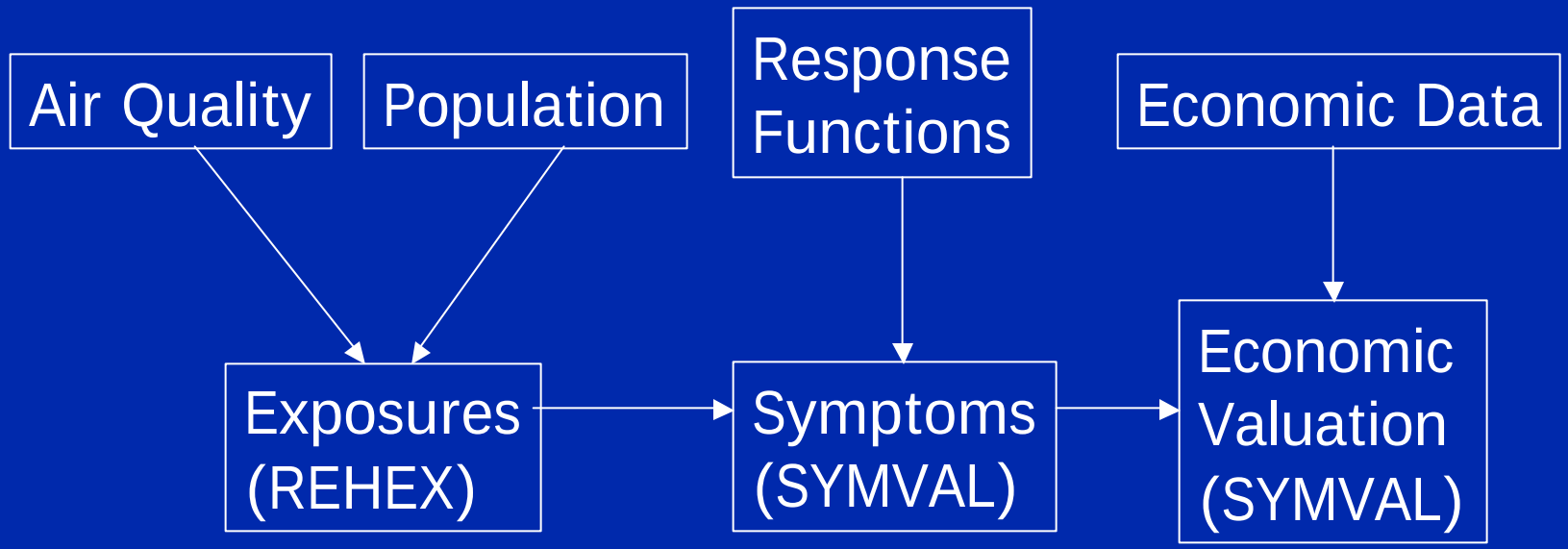
Study Objectives

- Determine who is exposed to poor air quality and how frequently.
- Quantify known adverse health effects that result from exposure.
- Assess the economic value of meeting health-based air quality standards.

Research Approach

- Closely integrated multidisciplinary research.
- Three essential elements:
  - Exposure
  - Health
  - Economics

Research Approach Schematic



Exposure

- Integrates air quality, spatial and demographic data.
- Represents who is exposed as well as frequency of exposure.
- Supports estimation of adverse health effects associated with exposure.

Adverse Health Effects

Include effects that:

- Are well established in the health literature.
- Are associated with ozone or $PM_{2.5}$.
- Can be quantified in economic terms.

Economics

- Attaches dollar values to adverse health effects resulting from exposure.
- Provides an easily understood measure of the cost of poor air quality.
- Is not the entire picture: equity.

Health Endpoints

Ozone-related:

- Respiratory-related hospital admissions.
- Emergency room visits.
- School absences.
- Asthma attacks.
- Days of restricted activity.

Health Endpoints

$PM_{2.5}$-related:

- Premature death (mortality).
- Acute bronchitis, children.
- Chronic bronchitis, adults.
- Work loss days.
- Days of restricted activity.
- Upper and lower respiratory symptoms, children.
- Non-fatal heart attacks.
- Respiratory and cardio hospital admissions.
- Children's asthma ER-related visits.

Other Health Endpoints

- Ozone-related mortality.
- Neonatal PM-related mortality.
- Loss of lung function.
- Asthma hospital admissions.
- Adult asthma ER visits.

Scope of the Results

- Expected reduction in exposure by attaining the federal (and state) air quality standards.
- Expected improvements in health.
- Economic value gained from fewer adverse health effects.

Health Studies Criteria

- Are peer-reviewed.
- Account for potential confounders.
- Are based on similar populations.
- Are more recent, using more advanced analytical methods.
- Cover longer periods and larger populations.
- Have been used in previous peer-reviewed benefits assessments.

Concentration-Response Equation

$? C = -C_o(e^{-ß?P} – 1)$

where:

?C	= the change in the number of cases
C_o	= the number of baseline cases
?P	= the change in ambient pollution concentrations
ß	= an exponential “slope” factor derived from the health literature

and

ß = (1 + Increased Odds)/(? Pollution)

PM Mortality Studies Used

Pope et al. (2002)

- Large scale, longitudinal cohort study.
- 16-year follow up from 1979-1983.
- 61 U.S. cities, ages 30 and older.
- Controls for lifestyle and occupation.
- Increase in all-cause mortality: *6% per 10 ug/m^3.*

Jerret et al. (2005)

- Based on LA subset of Pope study.
- Controls for same confounders.
- Better represents LA population.
- Finds greater association between traffic
- and health effects.
- Increase in all-cause mortality: *17% per 10 ug/m^3.*

Economic Values

New case of chronic bronchitis	$374,000
Hospitalization	$ 32,000
MRAD	$ 61
Work loss day	$123-141
School absence	$ 65-79
Respiratory symptom day	$ 20-32
Acute bronchitis	$ 110
Asthma attack	$ 50
Emergency room visit	$ 325

Value of a Statistical Life

One VSL = $6,700,000

Consider this example:

- 1,000,000 people are at risk.
- Risk is reduced for each by 1/100,000 a year.
- Each values that reduction at $670, which totals $670,000,000.
- Ten lives are saved: valued at $6,700,000 each.

NAAQS Results – Annually

2004 Population

- 460 fewer premature deaths.
- 325 fewer new cases of chronic bronchitis.
- 334,000 fewer days of reduced activity in adults.
- 345 fewer hospital admissions.
- 23,300 fewer asthma attacks.
- 188,000 fewer days of school absence.
- 3,230 fewer cases of acute bronchitis in children.
- 68,680 fewer work loss days.
- 595 fewer non-fatal heart attacks
- 445 fewer children's asthma ER visits
- Over 382,000 fewer days of respiratory symptoms in children.

Total Value

- $3.3 billion *per year*
- $1,000 per Valley resident per year
- Attaining California AQ standards would double the benefits

CAAQS Results

- 880 fewer premature deaths.
- 610 fewer new cases of chronic bronchitis.
- 322,400 fewer days of reduced activity in adults.
- 42,700 fewer asthma attacks.
- 262,600 fewer days of school absence.
- 5,920 fewer cases of acute bronchitis in children.
- Total Value: over $6 billion
- Nearly $2,000 per person per year

CAAQS-NAAQS Comparison

Adverse Health Effect	NAAQS	CAAQS
Premature deaths	460	880
Chronic bronchitis	325	610
Hospital admissions	865	1,635
Asthma attacks	23,300	42,700
Days of school absence	188,000	262,600
Children’s acute bronchitis	3,230	5,920

Effects of 24-hr $PM_{2.5}$ NAAQS Changes

Adverse Health Effect	Benefits of Achieving	
	Previous NAAQS	Current NAAQS
Upper Respiratory Symptoms in Asthmatic Children	16,000	364,000
Lower Respiratory Symptoms in Children	880	18,000
Respiratory Hospital Admissions in Elderly	7	158
Nonfatal Heart Attacks (18+ years)	27	590
Minor Restricted Activity Days (18-64 years)	17,000	334,000
Work Loss Days (18-64 years)	3,000	69,000

Implications

- SJV residents face significant risks from air pollution.
- There is no “clean” season (ozone in summer and PM in winter).
- As science advances, known risks grow.
- Impacts of air pollution are not distributed evenly.
- More exposures than average for Latinos and blacks; Fresno and Kern Counties.