

Health Benefit Assessment: Methods for 2012 AQMP Update

Prepared for:
STMPR AG for the SQ AQMD 2012 AQMP

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6 Critical Components of a Health and Valuation Analysis



- Air Quality Modeling
- Population Forecasts
- Health Effect Categories (“Endpoints”)
- Concentration-Response Risk Functions
- Public Health Data Forecasts
- Health Effect Valuation Functions

Goals of Revising Methods

- Design analysis to support 2012 AQMP
- Improve use of South Coast specific information
- Reflect new health research and understanding of air quality health issues
- Reflect new economic research and understanding of valuing health risks
- Use more recent data
- Improve communication of methods and results

Changes in Air Quality Modeling

- Air Quality Model
  - 2012 using CMAQ (‘07 used CAMx)
  - 4 km x 4 km grid system (‘07 used 5 x 5)
  - Adjusted to 2008 monitors (‘07 used ‘05)

Changes to Population Forecasts

- Forecasts for 2014, 2023
  - Based on 2005-2009 American Community Survey (ACS) population
  - REMI forecasts for 21 sub-County regions
- Population (by age group) is allocated to 4km x 4km grid based on 2010 Census
  - Age specific population density at 2010 Census Tract level

Selecting Health Effects to Quantify

- PM2.5 and NO2
  - '12 AQMP targets these 2 pollutants
- Must have both C-R function, valuation function and any required public health data (e.g., baseline incidence rates)
- Must be based on published, peer reviewed literature
- Must have methods used specifically reviewed and approved by an external peer review committee

Quantified PM2.5 Health Effects

Health Effect	In 2007 AQMP?	Recommended for 2012?
Mortality (adult and infant)	✓	✓
Chronic Bronchitis	✓	✗
Acute Myocardial Infarction	✓	✓
Acute Respiratory Symptoms	✓	✓
Work Loss Days	✓	✓
Hospital Admissions, Cardiovascular	✓	✓
Hospital Admissions, Respiratory	✓	✓
Acute Bronchitis	✓	✓
Upper Respiratory Symptoms	✓	✓
Lower Respiratory Symptoms	✓	✓
Emergency Room Visits, Respiratory	✓	✓
Asthma Exacerbations (“attack”)	✗	✓

Quantified NO2 Health Effects

Health Effect	In 2007 AQMP?	Recommended for 2012?
Respiratory Symptoms	✘	✓
Hospital Admissions, Respiratory	✘	??
Emergency Room Visits, Respiratory	✘	??
Asthma Exacerbations (“attack”)	✘	✓

Mortality C-R Functions in ‘07 AQMP

- 2007 used an average from 3 studies
  - Pope et al. (2002)
    - National ACS cohort RR=1.06
  - Laden et al. (2006)
    - Harvard 6-Cities RR=1.15
  - Jerrett et al. (2005)
    - Los Angeles area data from ACS
    - RR = 1.158

Candidate Mortality C-R Functions for ’12 AQMP

- Krewski et al. (2009)
  - National ACS cohort RR=1.06
- Laden et al. (2006) RR=1.15
- Roman et al. (2006, 2008) expert elicitation
  - Use consensus function per EPA 812 Study. RR ~ 1.11
- Krewski et al. (2009) Los Angeles function
  - Subset of ACS cohort study. RR = 1.197

Why Krewski et al. (2009) LA study?

- Expands on Jerrett et al. (2005)
- Based on PM2.5 monitors from 2000
  - 24 FRM monitors in LA metro area
  - Includes 6 “super site” species monitors
  - By using 2000 monitors estimation is based on PM changes resulting from targeted PM2.5 reductions
- Used by EPA in the 2010 Risk Assessment (part of PM2.5 process)

Public Health (Incidence Data)

- Baseline Mortality Rates
  - Based on 2006-2009 data
  - County and age specific forecasts to future years, consistent with Census estimates
- Hospital Admission Rates
  - Use California-specific rate
  - Limited set of LA-specific rates

Valuing Health Effects

- Economic Science preferred methods
- Willingness to Pay (WTP) based demand for risk reduction
- Local estimates
- Specific to age and source of risk

- **Can't Always Get What You Want**

Reality of Valuation Functions

- Mixed methods
  - Do the best we can for each health effect
- WTP used for some
  - Mortality, mild morbidity symptoms
- Cost of Illness used for some
- Value of Time Lost used for some
- Lost income used for some
- MIXED MODE IS COMMON
- Local WTP is rare; local COI & income exist

What Changes for 2012 Valuations?

- EVERYTHING
- Analytical date of matters
- Basis year of '12 AQMP benefits values = 2005
- 2 implications of basis year
  - Inflation. All analysis based on 2005 prices
  - Income. Will be based analytical year
    - WTP increases with real income
    - Income elasticity of demand
    - Real income growth: 2010 federal estimates

Valuing Fatal Risk Reductions "Value of Statistical Life" or VSL

- VSL is misnomer, but entrenched in literature
- Concept is WTP for a small reduction in a fatal risk
  - E.g., WTP for a 10^{-6} risk reduction in probability of dying is in range of $1 to $10
- If 1 million people will experience a 10^{-6} risk reduction
  - One expected death (or "statistical death)
  - Sum of all WTP = $1 to $10 million = VSL

VSL in 2007 AQMP Based on Then Current EPA Methods

- EPA always bases VSL on range of values from published studies
- In 2004 – 2006 time EPA commissioned 3 meta-analysis literature reviews
- In simple terms, EPAs decision was to use:
  - Middle study as mean of VSL distribution
  - Highest study as 75 percentile
  - Lowest study as 25 percentile
  - Estimate a normal distribution
- ~$5.5 million in 2000 prices and income

In 2009 EPA Changed Their VSL Policy

- New Administration established formal policy
  - VSL used in previous years was “repealed”
    - Never formally peer reviewed by full suite of EPA science advisors nor adopted in writing by OMB or EPA (always “interim”)
  - Therefore EPA would use the previous VSL that had been formally reviewed and adopted in OMB and EPA Guidance
  - Call that the “2000 VSL Policy”

The 2000 VSL Policy

- Based on Meta-Analysis done by Viscusi (1992)
  - Selected 26 studies
  - 20 wage based studies
  - 6 stated preference studies
  - Majority of studies from ‘80s, few from ‘70s
- EPA estimated a skewed (Weibull) distribution that best fit the 26 data points.
- VSL = $6.3 million in 2000 prices and income

Issues with Current EPA VSL Policy

- Few stated preference studies
- Both wage hedonic and stated preference studies methods have changed a lot
- Clear trend in recent stated preference studies have found lower values since ‘80s
- Age of studies makes adjusting for inflation and real income growth dominate the estimates of values in 2010 or future
- Viscusi no longer recommends his 1992 paper as the basis of VSL for policy purposes

Recommendation for 2012 AQMP

- Do not select VSL based on current EPA policy
- Base VSL on one of the meta-analysis studies from mid-2000's set
  - Kochi et al. (2006). An empirical Bayesian meta-analysis
  - Reviewed 196 VSL studies, selected 40
    - Included 60 data sets (ie., 60 estimates)
    - Published between '74 and '2000
    - Included 42 wage and 18 stated preference studies

Kochi et al. (2006), continued

- Mean estimate of their preferred model is
  - $5.4 million (s.e. = $2.4 million)
  - 2000 prices and incomes
- This is a Bayesian average of all studies
  - Wage hedonic are higher
    - Wage mean = $9.4 million
      - US alone wage is lower: $8.5 m
      - UK wage VSL = $22.6
    - Stated preference mean = $2.8 million