



# **A review of recent policy-relevant findings from the environmental health literature**

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# Purpose

- To review recent literature on monetary valuation of environmental health risks, focussing on morbidity impacts
- Aim to address the questions:
  - How does the empirical evidence on valuing morbidity end-points match-up with the needs of users (policy makers)?
  - What are the lessons for future morbidity valuation research?

# Overview

- Use of morbidity valuation in policy appraisal to date
- State-of-the art in primary morbidity valuation studies: methodological issues
- State-of-the art in transfer of morbidity values over time and space: methodological issues
- Future research priorities

# Summary of Health Endpoints

Outdoor air pollution	Indoor air pollution	Water	Noise	Heavy Metals & Radio-activity	Climate Change
Premature mortality (chronic)	Lung Cancer	Gastro-intestinal disorders, incl. diarrhoea	Ischemic heart disease / myocardial infarction	Lung Cancer	Premature mortality
Premature mortality (acute)	Leukaemia	Dental fluorosis	Hypertension	Skin cancer	Cardiovascular illness
Respiratory hospital admission	Respiratory hospital admission	Blue baby syndrome	Cognitive impairment	Leukaemia	Cardio-pulmonary disease
Cerebro-vascular hospital admission	Cardio-vascular hospital admissions	Skin lesions	Hearing impairment	Osteoporosis Old	Lymes Disease
Cancer (lung) (fatal/non-fatal)	Respiratory - Symptoms: those with asthma (Asthmatics)	Infections: eye, ear, skin	Annoyance	Renal dysfunction	Malaria
Chronic bronchitis (Adult)	Restricted activity days (RADs) (Adult)	Cholera		Anaemia	Diarrhoea
Restricted activity days (RADs) (Adult)	Lower respiratory symptoms	E. Choli		Neuro-devt. disorders, Child	Injuries
Minor RADs (Adult)	Atopy, conjunctival irritation, Allergy/ Irritant	Respiratory disease		Other cancers	
Chronic cough Child	Asthma attacks (Asthmatics)				
Congestive heart failure Child	Neuro-devt. disorders (Child)				
Asthma attacks Asth					
Lower respiratory symptoms					
Cough Child; Asth					
Bronchodilator usage Asth:					

# Characterisation of recent literature

- Most of the studies are from OECD countries
- The majority have been commissioned by USEPA or European Commission
- Most relate to air pollution from the energy and transport sectors
- The majority focus on the classical air pollutants
- About half have been conducted in relation to a Regulatory Impact Assessment; a few in relation to a green accounting exercise

# Sample of Policy applications – N. American; Air

<i>Author(s) / Date</i>	<i>Pollutant</i>	<i>Policy input / Purpose</i>	<i>Health Measurement</i>
<b>North America</b>			
Abt Associates Inc – 2002	PM	Annual benefits associated with South Appalachian Mountain air pollution Controls, USA	Mortality; CB; AB.
Austin, D <i>et al.</i> – 1998	SO <sub>2</sub> , NO <sub>x</sub> , PM	Environmental Benefits from air pollution emissions reduction to 2010, Maryland, USA	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks
Blloyd, C – 2002	NO <sub>x</sub> , SO <sub>2</sub>	Investment in Electricity Transmission and Ancillary Environmental Benefits in Western States, USA	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks
Burtraw, D <i>et al.</i> – 1997	SO <sub>2</sub> and NO <sub>x</sub>	Costs and Benefits of Reducing Acid Rain (USA)	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks
Burtraw and Toman, – 1997	SO <sub>2</sub> , NO <sub>x</sub> , PM	Benefits of Reduced Air Pollutants from Greenhouse Gas Mitigation Policies (USA)	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks
Burtraw and Toman – 2000	SO <sub>2</sub> , NO <sub>x</sub> , CO	Ancillary Benefits of Greenhouse Gas Mitigation Policies	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Days of bronchodilator usage; Cough days; Lower respiratory symptoms; Asthma attacks; Cancer
Burtraw, D <i>et al.</i> – 2001	NO <sub>x</sub>	Health Benefits (Relating to Carbon Tax) Ancillary Benefits of Reduced Air Pollution in the United States from Moderate Greenhouse Gas Mitigation Policies in the Electricity Sector	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks;
Burtraw, D <i>et al.</i> – 2001	NO <sub>x</sub>	NO <sub>x</sub> Reduction Policies from Electricity Generation	Acute mortality; Chronic Mortality; ERV; RHA; RAD; MRAD; Lower respiratory symptoms; Asthma attacks
Chestnut and Mills – 2005	SO <sub>2</sub> ; NO <sub>x</sub>	Benefits and Costs of the US Acid Rain program	Acute mortality; Chronic Mortality; ERV; RHA; CHA; CHF; RAD; MRAD; Upper and Lower respiratory symptoms; Work Loss Days
		New estimates of the benefits of vehicle emission	

# Policy-related Applications of Health Values for Water, Waste and Noise

Authors/year/RIA-related	Pollutant	Source	Measurement
Anderson, <i>et al.</i> (2000). Yes	Bacterial; Harmful Algal blooms	General effluent	Cost of public health impacts
Blomquist, <i>et al.</i> (2003). Yes	Bacterial; Chemical	Various	Allocation of state funds to environmental programmes
Browner, <i>et al.</i> (2000). Yes	Bacterial; Chemical	Transport discharge (Truck and rail)	Benefit of final effluent guidelines (Reduction of carcinogenic risk)
Droste-Franke, <i>et al.</i> (2004)	Chemical (Heavy Metals)	Various	Fatal and non-fatal cancers (lung, leukaemia, other), IQ, Renal effects
Dwight, <i>et al.</i> (2004). No	Bacterial	Urban run-off	Cost of : Gastro-intestinal episode; Acute respiratory disease; Ear infections; Eye infections
Landrigan, <i>et al.</i> (2002). No	Chemical	Various	Costs of pediatric disease: Lead poisoning; Cancer; Asthma; Neuro-behavioural disorders
Scasny <i>et al.</i> (2008)	Chemical (Heavy Metals)	Various	Fatal and non-fatal cancers (lung, leukaemia, other), IQ, Renal effects, Osteoporosis,
Zhang, (1999). Yes	Bacterial; Chemical	Waste water	Health benefits of waste water treatment (China)
Defra – ICGB Noise Subject Group (2008). No	Noise	Various	Annual UK Impact of Noise: Heart disease; Severe sleep disturbance; Severe annoyance; Tinnitus; Learning deficit in children;
Den Boer & Schrotten (2007). No	Noise	Transport (Road and Rail)	WTP for reduction in noise pollution – social costs of noise across EU22
OECD/INFRAS/Herry (2002). No	Noise	Transport (Road and Rail)	Social cost of noise in Central and Eastern Europe
EC DG Research UNITE Project (2002). No.	Noise	Transport (Road and Rail)	Myocardial Infarction; Angina Pectoris; Hypertension; Severe sleep disturbance

# Characterisation (contd)

- Most studies adopt a WTP measure
- Relatively few studies for policy application in the water, waste and noise contexts
- In the case of water and waste, this may be due to difficulties in modelling emissions pathways
- Scasny et al (2009) – health impacts of micro pollutants unlikely to exceed 2% of health impacts associated with air pollution
- Scasny – health impacts of noise pollution equivalent to 55% of those of air pollution

# What are the most important health endpoints?

- Welfare costs of premature mortality constitute largest single cost
- In terms of morbidity endpoints, studies show that there is a fairly consistent rank ordering – chronic bronchitis, restricted activity days, symptom days being the most costly
- Precision around absolute valuations has not been achieved due to a number of areas of uncertainty in modelling valuations

# AQ-related Physical Units & Costs – EU15, in 1998

Impact	Unit	Physical Impacts	Unit values (€)	Damage Costs	Damage Costs
				[M. € <sub>2000</sub> ]	% of total
Years of Life Lost (YOLL)	[1000 years]	886	104760	88000	67.69
Congestive heart failure older 65	[1000 cases]	14.3	3260	48	0.04
Chronic bronchitis, adults	[1000 cases]	107	169330	18000	13.85
Restr. Activity days, adults	[1000 days]	110000	110	12000	9.23
Bronchodilator usage, adults	[1000 cases]	24600	40	1000	0.77
Cough, asthmatics, adults	[1000 days]	26100		1200	0.92
Lower resp. symptoms, adults	[1000 days]	9400	8	75	0.06
Bronchodilator usage, children	[1000 cases]	2950	40	120	0.09
Cough, asthmatics, children	[1000 days]	5100	45	230	0.18
Lower resp. symptoms, children	[1000 days]	4000	8	32	0.02
Chronic cough, children	[1000 epis.]	2280	240	550	0.42
Cerebrovascular hosp. Adm.	[1000 cases]	29	16730	470	0.36
Respiratory hosp. Admission	[1000 cases]	27	4320	110	0.08
Minor restr. Activity days, adults	[1000 days]	14000	45	640	0.49
Asthma attack, asthmatics	[1000 days]	390	75	29	0.02
Symptom days	[1000 days]	85000	45	3800	2.92
<b>Total</b>				<b>130000</b>	<b>100</b>

# Use of valuations in policy-making

- Policy needs
  - Economic efficiency (CBA)
  - Environmental costing (internalising externalities)
  - Environmental accounting
  - Determining compensation levels
- More broadly, use of values could be viewed as having instrumental, conceptual, political and/or symbolic roles (Gerdes et al 2008)
- Different degrees of accuracy are needed for applications to the different policy contexts

# Use of valuations in policy-making

- As noted, many of the existing studies have been conducted in the context of an RIA
- Recent studies (Bureau & Glachant, 2006; Harrington and Morgenstern, 2004) have found that:
  - Guidance around the use of non-market valuations is available, but is not mandatory except in the US for RIAs
  - Where monetary valuation is included in a policy evaluation, CBA is often included in the later stages as a defensive strategy

# Obstacles to the use of non-market values in policy decision making

- Methodological issues including uncertainties around the valuations themselves and the transfer of valuations, spatially and over time
- Cost of new primary studies
- Ethical issues

# Methodological issues

- Cost of illness (COI) approach and/or WTP approach?
- Issues with COI approaches
  - Precision in physical description of health endpoint
  - Variation in medical treatment for a given condition
  - Valuation of opportunity costs

# COI Studies on Lung Cancer:

## Medical Treatment Costs €, 2005, PPP

Author	Country	Approach	Viewpoint	Discounting	Time-span	Lung cancer
Koopmanschap (1994)	Netherlands	Incidence Prevalenc	Not specified	No	-	14,131
Evans <i>et al.</i> (1995)	Canada	Incidence	GOV	No	-	21,292
Berthelot <i>et al.</i> (2000)	Canada	Incidence	GOV	No	-	-
Wolstenholme Whynes (1999)	UK	Incidence	Hospital	Yes (6%)	4 years	-
Weissflog <i>et al.</i> (2001)	Germany	Prevalence	Sickness fund	No	-	33,744
Serup-Hansen <i>et al.</i> (2003)	Denmark	Incidence	?	Yes (3%)	-	15,231
Braud <i>et al.</i> (2003)	France	Incidence	Hospital	No	-	13,332
Chouaid <i>et al.</i> (2004)	France	Incidence	Healthcare payment	No	1.5 years	-
Vergnenegre <i>et al.</i> (2004)	France	Incidence	Healthcare payment	No	2 years	-
Dedes <i>et al.</i> (2004)	Switzerland	-	Health service expenses	?	2.5 years	-
Abal Arca <i>et al.</i> (2006)	Spain	Incidence	?	?	-	4,637
Scasny <i>et al.</i> (2008)	Czech Republic	Incidence	GOV	Yes (1%)	10 years	10,993

# Importance of including non-market components

- **EU CAFE CBA With/Without WTP Components of Health Impacts € , 2005 (Source;Holland, Pye and Hunt, 2006)**

Cost element	Unit	Total
Medical cost	€billion	0.38
Lost production cost	€billion	3.06
Crop losses	€billion	0.33
Materials	€billion	0.19
Total	€billion	3.96
<b>Total</b>	<b>as % of €7.1 billion cost</b>	<b>56%</b>
<i>Adding in non-mortality WTP</i>		
Non-mortality WTP	€billion	10.40
New total	€billion	14.36
<b>New total</b>	<b>as % of €7.1 billion cost</b>	<b>202%</b>
<i>Adding in mortality WTP</i>		
Mortality WTP	€billion	29.09
Grand total	€billion	43.45
<b>Grand total</b>	<b>as % of €7.1 billion cost</b>	<b>612%</b>

# Methodological issues- SP approach

- WTP measures usually employ a Stated Preference (SP) methodology, and occasionally Revealed Preference
- There are a number of challenges inherent in the SP approach:
  - Definition of health endpoint
  - Human understanding/experience of the illness
  - Understanding/rationality in assessing risk
  - Understanding of context
  - Survey design (cognitive load on respondents)

# Methodological Issues – value transfer

- Unit value transfers most useful if contexts almost identical
- For international VT, unit values need conversion to PPP
- Transfer of benefit function usually has more explanatory power
- Benefit function transfer accounts for (only?) 30-50% of the variance in stated WTP
- Same issues affecting SP studies affect BT studies, that is, understanding and controlling for context, motivation, attitudes and stake-holding

# Concluding comments – research design

- Coverage (& consistency) of welfare components – more needed...
- Revealed → Stated Preference; CV → CE?
- Alignment with epidemiology(?)
- Scope sensitivity – software tools may help?
- Context – more experimentation needed...
- Valuation of children's health endpoints – exploit VERHI experience – soon..
- Ordering - vary
- No of episodes – be led by epi. With testing.
- Value transfers – no substitute for more evidence...

# Concluding comments

- Greater international convergence amongst researchers around definitions of health impacts and endpoints
- Guidance for commissioning bodies about research design and levels of precision required to meet policy needs
- Willingness of economists to embrace the ‘social science’ aspects of research design
- Anticipation of emerging/future health risks and associated ethical and technical issues