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Morbidity impacts

State of the science for air pollution health risk assessment at various scales

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WHO Expert Meeting: Methods and tools for assessing the health risks of air pollution at local, national and international level
Bonn, Germany 12-13 May 2014

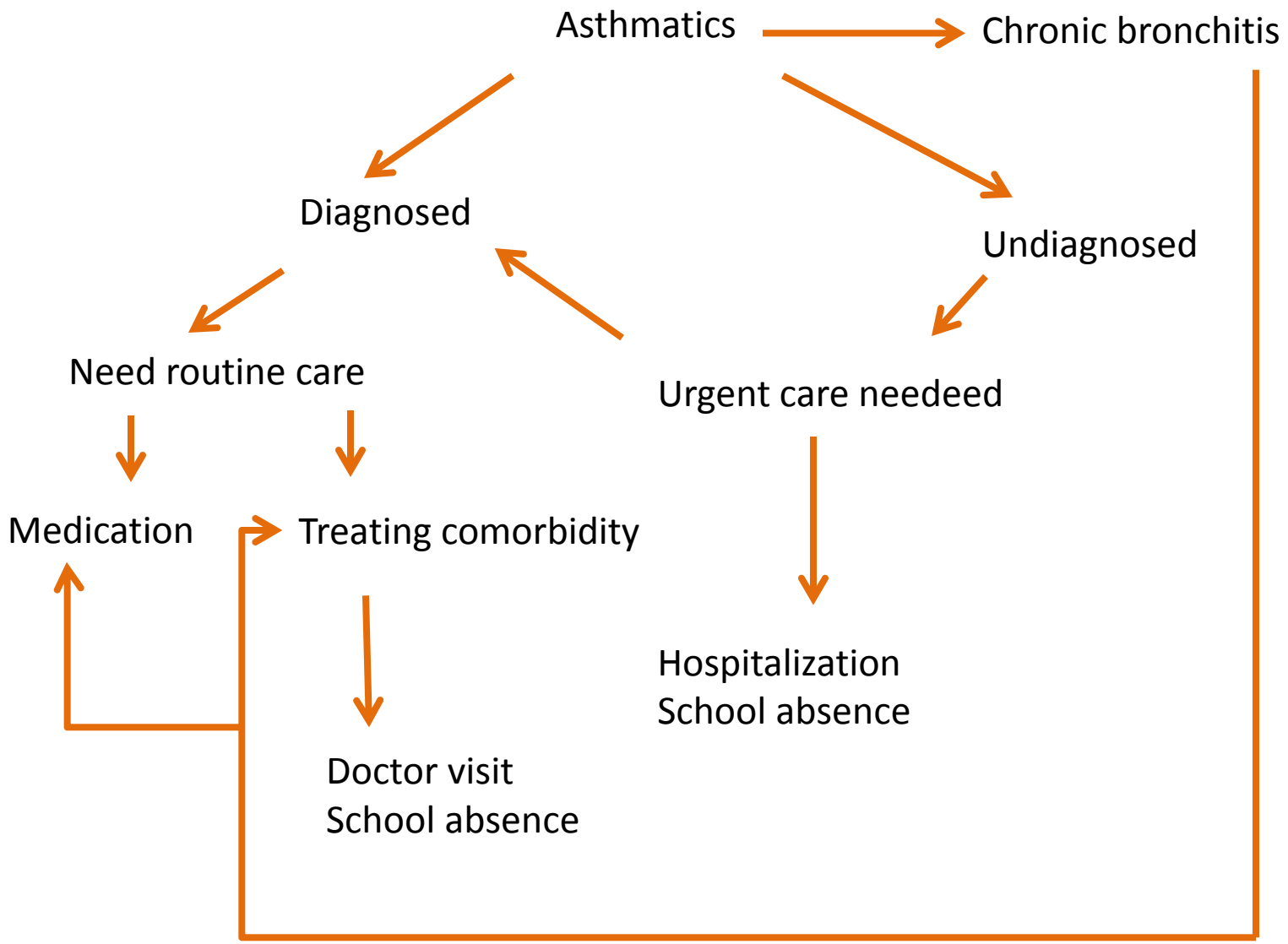
Outline

- Identification of general principles and recommendations about methods/data to use
- Limitations and gaps in knowledge, including uncertainties
- Future opportunities for methodological advancements
- Case studies and examples

Morbidity impacts and policy

- Obtain more precise estimates of the true cost of air pollution
- Make more evident the morbidity costs bore by families or health systems
- Better evaluate effectiveness of policy measures
- Identify and reduce sources of inequality due to air pollution exposure
- Improve communication with stakeholders

The «disease carrier» of an asthma case: more than just the sum of exacerbations



Brandt et al. ERS, 2013

MEAN ANNUAL FREQUENCY AND DIRECT AND INDIRECT COSTS OF CARE FOR A TYPICAL ASTHMA CASE

Per year, a child with asthma cost an extra ~$4,000

	Mean* †	Direct cost per outcome*	Indirect costs per outcome*	
Outcome			**Riverside**	**Long Beach**
Asthma-specific office visit	1.5	$113	$45	$40
Emergency room visits	0.2	844	112	100
Inpatient hospitalizations	0.04	12,776	506	451
School days missed	5.9	NA	230	205
Medication				
Inhaled corticosteroid	2.2	125	NA	NA
Cromolyn	1.1	95	NA	NA
Albuterol	6.8	55	NA	NA
Co-morbidities				
Non-urgent office visits	0.9	113	45	40
Mean cost of antibiotics	2.2	85	NA	NA
Urgent care visits	0.2	113	112	100
Inpatient days	0.03	6,646	230	205
Bronchitic episodes				
Office visits	0.5	113	45	40
Emergency room visits	0.02	844	112	100
Inpatient hospitalizations	0.004	16,625	759	677
School absences	0.8	NA	230	205
Antibiotics	0.5	85	NA	NA

Brandt et al. ERS, 2013

General principles of cost-benefit analysis

- Complete assessment of all impacts
- Pair outcome-exposure selected based on evidence
- Minimize double-counting
- Transparently identify, describe, and test uncertainties

Advances in knowledge (REVIHAAP)

- PM (long-term)
  - ✓Markers of atherosclerosis such as thickness of the intima-media, coronary artery calcification, or pulse pressure
  - ✓Development of respiratory diseases, such has infections, bronchiolitis and low lung function in children and lung function development in adults
  - ✓Diabetes, neurological development in children and disorders in adults
  - ✓Birth outcomes

- Ozone (Short-term/long-term)
  - ✓Asthma incidence, asthma severity, hospital care for asthma and lung function growth
  - ✓Cognitive development and reproductive health, including preterm birth

Near-road traffic pollution (independent of PMs or ozone)

✓Morbidity effects related to proximity to road include several markers of cardiovascular diseases, asthma hospitalization, lung function reduction, and lung cancer.

✓Respiratory conditions in children appear the most robust with NO_2

✓Short-term effects of NO_2 have been principally associated with respiratory hospital admissions, evidence on cardiovascular admission more uncertain.

✓Pollutant at cause unknown. Tailpipe primary PM may be a cause, but non-exhaust emissions also associated with some effects.

HRAPIE Proposed outcomes for cost-benefit analysis LIMITED

	PM	Ozone	NO_2
Short-term	$PM_{2.5}$ daily mean. Hospital admissions, CVD diseases (includes stroke), resipratory, adults all ages (Meta-analysis, 4 single city studies and one multicity)	O_3, daily maximum 8-hour mean. Hospital admissions, CVD (includes stroke) and respiratory diseases, age 65+ (APHENA study, eight European cities-adjusted for PM10)	NO_2 24-hour mean. Hospital admissions due to respiratory diseases, all ages (Meta-analysis, city studies. Estimate robust after adjustment for PM)

HRAPIE Proposed outcomes for cost-benefit analysis (EXTENDED)

	PM	Ozone	NO_2
Long-term	PM_{10}, annual mean. Prevalence of bronchitis in children, age 6-12 years (or 6-18) (Meta-analysis 9 countries)	'--	NO_2 annual mean. Prevalence of bronchitic symptoms in asthmatic children (one study, US, adjusted for OC, estimate higher after adjustment for PM)
	PM10, annual mean. Incidence of chronic bronchitis in adults (2 studies, US+CH)	'--	
Short-term	PM_{10} daily mean. Incidence of asthma symptoms in asthmatic children 5-19 years (Meta-analysis 36 panel studies on asthmatics Europe)	O_3, daily maximum 8-hour mean . Minor restricted activity days, all ages (one study, US)	'--
	$PM_{2.5}$ two-week average. Restricted activity days, all ages** (one study, US)	--	--
	$PM_{2.5}$ two-week average. Work loss days, among working population (one study, US)	--	--

Baseline health data: scale of availability

Outcome	Scale	Example of source of background health data in Europe
Hospital admissions	National, local	European hospital morbidity database. or local registries
Prevalence of bronchitic symptoms in asthmatic children	National	The background rate of asthmatic children: "asthma ever" in Lai et al (2009). Prevalence of bronchitic symptoms among asthmatic children 21.1% to 38.7% (Migliore et al,2009, McConnell et al, 2003)
Prevalence of bronchitis in children, age 6-12 years (or 6-18)	Study	Mean prevalence from PATY study: 18.6% (range 6% - 41%)
Incidence of chronic bronchitis in adults (age >=18)	Study	Annual incidence 3.9 per 1000 adults based on Swiss study SAPALDIA
Incidence of asthma symptoms in asthmatic children 5-19 years	National	The prevalence of asthma in children based on "severe asthma" in ISAAC (Lai et al 2009). Daily incidence of symptoms in this group: 17% (interpolation from several panel studies)
Restricted activity days, all ages	Study	19 RADs per person per year, 7.8 days/year for minor RADS: baseline rate from Ostro and Rothschild (1989) study
Work loss days, among working population	National	Health for All database (HFA-DB). (http://data.euro.who.int/hfadb/), local occupational data

Limitations

- Limited evidence for some long-term outcomes
- Limited/extended dichotomization
- Effect of sources
  - ✓ No sufficient evidence to differentiate source and constituents that may be more closely related to health outcomes
  - ✓ RA with PM/ozone as sole pollutant indicator of long-term exposure will underestimate the whole burden of air pollution. Multi-pollutant models not available.
- Range of exposure CRFs are assumed to be valid at any levels of exposure
- Double-counting. Greater potential for overlapping of health endpoints used in different CRFs than in the mortality domain. Mortality/morbidity differenciation difficult to know in some studies.
- Baseline health rates. General lack of relevant baseline health data in most settings
- Outdoor/indoor. For some pollutants (ozone) exposure depend on indoor sources and activity patterns relating to housing activity. But as far as CRFs based on outdoor levels, impact has to be calculated with that.
- Well-being not integrated

Conclusions

- Morbidity impact can help policy-making and communication
- Specifically useful at local scales
- Evidence and methods are less robust than for mortality
- Some effects are still not established thus ignored in the risk assessment process
- Disease modelling and forecasting: building on existing tools from other disciplines

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Thank you for your attention