Linking environmental effects to health impacts – a computer modelling approach

J Mindell [1] & R Barrowcliffe [2]

1. Imperial College London
2. Environmental Resources Management Ltd

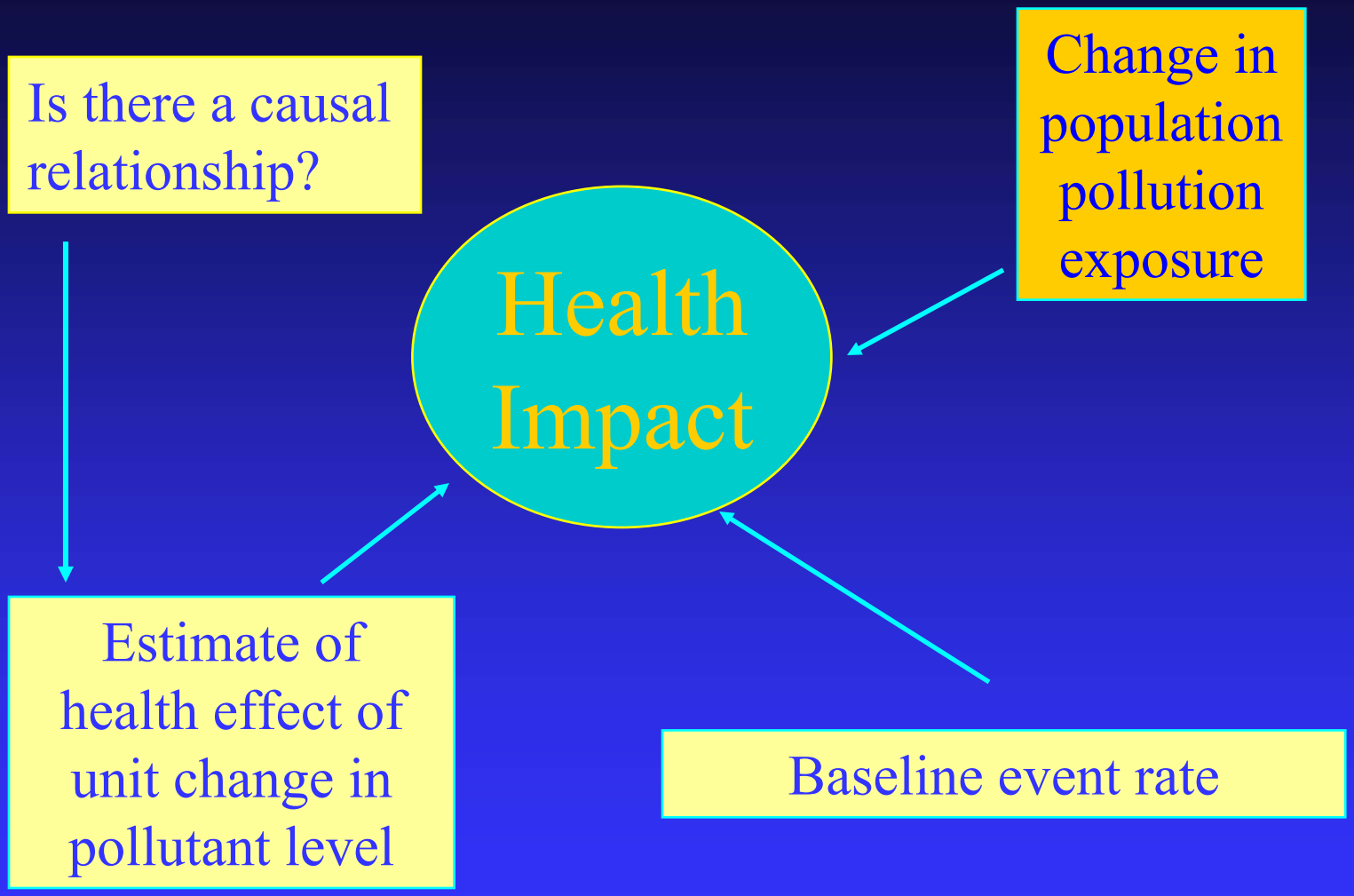
EIA & human health

- A statutory European Union requirement for EIA to consider impacts on human health
- Seldom done in practice

- We describe a computer modelling approach to quantifying potential health impacts from predicted air quality impacts of a proposed waste incinerator in England

Aim

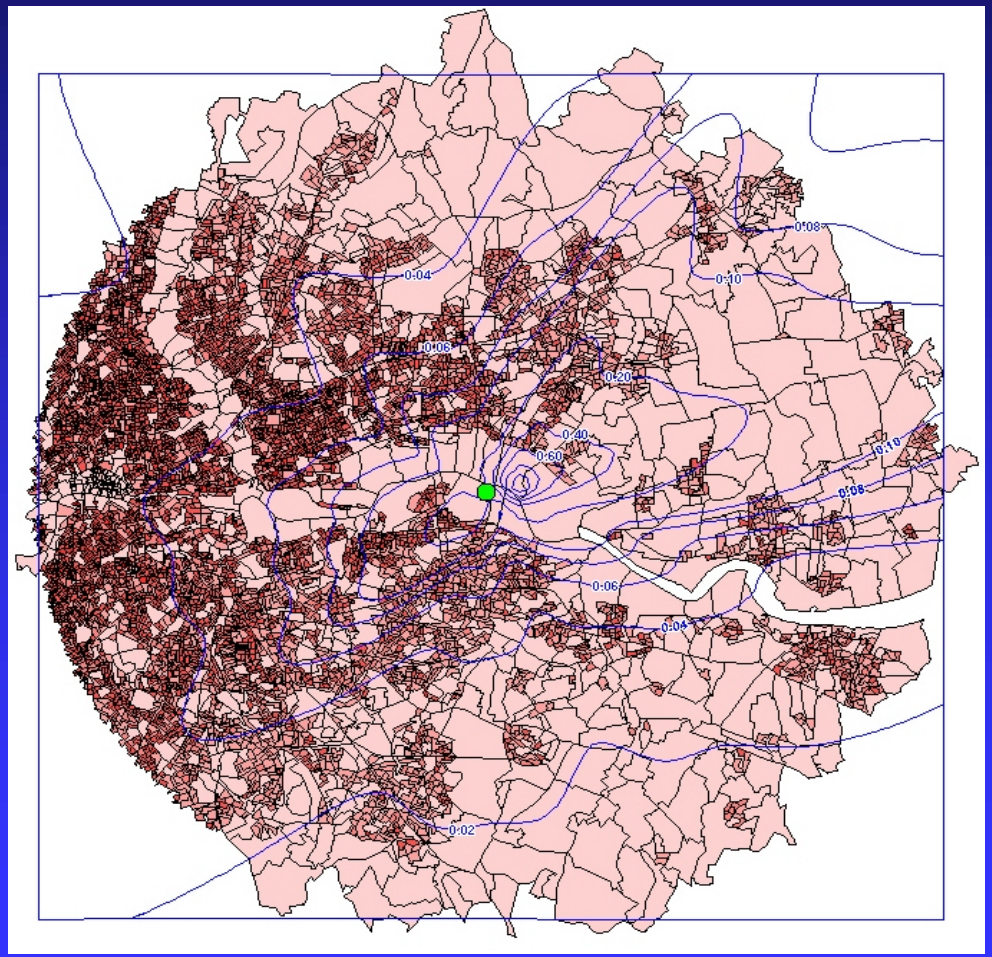
To model the likely health impacts of exposure to criterion air pollutants from a proposed energy-from-waste plant in England


Is there a causal relationship?
Change in population pollution exposure
Health Impact
Estimate of health effect of unit change in pollutant level
Baseline event rate

Prediction of environmental effects

- Estimates of emissions of criterion air pollutants from the incinerator
- Ground level concentrations predicted using the ADMS air dispersion model
- Contour maps of additional annual average pollution exposure from the proposed plant and entered into a geographical information system (GIS)
- Enumeration district -level population data also entered into GIS (Total population = 0.5 million)

Population Data and Additional Pollution Estimates

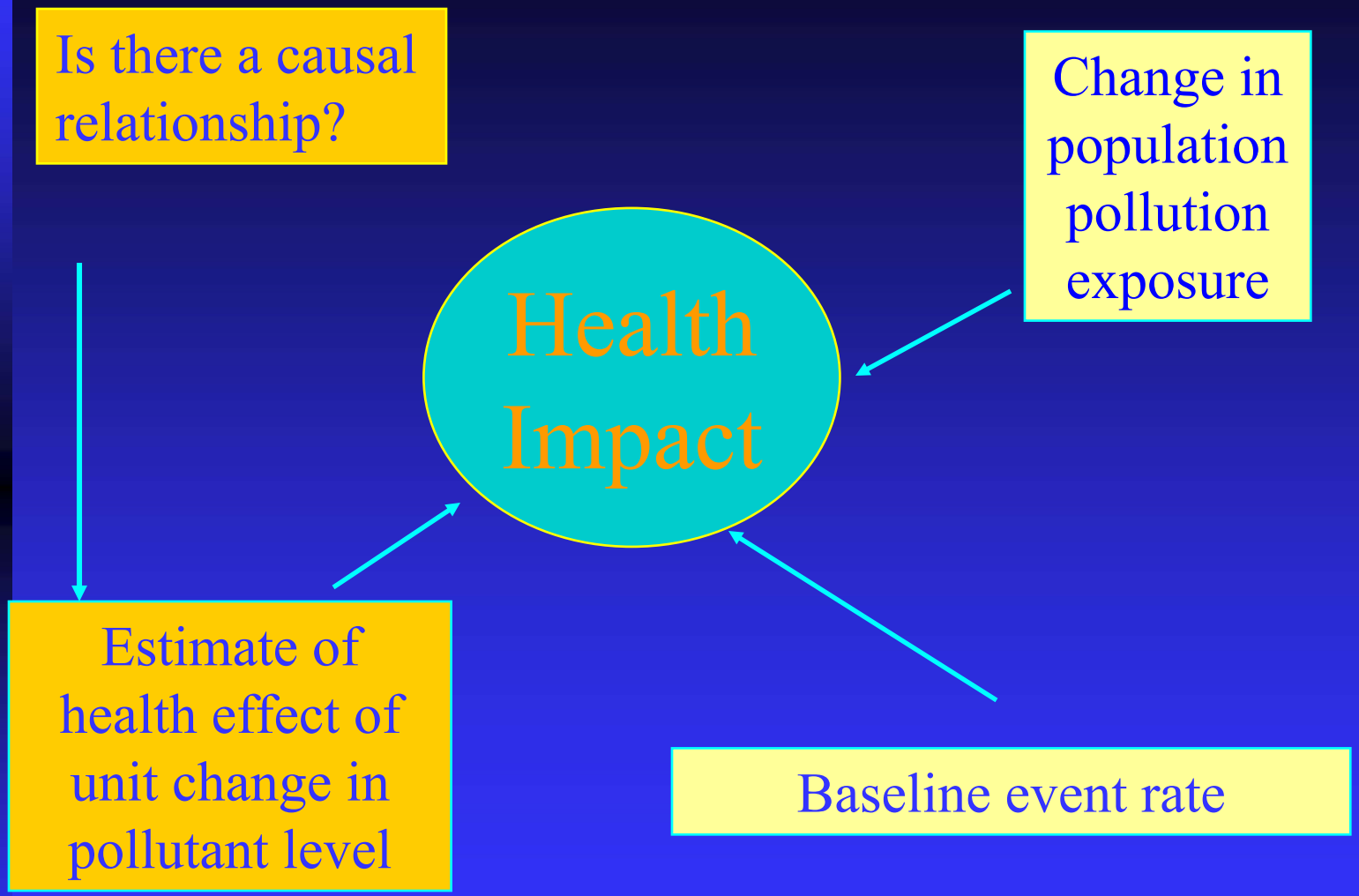


Calculating the health impacts

- $\delta E = ß * \delta CP * E$

Where

- *δE = Change in number of outcome events*
- *$ß$ = Exposure-response coefficient*
- *δCP = Change in ambient concentration * Population*
- *E = Background rate of outcome events*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Data Sources

- Literature search: Medline, Embase, Biological Abstracts, HELMIS
- Literature reviews on the effects of :
  - Particulate matter
  - nitrogen dioxide
  - sulphur dioxide

Effects of particulate matter (epidemiological studies)

Strong evidence for a causal effect of acute PM_{10}

- Non-traumatic deaths

Moderate evidence for a causal effect of acute PM_{10}

- Respiratory deaths
- Emergency hospital admissions for respiratory and circulatory diseases in adults
- Emergency hospital admissions and emergency attendances for asthma in children and younger adults

Moderate evidence for causal effect of longterm PM_{10}

- Non-traumatic deaths

Estimates of some health outcomes in UK of a 10 μg/m^3 increase in PM_{10}

- 0.5% increase in non-traumatic mortality

  Combined NMMAPS and APHEA (Anderson 2002)

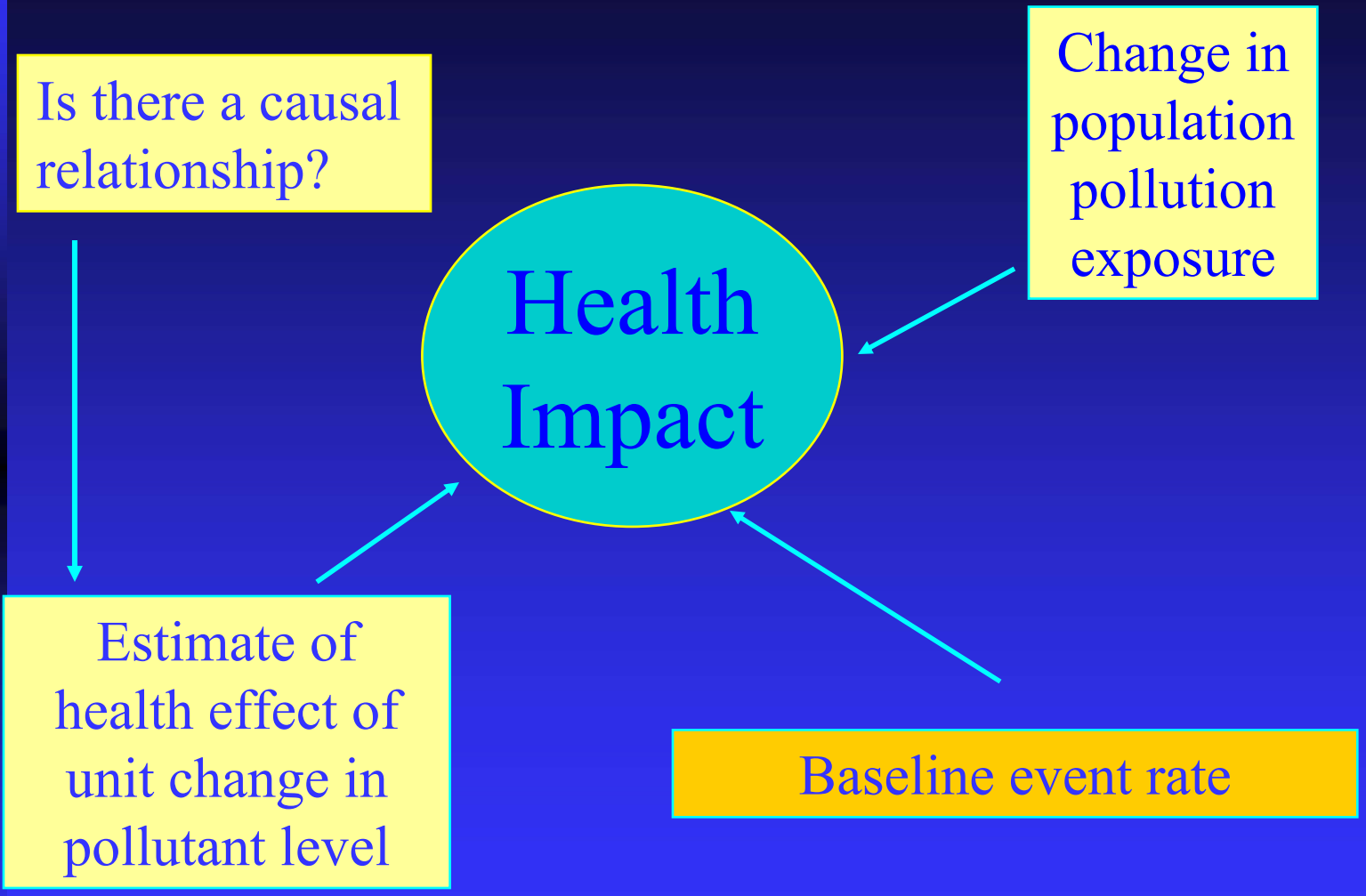
- 0.8% increase in hospital admissions for respiratory diseases

  WHO (WHO 2000)

Sensitivity Analyses

e.g. Change in all-cause mortality per 10μg/m^3 increase in PM_{10}

- London 0.3%
- W Europe (APHEA) 0.4%
- International (WHO) 0.7%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Data Sources

- ONS mortality statistics 1998 - 2001
  - Non-traumatic deaths: 8.126/1,000 pop
- Hospital episode data 1998 – 2001
  - Respiratory admissions: 7.411/1,000 pop

Effect of an Individual Pollutant

Exposure-response coefficient

X

Change in population ambient annual pollution exposure

X

Rate of outcome events

No. of deaths brought forward per annum, from PM_{10}

Cause of death	Age group	No. of deaths pa
Total non-traumatic	All	0.030
Respiratory	All	0.013
COPD+ asthma	≥65	0.0078

No. of extra or earlier admissions per year, from PM_{10} exposure

Disease	Age Group	No. pa
Respiratory	All	0.044
	≥65	0.0104
Asthma	*0-14*	*0.0027*
	15-64	*0.0055*
Circulatory	0-64	0.029
	≥65	0.021
Ischaemic heart disease	*0-64*	*0.011*
	≥65	*0.011*

Discussion (1)

- It is possible to quantify the impact on some health outcomes of exposure to some additional pollutant concentrations, caused by a new point source.
- But:
  - How certain are these estimates?
  - How meaningful are they?
  - Do they inform planning decisions?

Discussion (2)

- We believe that:
  - The estimates are a useful *order of magnitude* guide to some health impacts;
  - The analysis provides useful contextual information for decision makers;
  - The results require careful presentation – for the public, any additional effects are unwelcome and unacceptable.

Acknowledgments

- Dr Michael Joffe, Imperial College London

- The waste company that funded us to develop the method

Numbers affected

Severity of disease

Knowledge - of effects
and of numbers affected