

### Case-study 8.3.5

## Health impact of air pollution quality management in Kensington & Chelsea and in Westminster

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### Introduction

In the UK National Air Quality Strategy (UKNAQS), first published in 1997 and revised in 1999:

- targets were set for 8 outdoor pollutants by the year 2005;
- local authorities were given the responsibility of conducting reviews and assessments of air quality;
- air quality management areas (AQMA) were instituted.

In the Royal Borough of Kensington and Chelsea and in the City of Westminster, the targets for nitrogen dioxide and particulates are likely to be broken.

### Aim

To assess the effects on health of proposals for air quality management in Kensington & Chelsea and in Westminster.

### General model

To achieve this aim, various modelling techniques are being used. However, the general model to determine the effect of an individual pollutant that will be used in all of them is given in the equation below:

*Exposure-response coefficient x change in exposure x baseline number of outcome events*

### Objective 1

- To model the likely impact on health of a reduction from the current levels of air pollution in Kensington & Chelsea and Westminster to the UKNAQS target levels

### Methodology

Published data were applied to the local situation to extrapolate the potential effects on health. For each pollutant and outcome (eg all-cause mortality, emergency respiratory admissions), it was necessary to determine:

- the exposure-response coefficient;
- the change in ambient concentration;
- the baseline number of outcome events.

### Data sources

- the published literature on the effects of particulates and nitrogen dioxide;
- local authority hourly air pollution data, 1996-98;
- hospital episode data (HES), 1996-98;
- mortality statistics from the Office of National Statistics (ONS), 1996-98.

### Determining the exposure-response coefficient for a unit change in exposure

The Committee on the Medical Effects of Air Pollutants (COMEAP) has estimated the effects on health of urban airborne particulates in Great Britain as:

- 8100 deaths annually brought forward (1.9% of 430,000 urban deaths);
- 10,000 extra and early hospital admissions annually for respiratory diseases (2% of 530,000).

COMEAP has also estimated the effects on health of an increase in particulates (PM<sub>10</sub>) of 10 g/m<sup>3</sup> in the UK as:

- an increase of 0.7% in mortality, which occurs in individuals who have pre-existing serious disease, the very old and the very young;
- an increase of 0.8% in hospital admissions for respiratory diseases.

Sensitivity analyses were conducted by using as the exposure-response coefficients the results of the most recent studies in London, in western Europe (pooled results) and an international meta-analysis. For example, the change in hospital admissions for respiratory conditions for every increase of PM<sub>10</sub> of 10 g/m<sup>3</sup>, was:

- London 0.8%;
- International (World Health Organisation) 0.74%;
- Western Europe (APHEA) 0.44%.

#### ***Estimating the change in exposure***

The theoretical ways in which pollutant levels could fall, and the magnitude of such falls, were modelled. Three models were used: the minimum and maximum to achieve the objectives and a more central estimate. This provided an additional set of sensitivity analyses.

#### ***Problems***

- A marked change in the population alters the estimates;
- It is harder to assess the situation in which more people are affected but less seriously because there are no routine data that are easily available.
- Nitrogen dioxide is more complicated to assess

There is also an issue about whether to estimate long- or short-term effects on health. Long-term effects are probably more important and may increase the incidence of diseases, and probably increase the consequences of diseases. However, the evidence is much less robust and it is difficult to quantify.

#### ***Key findings***

- a lower target, equivalent to European standard, increases health benefit;
- exceedences permitted by the strategy decrease health benefit;
- nitrogen dioxide has less effect than particulates

#### **Objectives 2 and 3**

- To estimate the impact on health of the local authorities' action plans to manage air quality
- To estimate the impact on health of one or more possible scenarios to reduce air pollution to the target levels by reducing the level of emissions from road traffic

#### ***Health impacts of transport***

The positive effects of transport on health include recreation, and exercise, and the access it confers to education, employment, shops, social support networks, recreational facilities, health services and, for urban populations, the countryside.

Physical activity or exercise reduces the risk of heart disease, stroke, depression, osteoporosis, diabetes, raised blood pressure and obesity. It also improves the level of well-being. Walking or cycling to school or work is as effective as a training programme and can fulfil the recommendations for exercise. Indeed, the health benefits from cycling regularly are said to outweigh the loss of life from injuries by about 20:1.

However, the negative effects of transport on health include:

- air pollution;
- road traffic injuries;
- a lack of exercise;
- noise pollution;
- increased levels of stress and anxiety;
- the impact of land loss and planning blight;
- the impact of community severance;

- the impact of loss of access.

In the UK, motor vehicles are the source of 91% of carbon monoxide (CO), 48% of particulates, 46-61% of nitrogen dioxide (NO<sub>x</sub>), 41-48% of volatile organic carbon (VOCs), and 67% of benzene. The impacts of *air pollution* from motor vehicle emissions are shown in *Box 1*.

*Road traffic injuries* were the cause of 39% of all accidental deaths in 1992, and 6% of the years of life lost in those aged under 70 years in 1993. There were 46,173 road casualties in Great Britain in 1997. Pedestrian involvement in road traffic accidents is higher in the UK than in most Western countries, and the perceived danger from traffic leads to restrictions of the independent mobility of children, with a consequent increase in traffic to transport children.

In Great Britain, both adults and children are less fit and less active than previously: the average distances cycled or walked per year continue to fall, and obesity is increasing which is related to inactive lifestyles.

*Noise pollution* from traffic is very common, but it is unlikely to lead to hearing loss. However, it does contribute to stress-related health problems such as high blood pressure and minor psychiatric illnesses. It can also cause loss of sleep, and be a source of difficulty in hearing speech and in concentrating (for example, at school).

In terms of *community severance*, major roads built through a comity cut some residents off from safe and easy access to shops, schools and other facilities, and also from their social networks. Traffic reduces the use of residential streets as play areas for children. Moreover, as traffic volumes increase, the number and frequency of social contact decrease. People who lack social support have a higher mortality rate.

Loss of *access to various facilities and services* can lead to inequities, with children, the elderly, women, people who have disabilities, and the poor being particularly disadvantaged. Journeys are not made because of the perceived danger from strangers, traffic, and air pollution. This is exacerbated by the fact that facilities are built on the assumption that potential customers have access to cars, for example, out-of-town shopping centres, and maternity hospitals sited at the top of a hill which are not served by public transport.

### **Methodology**

To achieve Objectives 2 and 3, I need to develop the methods for quantifying the assessment of health impacts. Once there is a robust method for quantifying these, additional inputs needed for a broad HIA of transport proposals will be modelling techniques to:

- predict the effects on modal split of transport;
- predict the effects on traffic fleet, volume and speed;
- modelling the effects of (2) on emissions;
- air pollution dispersion modelling.

### **Results**

All I can say at present about the health impacts of air quality management is that it is very difficult to quantify! Reducing air pollution by using technical fixes will produce small benefits to health. It is likely that traffic reduction and a move to physically active transport would result in larger decreases in premature morbidity and mortality as well as increases in well-being among people of all ages and in all but the very frail and disabled.

### **Outputs**

I have written a spreadsheet that will enable local and health authorities to calculate the effects of reducing particulates and nitrogen dioxide pollution in their area to the UKNAQS targets.

My current work is to develop a method for performing robust, quantified HIA, using air quality management in central London as a case-study.

**Box 1:****The impact of air pollution from motor vehicle emissions on health*****Air pollution episodes: London, 1952******Deaths***

- 4000 extra in 1 week: 2.8-fold increase in those aged 65-74 years; 2.7-fold higher in those aged 75 years and over
- from bronchitis and emphysema increased 9.5-fold

***Hospital admissions***

- trebled for respiratory diseases
- doubled for cardiovascular diseases

***Sickness Benefit***

- Applications increase by about 50%

***Air pollution episodes: London, 1991******Deaths***

- An increase of 10% in all deaths (excluding injury and poisoning) at all ages
- An increase of 14% in cardiovascular deaths at all ages
- An estimated 101-178 excess deaths occurred: 37-109 from respiratory conditions, and 46-91 from cardiovascular conditions

***Disease***

- An increase of 18% in ischaemic heart disease for all ages
- An increase of 22% in ischaemic heart disease in those aged 65 years and over

***Epidemiological studies******Particulates***

The effects of particulates have been investigated using the following indicators for health status:

- Changes in lung function, in both asthmatic and normal individuals;
- Lower respiratory tract (LRT) symptoms, e.g. cough;
- Medication use;
- GP consultations;
- Emergency admissions for all respiratory diseases, asthma, chronic obstructive pulmonary disease, and for all cardiovascular diseases, ischaemic heart disease, myocardial infarction (heart attack) and cerebrovascular disease (stroke);
- all cardiovascular deaths;
- all respiratory deaths – obstructive airways disease;
- all cause mortality.

***Nitrogen dioxide***

The effects of nitrogen dioxide have been investigated using the following indicators for health status:

- Changes in lung function;
- LRT symptoms;
- use of bronchodilators;
- absenteeism due to respiratory illness;
- GP consultations for asthma and LRT symptoms in children;
- Emergency home visits for LRT infection, asthma and headache;
- Emergency admissions for asthma, chronic obstructive pulmonary disease, all respiratory disease, angina, heart attack, and arrhythmia;
- Respiratory deaths in children and adults;
- Cardiovascular deaths;
- all cause mortality.

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