JSNA Chapter – Air Quality

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Executive Summary

Introduction

Despite great improvements in air quality in the UK since the Clean Air Act of 1956, current background levels of air pollution still pose a significant risk to health.

Long term exposure to air pollution at the levels experienced in many urban centres in the UK is now known to cause respiratory and cardiovascular disease and lung cancer. Short term exposure to episodes of elevated air pollution also leads to a worsening of symptoms for those with existing asthma, respiratory or cardiovascular disease, and can trigger acute events such as heart attacks in vulnerable individuals.

Air pollution can also be seen as a matter of social injustice. The most deprived 20 % of neighbourhoods in England have higher air pollution levels than the least deprived neighbourhoods. Those communities that are most polluted and which also emit the least pollution tend to be amongst the poorest in Britain

Human-made air pollution comes from a number of different sources, but the leading contributor in urban centres is road traffic emissions.

There are cost-effective, achievable local actions that can be taken to address air quality. These involve a shift towards greater use of active travel (walking and cycling), public transport and cleaner low emission vehicles. These actions also produce benefits across local priorities, including reduction in hospital admissions, increase in physical activity and healthy weight and tackling climate change. Addressing air pollution has been shown to achieve a high return on investment.

Unmet need and gaps

In Nottinghamshire County 5.7% of all adult mortality (430 deaths), and in Nottingham City 6.4% of all adult mortality (150 deaths) was attributable to long term exposure to human-made particulate air pollution in 2010.

There are 8 air quality management areas in Nottinghamshire County and Nottingham City, where levels of nitrogen dioxide (NO_2) exceed nationally set air quality objectives. Key drivers of high NO_2 levels include use of diesel engines, particularly in public transport fleets. In addition, background (ambient) particulate matter (PM2.5) levels exceed World Health Organisation guidelines across the majority of Nottinghamshire County and Nottingham City. Further reductions in levels of PM2.5 and NO_2 are required to protect human health.

Gaps include:

- Evaluation and update of the existing Nottinghamshire Air Quality Strategy (which was published in 2008 and due to be reviewed in 2011)
- Evidence of cost effectiveness, impact and local applicability of proposed actions on air quality
- Clarity on the existing powers and mechanisms for local authorities to prioritise actions which protect and improve air quality.
- Regional collaboration and sharing of best practice
- Quantification of the impact of NHS employment, transport and facilities on local air quality
- Identification of the role which NHS commissioners can play in tackling air quality

Recommendations for consideration by commissioners

- Review and update the Nottinghamshire Air Quality Strategy, including consideration of evidence of effectiveness and cost effectiveness of various interventions, and linking with partners in health, environment, planning, transport and sustainability.
- Consider inclusion of air quality as a priority within the Health and Wellbeing Strategy.
- Continue to strengthen the joint working across planning, transport and environmental health to identify shared opportunities to improve air quality.
- Develop a communication strategy to provide key messages on air quality to the public.
- Recommendations are provided in full in Section 10 of this chapter.

What do we know?

1) Who is at risk and why?

The health impacts of air pollution are increasingly well understood. Despite great improvements in air quality in the UK since the Clean Air Act of 1956, current background levels of air pollution still pose a significant risk to health. The air pollution episodes in Paris in March 2014 and across the UK in April 2014 included visible smog conditions. This raised the issue of air quality in public awareness. However the health risks posed by invisible air pollution on a day to day basis in towns, cities and along major traffic routes are less obvious and may be less readily recognized as a key health issue by the wider population.

The health focus has previously been on the effects of short term exposure to air pollution for vulnerable individuals with respiratory conditions such as asthma and COPD. However, the

evidence base on the health impacts for the wider population of long term exposure to air pollution has developed substantially over the past decade. The World Health Organisation considers air pollution to be a major environmental risk to health. By reducing air pollution levels, countries can reduce the burden of disease from stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases, including asthma.[1]

The Committee on the Medical Effects of Air Pollutants (COMEAP) found that the burden of human-made (anthropogenic) particulate air pollution had an effect on mortality in 2008 equivalent to nearly 29,000 deaths in the UK and an associated loss of 340,000 life years. This can also be estimated as a loss of life expectancy at birth of approximately six months[2] (COMEAP, 2010).

Across the globe, WHO estimates that some 80% of outdoor air pollution-related premature deaths were due to ischaemic heart disease and strokes, while 14% of deaths were due to chronic obstructive pulmonary disease or acute lower respiratory infections; and 6% of deaths were due to lung cancer.[3]

What is air pollution?

The World Health Organisation defines air pollution as 'contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.' [4]

Air pollution is a mixture of particles and gases that can have adverse effects on human health. Particulate matter (PM) is usually categorised according to size fractions:

PM10 all particles smaller than 10 microns (including PM2.5 and PM0.1) and

PM2.5 all particles smaller than 2.5 microns (including PM0.1)

PM 0.1 all particles smaller than 0.1 microns

The composition and proportions of each component in air pollution vary with location and prevailing weather conditions. A full list of the most common air pollutants, their sources and their health impacts is provided in the Factsheet on Air Pollutants. (Appendix 1)

Air Pollution occurs both outside and inside buildings. This chapter will focus primarily on outdoor pollution, linked substantially to emissions from the use of diesel and petrol engine motor vehicles. This is the area for which evidence of substantial long term health impacts is emerging and for which there are clear achievable actions which can be taken to improve air quality.

Outdoor Air Pollution

Historically, in towns and cities the main source of air pollution was high levels of smoke and sulphur dioxide emitted through the burning of fuels such as coal for domestic and industrial purposes. Today, air pollution in town and cities is primarily due to emissions from diesel and petrol engine motor vehicles and air-borne particles generated by tyre, road and brake wear.

Emissions include a variety of pollutants – particulate matter (PM), nitrogen oxides (including NO2), volatile organic compounds (VOC – benzene, 1-3 butadiene) and carbon monoxide. Traffic pollution creates both a highly localized health risk, with high concentrations occurring along traffic routes and is also carried over long distances, with weather conditions and local geography contributing to increased concentrations.

While combustion, agriculture and industrial processes all contribute to pollution, road transportation is particularly important because the emissions often occur in close proximity with pedestrians,

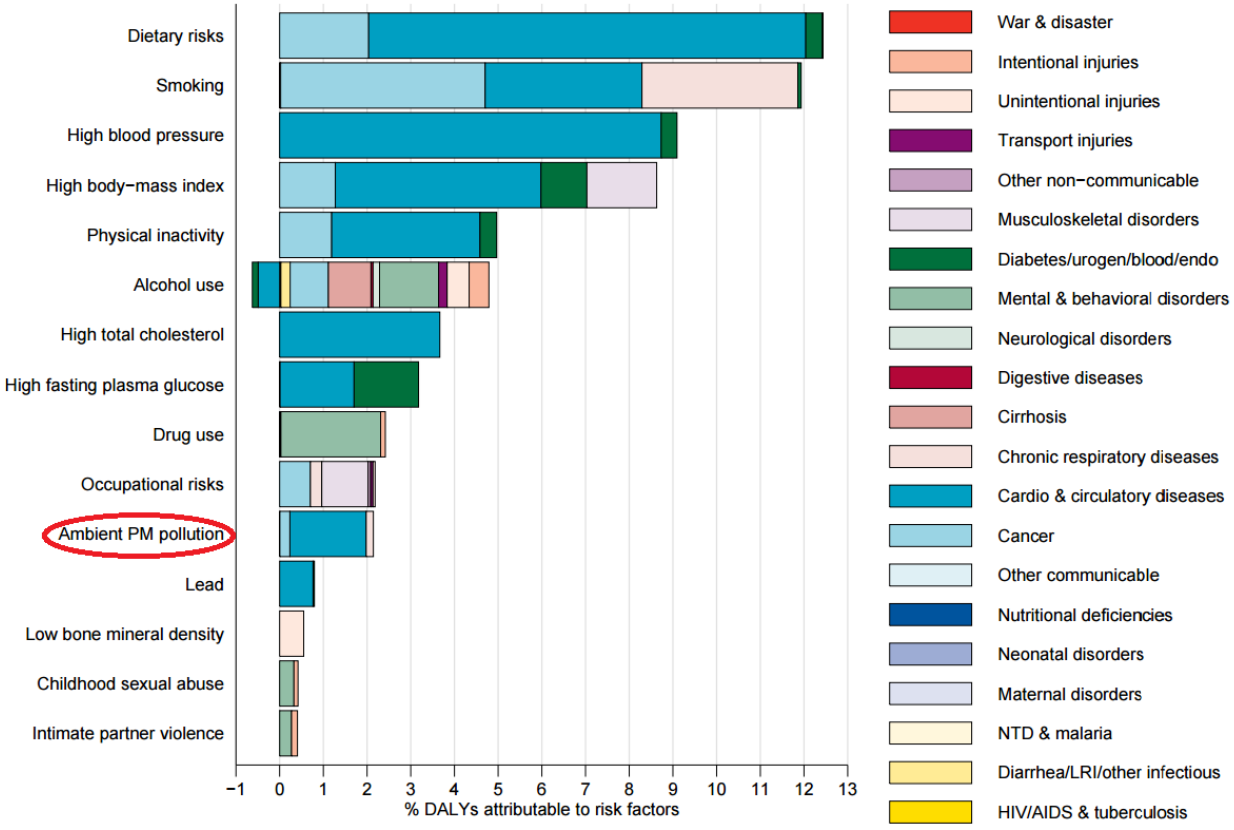
homes, hospitals, schools etc. There is also a large difference in emissions of different vehicles and fuels. In particular diesel exhaust contains up to 30 times more PM than petrol.[5]

The International Agency for Research on Cancer (IARC) has listed diesel exhaust pollution6 and outdoor air pollution as a Class 1 carcinogen. Outdoor air pollution is recognised as a leading environmental cause of cancer deaths.[7]

There is now firm evidence that long-term exposure to everyday air pollutants over months to years contributes to the development of cardiovascular disease (CVD), lung cancer, and respiratory disease. This is substantiated by two major reviews by the World Health Organisation in 2013, which considered the findings of 2,200 studies, including large cohort studies, epidemiological, toxicological and laboratory evidence.[8,9]

In 2011 the Global Burden of Disease Report ranked air pollution as the 11th cause of disease overall in the UK (Figure 1).[10]

Figure 1: Burden of Disease Attributable to 15 Leading Risk Factors in 2010, expressed as a percentage of United Kingdom DALYs



Source: Global Burden of Disease Study 2010, Institute for Health Metrics and Evaluation (IHME), University of Washington.[11]

The main pollutants of concern in the UK are PM, NO_2, and ground level Ozone (O3).[12]

The impact of air quality on mortality is most closely associated with concentrations of ambient (background) **PM2.5**.[13] The risk of mortality increases by 6% with each 10µg m^{-3} increase in ambient human-made PM2.5 concentration.[14] These effects persist at low concentrations of PM, so there is no established safe lower limit of exposure to PM.[15]

Current levels of particulate air pollution in the UK have a significant impact on the life expectancy of the population. In 2012, an estimated 5.1% of all-cause mortality in England was attributable to human-made particulate air pollution.[16]

Long term exposure to elevated PM2.5 concentrations contributes to development of atherosclerosis, cardiovascular disease[17], lung cancer,[18] other respiratory diseases and increased incidence of coronary events.[19]

Nitrogen Dioxide (NO_2) is an acidic gaseous pollutant produced by combustion processes, such as diesel and petrol engines, space heating and cooking that uses hydrocarbon fuel (e.g. coal, oil, natural gas, wood or other biomass). Short term exposure to NO_2 is associated with respiratory symptoms, hospital admissions and mortality.[20]

Studies of long-term exposure to NO_2 report associations with all-cause, respiratory and cardiovascular mortality, children's respiratory symptoms and lung function. There are still uncertainties about causality, due to strong correlations with other pollutants meaning that NO_2 may be an indicator for other pollutants. The US Environmental Protection Agency's current draft conclusion, at time of writing, is that there is likely to be a causal relationship for long-term exposure and respiratory effects. The evidence for cardiovascular effects and total mortality is only suggestive but not sufficient to infer a causal relationship. In a recent statement COMEAP concludes that it is reasonable to regard NO_2 as responsible for some of the adverse health impact identified in epidemiological studies.[21]

Ozone comes from a combination of natural and human processes. It is not emitted directly from any human-made source. It forms as a secondary pollutant through reactions between volatile organic compounds and nitrogen oxides in the atmosphere. Respiratory health effects and effects on mortality are associated with short-term exposure to O3.[22]

The effects from long term exposure to both NO_2 and O3 remain uncertain.

Vulnerable groups

The health effects of air pollution are distributed unequally across the population. The burden of disease is dependent on both individual physiological vulnerability and the extent of exposure to pollutants.

The elderly, children and those with cardiovascular or respiratory disease are at greatest risk.

Short term exposure to PM2.5 is a risk for particularly susceptible individuals: exposure to episodes of high PM2.5 levels from a few hours to weeks in duration can trigger CVD-related mortality, myocardial ischemia and myocardial infarctions (heart attacks).[23]

Evidence is also emerging from birth cohort studies of health impacts for babies and young children, resulting from exposure to PM2.5 during pregnancy and early years. This includes associations with respiratory infections, bronchiolitis and asthma in young children, low birth weight, preterm birth and small for gestational age births.[24]

Those who spend more time in highly polluted locations are more at risk due to high exposure. Because air pollution levels within motor vehicles are typically as high as directly outside the vehicle, this will include those who drive for a living, as well as those who live and work near to busy roads.[25] The evidence of health impacts for exposure from varying types of activity and characteristics of urban environments is not well developed as yet. Part of the reason for this is the difficulties in modelling population health risks from the measurement of individual exposures.

There are also geographical inequalities in the distribution of certain pollutants, with higher relative concentrations of pollutants in more deprived urban areas.[26] Road transport is responsible for up to 70% of air pollutants in urban areas.[27] This leads to geographic inequalities in death rates as a result of air pollution.

Recent research has found that, in England, the most deprived 20% of neighbourhoods had higher air pollution levels than the least deprived neighbourhoods, 1.5 µg/m3 higher PM10 and 4.4 µg/m3 NO2, after adjusting for other factors.[28] The same study found that the worst air pollution levels were seen in ethnically diverse neighbourhoods, defined as those where more than 20% of the population are non-white.

An earlier study found that "communities that have access to fewest cars tend to suffer from the highest levels of air pollution, whereas those in which car ownership is greatest enjoy the cleanest air" and " Those communities that are most polluted and which also emit the least pollution tend to be amongst the poorest in Britain."[29] This is linked to the fact that in many places poor housing stock is located close to busy road networks, and occupied by more deprived communities.

Since air pollution disproportionately affects the vulnerable and deprived groups, it has been highlighted by many researchers as a matter of social injustice[30, 31]

Indoor Air Pollution

The WHO notes indoor air quality as a very significant risk to public health, particularly in low and middle income countries where people cook and heat their homes using solid fuels (i.e. wood, charcoal, coal, dung, crop wastes) on open fires or traditional stoves. However in high income countries the burden of disease and mortality due to indoor air pollution is small in comparison to that due to outdoor air pollution.[32] WHO estimates that less than 5% of the UK population is exposed to indoor air pollution from the burning of solid fuels. [33]

The main indoor air pollutants of concern in the UK include

Radon - a colourless, odourless, radioactive gas that is emitted from rock and soils which contain naturally occurring uranium. Concentrations are higher indoors than outdoors and higher in radon affected areas. Approximately 1,100 people die each year from lung cancer associated with long term exposure to radon. This compares with 28,000 lung cancer deaths annually associated with smoking.[34]

Carbon Monoxide - a colourless, odourless, poisonous gas produced by the incomplete combustion of carbon-based fuels. More than 50 people are killed by carbon monoxide poisoning each year in England and Wales. Incorrectly installed, poorly maintained or poorly ventilated cooking and heating devices are often the main sources. [35]

Incomplete combustion products from burning of biomass fuels or faulty appliances in domestic properties - has the potential to contribute to issues of both indoor and outdoor air quality.

There are regulations and recognised processes in place to control and reduce each of these air pollutants in work and residential environments.

Indoor air pollutants are potentially important but the extent to which they affect health is not fully known. Heating and cooking appliances and environmental tobacco smoke are the most important indoor sources of pollution in UK homes. Nationally, there is a need for more information about levels of exposure to indoor air pollutants, as well as the risks posed by long-term exposure.36

A separate briefing note on indoor air pollution is available here. (Appendix 2)

2) Size of the issue locally

The Local Impact on Mortality

One of the best characterized and most important health impacts of air pollution is the increase in mortality risk associated with long-term exposure to particulate air pollution.[37] Public Health England (PHE) has produced estimates of this risk for all local authorities in the United Kingdom. These estimates are based on the research evidence of mortality risk, combined with modelled levels of the background air pollution to which populations are exposed at local authority level. Local estimates are given in Table 1.

Table 1: Estimated effects on annual mortality in 2010 of human-made PM 2.5 air pollution.

Area	Attributable Fraction	Attributable* deaths aged 25+	Associated Life-years Lost
EAST MIDLANDS	5.7	2314	24016
Nottingham UA	6.4	150	1559
Nottinghamshire CC	5.7	430	4270
Ashfield	5.7	68	662
Bassetlaw	5.3	61	620
Broxtowe	6.1	62	612
Gedling	5.8	63	628
Mansfield	5.6	57	594
Newark and Sherwood	5.4	63	626
Rushcliffe	5.8	56	528

Source: Estimating Local Mortality Burdens associated with particulate air pollution, Public Health England, 2014

* in reality, air pollution is likely to contribute a small amount to the deaths of a larger number of exposed individuals rather than being solely responsible for the number of deaths equivalent to the calculated figure of attributable deaths

To place these figures in context, Table 2 presents a comparison of deaths attributable to some other key risk factors in Nottinghamshire County and Nottingham City

Table 2: Comparison of deaths attributable to human-made air pollution, smoking and deaths related to alcohol consumption, Nottinghamshire County and Nottingham City.

Area	Deaths attributable to human-made air pollution	Deaths attributable to smoking	Deaths related to alcohol consumption
Nottinghamshire County	430	1,282*	326¥
Nottingham City	150	420	115

*Estimate based on 1/3 of deaths attributable for 2011-2013, Tobacco Control Profiles, PHE, http://www.tobaccoprofiles.info/profile/tobacco-control

¥ Estimates for 2010, Local Alcohol Profiles for England, http://www.lape.org.uk/data.html

Attributable fractions and attributable deaths associated with human-made particulate air pollution are useful in establishing the scope of the health impact locally, and in comparing the mortality burden from various preventable causes within a local area. They can help inform local public health priorities.

However there are some important limitations to their use:

- They are not suitable for assessing the impact of local interventions to improve air quality in the short term. This is because the methods used to model health impacts are not sensitive to the impact of small local initiatives that improve air quality.
- They are not suitable to use in comparing differences between local areas in order to assess the performance of the area, in terms of having good or poor practices around air quality. This is because the modelled concentrations of PM2.5 are dependent on characteristics of the area including urban versus rural populations and the influence of pollution originating from sources elsewhere.

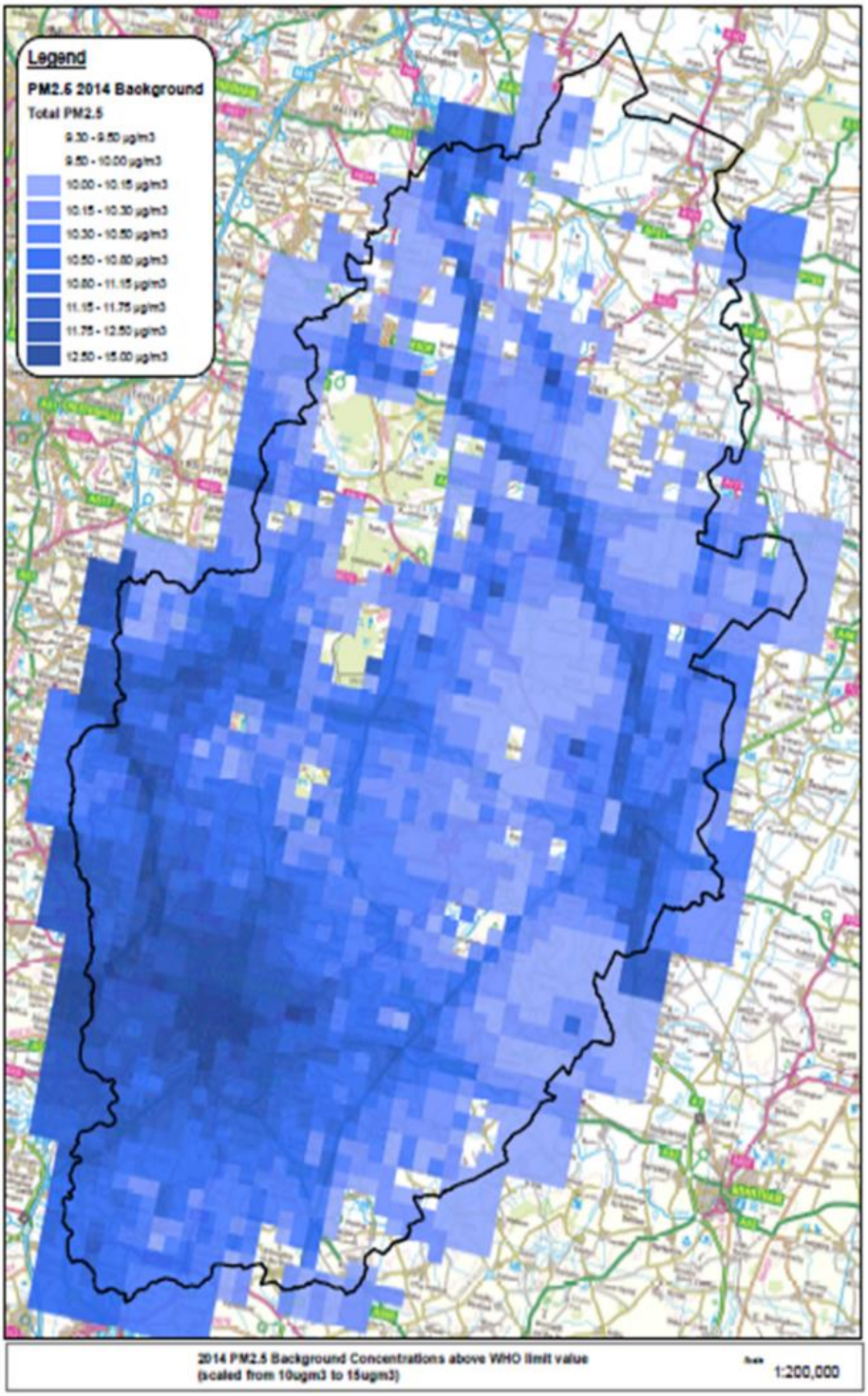
PM2.5 and WHO Air Quality Guideline Levels

WHO has developed standards which include maximum limit values for different air pollutants. These are incorporated into the WHO 2005 Air Quality Guidelines (AQG). These guidelines can be found in full here (Appendix 3)

It is now known that significant harm to health occurs at concentrations of PM well below the current EU and UK limit values.[38] It is expected that the WHO will produce new lower guideline values in the future.

Current WHO Air Quality Guidelines levels for PM2.5 are set at 10 ug/m3. Figure 2 provides a map of Nottinghamshire County and Nottingham City showing modelled concentrations of PM2.5. All coloured areas indicate areas where levels of PM2.5 are at or above WHO AQG. Darker colours indicate higher modelled concentrations of PM2.5. This means that the current levels of PM2.5 across the majority of Nottinghamshire County and all of Nottingham City are sufficient to be causing significant long term harm to health.

Figure 2: Nottinghamshire County and Nottingham City: Background Concentrations of PM2.5 above WHO Limit Value (scaled from 10 to 15 ug/m3)



Air Quality Management Areas

UK legislation (the Air Quality Standards Regulations 2010) includes Air Quality Objectives. These set concentration values for various pollutants that should be met by specified dates. These values are incorporated into British legislation from European law regarding ambient air quality. More

information on the measurement of air quality, EU limit and target values and UK national air quality objectives can be found **here. (**Appendix 3**)**

Where it is determined that an Air Quality Objective will not be achieved by the specified date in a local area, the local authority must designate this as an Air Quality Management Area, and develop and publish an Air Quality Action Plan to address the exceedance.

In Nottingham City and Nottinghamshire County, Air Quality Objectives are being met for PM. However, as noted previously, we now know that significant harm to health results from exposure to current concentrations of particulate air pollution, even though target and limit values are being met.

There are currently 8 designated Air Quality Management Areas in Rushcliffe, Gedling, Broxtowe and Nottingham City. All the areas arise due to nitrogen dioxide from road traffic and thus occur at the City and County's major roads and junctions.

Maps of these Air Quality Management Areas are available **here (Appendix 4)**

3) Targets and performance

Public Health Outcomes Framework

An indicator on air quality is included in the Public health Outcomes Framework

3.01 - Fraction of all-cause adult mortality attributable to anthropogenic particulate air pollution (measured as fine particulate matter, PM2.5)

Further information on this indicator and latest performance data can be accessed **here.**

Prioritising action on air quality delivers benefits across the agendas of local authorities and clinical commissioners, including contributing to the Public Health and NHS Outcome indicators listed in Table 3. This is because there are significant overlaps between the actions needed to improve air quality and those actions needed to improve use of green space, physical activity, obesity and cardio-respiratory health. Action to improve air quality can reasonably be expected to reduce premature mortality from cardiovascular and respiratory disease over time. Action to reduce vehicle emissions and improve air quality will also contribute to sustainability and help to address a key contributor to climate change. Climate change has been described as one of the most important public health issues of the 21st Century.[39]

Table 3: Indicators from the Public Health Outcomes Framework and NHS Outcomes Framework for which action on air quality could contribute towards improvements

Indicator (Framework)	Description	Example of Actions
1.10 (PHOF)	Rate of people killed and seriously injured on the roads, all ages, per 100,000 resident population	Developing safer routes for walking to school, and creating road spaces which prioritise 'place' over cars by creating safe enjoyable local environments with 'walkability' will improve air quality and also reduce road accidents.
1.16 (PHOF)	Percentage of people using outdoor space for exercise/health reasons	A modal shift toward active travel would result in larger numbers of people using outdoor space for exercise, and improve air quality.
2.06i (PHOF)	Percentage of children aged 4-5 classified as overweight or obese	A modal shift toward active travel would contribute to reductions in obesity, and improve air quality
2.06ii(PHOF)	Percentage of children aged 10-11 classified as overweight or obese	A modal shift toward active travel would contribute to reductions in obesity, and improve air quality
2.12 (PHOF)	Percentage of adults classified as overweight or obese	A modal shift toward active travel would contribute to reductions in obesity, and improve air quality
2.13i (PHOF)	Percentage of adults achieving at least 150 minutes of physical activity per week in accordance with UK CMO recommended guidelines on physical activity	A modal shift toward active travel would contribute to increases in physical activity, and improve air quality
3.01 (PHOF)	Fraction of all-cause adult mortality attributable to long-term exposure to current levels of anthropogenic particulate air pollution	All actions to improve air quality and reduce exposure to air pollution would result in an improvement in mortality attributable to exposure to air pollution.
3.06 (PHOF)	Percentage of NHS organisations with a board approved sustainable development management plan	Commitment to actions on air quality can reasonably be incorporated into board approved sustainable development management plans.
4.04i (PHOF)	Age-standardised rate of mortality from all cardiovascular diseases (including heart disease and stroke) in persons less than 75 years of age per 100,000	A reduction in traffic emissions would lead to less long term exposure to air pollution with an associated reduction in cardiovascular disease.

	population	
4.07i (PHOF)	Age-standardised rate of mortality from respiratory disease in persons less than 75 years per 100,000 population	A reduction in traffic emissions would lead to less long term exposure to air pollution with an associated reduction in respiratory disease.
2.3i and 2.3ii (NHS OF)	Reducing time spent in hospital by people with long-term conditions i Unplanned hospitalisation for chronic ambulatory care sensitive conditions (adults) ii Unplanned hospitalisation for asthma, diabetes and epilepsy in under 19s	A reduction in traffic emissions, together with a reduction in exposure to air pollution for vulnerable groups would result in fewer acute episodes related to heart disease, asthma and respiratory disease, as well as reducing the long term prevalence of these conditions.

Regulatory requirements on Air Quality

The Local Air Quality Management process undertaken by Nottingham City and Nottinghamshire's Borough and District Council's identified a number of roads and adjacent areas where the Annual Mean Air Quality Objective for nitrogen dioxide of 40 ug/m3 would not be met by the due date and declared Air Quality Management Areas for nitrogen dioxide.

It is important to note that although local authorities in Nottinghamshire County and Nottingham City have not declared Air Quality Management Areas with respect to PM10, the PM10 and PM2.5 levels monitored at DEFRAs Automatic Urban and Rural Network (AURN) station in Nottingham exceed current WHO Air Quality Guidelines levels for PM10 of 20 ug/m3 and for PM2.5 of 10 ug/m3. AURN monitoring data are available **here. (**Appendix 3**)**

4) Current activity, service provision and assets

No one individual, company or authority is ultimately responsible for air pollution and it is recognised that efficient air quality management requires strong multidisciplinary co-operation between stakeholders. Nottingham City Council and Nottinghamshire's District and Borough Councils are working together, and with other partners, to reduce emissions and improve air quality.

Key areas of action in addressing air quality include regulatory activity, urban planning and transport. Action on air quality is required at multiple levels including at district, city and county level, and will build on work which is already taking place.

Local authorities work with developers and planners to ensure developments within their area consider air quality and incorporate design features, mitigation or alternative provision to reduce or minimise emissions that may affect air quality or climate change. However, in local authorities where there are no air quality management areas, it can be difficult for environmental protection and pollution control colleagues to make a strong case for considering the impact on air quality for planned developments. Any proposed development will have some impact on local emissions.

Considering the impacts to health rather than compliance with air quality regulations alone may be a useful approach to ensure developments reduce or minimise emissions to the greatest extent possible.

Nottinghamshire County Council, as the highway authority for most of Nottinghamshire's road network outside the Nottingham City boundary, has identified and is implementing a range of measures to reduce emissions from road transport throughout Nottinghamshire. These are reported in the Local Transport Plan that is produced jointly with Nottingham City Council.

It must be noted however, that the measures detailed in the Local Transport Plan will not be sufficient on their own to address the air quality challenge faced in Nottingham City and Nottinghamshire County.

Although regulatory activity does control polluting emissions, the collective benefits of small changes in the actions, life and travel choices of individuals will also have a significant impact on air pollution and on the health of those individuals.

Air Quality Strategy

A Nottinghamshire wide Air Quality Strategy, **'A Breath of Fresh Air for Nottinghamshire'** was published in 2008, which covers the districts and boroughs of Nottinghamshire County and Nottingham City Council. The purpose of the strategy is "to help local authorities and partner organisations manage and improve ambient air quality and to protect the health and wellbeing of the public in a co-ordinated and integrated manner."[40]

The air quality strategy is an important asset for the local health economy. It provides one coherent framework for action across Nottinghamshire, acknowledging that effective action needs to be taken across local authority boundaries, since the sources of air pollution are local, regional and national in nature.

The Nottinghamshire Air Quality Strategy is now due to be reviewed and updated. The evidence of both the health impacts and effective actions to address air quality has developed since its publication. The new strategy should ensure that air quality remains a strategic priority with shared goals and purposeful, co-ordinated action across local government, health and wider partners.

Air Quality Action Plans

The aim of an Air Quality Action Plan (AQAP) is to improve air quality and reduce areas of exceedance. It contains a description of measures to be taken and dates by which it is hoped they will be achieved.

Throughout the LAQM Review and Assessment process, local road traffic has been identified as the major source of the measured/predicted exceedances of the nitrogen dioxide annual mean AQO.

Consequently the Air Quality Action Plans (AQAPs) for Nottingham City and Nottinghamshire County Councils have been incorporated into the Local Transport Plan (LTP). The AQAP relating to the current AQMAs were produced in June 2010 and are part of the current LTP – 'Nottingham City Council's Local Transport Plan 3: 2011 – 2026 Strategy' (LTP 3).

Nottinghamshire District and Borough Councils which have AQMAs produce their own AQAPs.

Links to further information on AQAPs are provided below

Nottingham City Council's Local Transport Plan

www.nottinghamcity.gov.uk/transportstrategies

Nottinghamshire County Council's Local Transport Plan
http://www.nottinghamshire.gov.uk/travelling/travel/plansstrategiesandtenders/local-transport-plan/ltp3/

Broxtowe Borough Council Air Quality Monitoring

http://www.broxtowe.gov.uk/index.aspx?articleid=7996

Gedling Borough Council Air Quality Monitoring

http://www.gedling.gov.uk/wasterecyclingenvironment/environmentalhealth/airpollution/localairquality/

Rushcliffe Air Quality Monitoring

http://www.rushcliffe.gov.uk/environmentalhealth/pollution/airquality/airqualitymanagementareas/

Local Authority Action on Air Quality

Nottingham City and Nottinghamshire's Borough and District Councils are all taking local action to address air quality in local areas. Details of this can be found in **here. (Appendix 5)**

5) Evidence of what works

Introduction

The King's Fund (2013) report on *Improving the Public's Health* found that: "The cost-benefit evidence for investing in air quality is substantial". They cite a review for the London Royal Borough of Kensington and Chelsea which identified a series of options for reducing air pollution that were "cost-beneficial, with potential for significant revenue generation, and spill over benefits including noise reduction. The overall benefit-to-cost return was £620 in benefits for every £100 spent.[41]

There are a range of evidence based and achievable actions which improve air quality and health outcomes. Action can be taken at a number of levels and, in some cases, overlaps significantly with those to increase physical activity, decrease obesity and improve cardiovascular and respiratory health. For example, increasing walking and cycling will not only reduce air pollution through a reduction in car use, but contribute to physical activity targets, improve cardiovascular and respiratory health and reduce obesity. It will also contribute to sustainability of travel options, and over the long term reduce the contribution to climate change. Developing safer routes for walking to school and creating road spaces which prioritise 'place' over cars by creating safe enjoyable local environments with 'walkability' will also reduce road accidents.

There is consistent evidence that using a variety of different interventions provides the best way to decrease pollution levels.[42] This chapter highlights a range of approaches – further work is needed to determine both those initiatives with the greatest evidence of effectiveness and impact, and those which can reasonably be expected to work locally

Actions to tackle air pollution can be broadly considered under 3 headings - Reducing polluting emissions, reducing human exposure to emissions and improving public awareness of air quality issues.

Reducing Emissions

Active Travel: Walking and Cycling

A Cabinet Office report in 2009 found that 68% of all trips under 5 miles are made by car. A decline in trips taken via walking since 1985 has been matched by an increase in trips taken by car. It is estimated that nearly 80% of car trips under 5 miles could be replaced by walking, cycling or taking public transport.[43]

The business case for alternative approaches to transport is strong. Replacing car journeys with walking or cycling and making roads and neighbourhood environments safer and more pleasant could deliver considerable savings: Getting one more person to walk to school could pay back £768[44] in terms of the health benefits to individuals, savings in NHS costs, productivity gains and reductions in air pollution and congestion. A savings of up to £641 a year for every person who cycles instead of using their car is also achievable.[45]

Active travel involves replacing car transport with alternative active forms of transport such as walking and cycling. This has the benefit of both reducing vehicle emissions and increasing individual levels of physical activity. An analysis of several alternative scenario interventions found that a combination of increased active travel and use of lower emission vehicles would provide greater benefit to health than policies focussed solely on low emission vehicles.[46]

The benefits of physical activity involved in cycling have been found to substantially outweigh individual risks of harm through exposure to air pollutants and increased risk of accidents.[47] There is also some evidence to suggest that on average cyclists are exposed to lower levels of air pollution than are car drivers.[48]

A number of initiatives can improve levels of walking and cycling:

- Work with employers to promote cycling to work, which reduces the risk of cardiovascular disease and obesity, and lead to better general health, resulting in lower absenteeism[49]
- Promote Bikeability schemes which improve confidence and skills of cyclists.
- Promote the Cycle to Work scheme[50] which reduces upfront costs of buying a bike for commuting purposes, and introduce cycle hire schemes.
- Improve street environments to prioritise place over cars by increasing perceptions of safety, quality of life and 'walkability'[51]

The King's Fund has summarised an extensive list of resources, evidence and case studies on active and safe travel. NICE guidance is available for Local Authorities on promoting cycling and walking.[52]

Regulation of Vehicle standards

European standards regulating new vehicle emissions have been particularly important in delivering improvements in air quality in urban areas.[53] New standards for emissions of light-duty vehicles and heavy-duty vehicles (Euro VI) were due to be implemented from 2014 onwards. Regulation of transport fuels has also supported air quality improvements, with petrol required to be unleaded, low in sulphur content and compliant with other organic compound limits.

Low Emission Zones

Low Emission Zones (LEZ) are used to reduce air pollution in urban centres, by imposing emissions standards on polluting heavy diesel vehicles and imposing daily access fees for any vehicle accessing an urban centre which does not meet these standards. Some studies have shown reductions in roadside traffic related air pollution associated with introduction of LEZ. However use of this regulation needs to be carefully considered on case by case basis to ensure that benefits outweigh costs.[54]

The latest report of the Environmental Audit Committee has recommended that a national framework for LEZ should be introduced to help local authorities reduce air pollution.[55]

Congestion Charging

Congestion charging in London and Stockholm were shown to reduce traffic volume by 18% and 22% respectively. In London reductions in air pollution concentrations were greatest within the charging zone, with more deprived areas experiencing greater air pollution reductions compared to the least deprived areas. [56]

Traffic Calming

Traffic calming measures (including speed humps, roundabouts and traffic lights) have been shown to increase total traffic emissions, despite reducing traffic flow.[57] A report by Imperial College London finds that the effect of 20 mile per hour speed limit zones on traffic emissions is mixed, but overall they cannot be assumed to be detrimental to local air quality.[58]

Anti-Idling Campaigns

Un-necessary idling of motor vehicles increases air pollution, wastes fuel, and causes excess engine wear. The United States Environmental Protection Agency promotes a national anti-idling campaign aimed at school buses[59], and one study has found that such campaigns are effective at reducing emissions at schools with significant amounts of buses and passenger cars.[60] Several London Boroughs have introduced fines for motorists who sit in a stationary car with the engine running and refuse to turn it off.[61]

Public Transport

The use of public transport can have dual benefits of reducing the number of journeys made by individual motor vehicles and increasing physical activity.

However public road transport is dominated by heavy diesel vehicles with very high mileage punctuated by frequent stops and starts. It is responsible for a disproportionate amount of emissions, particularly of nitrogen dioxide. Transport for London noted that its buses account for 0.2% of London vehicles but are the source of 25% of NOx emitted by vehicles in the city.[62]

Priorities to improve air quality will include a combination of

- Replacing older buses with Euro VI buses
- Retrofitting existing bus fleets to decrease their emissions
- Introduction of hybrid engine taxis, and requirement of “zero-emission capability” for all newly licensed taxis.
- Local authorities requiring air pollution standards for public transport when putting routes out to tender.[63]

The Environmental Audit Committee has noted a lack of clarity regarding the degree of influence that local authorities have to ensure good air quality standards in local bus fleets. It has called on government to identify best practice and provide advice to local authorities.

Local Authority Led Initiatives

The King's Fund[64] considers that local authorities can lead by example by:

- implementing business engagement programmes to reduce air pollution
- encouraging expansion of council-run income-generating car clubs
- promoting zero emission 'last mile' delivery of as many goods and services as possible
- organising 'eco-driving' training for taxi-drivers to encourage more fuel-efficient driving, and finding ways to reduce idling at taxi ranks

Local Authorities can also invest in longer-term changes with potentially greater impacts, such as:

- vertical roof exhausts for buses, and fitting diesel particle filters
- rolling replacement of boilers with the least polluting models
- ensuring that new buildings are air quality neutral

Reducing Exposure

The impact of air pollution on health can also be mitigated through actions to separate residents, pedestrians and cyclists from sources of air pollution, which overcomes localised effects of high concentrations of pollutants. These include encouraging walking and cycling on quiet routes, with lower traffic volumes, constructing roads with sufficient space between roadside housing, pedestrian walks, cycle lanes and road traffic. However the latter is difficult to achieve with existing urban infrastructures and these measures do not reduce risks for motorists themselves, who experience the highest exposure to air pollution.

There are a range of initiatives being trialled within the UK, but research is needed to establish a measurable effect on individual exposure and health outcomes.

Mobile phone alerting systems

Some counties in England commission access to a free mobile telephone text messaging service, which provides alerts on air quality to vulnerable individuals in the community who have registered with the scheme. It is aimed at providing forecasts of air quality to those with respiratory conditions, to allow them to plan their activity to reduce their exposure and ensure they have necessary medications to hand.[65] These services have been popular with users, and there is some evidence of behaviour change amongst service users including increased preparedness and avoiding exposure during episodes of elevated air pollution.[66,67] Research by King's College London found that the airAlert service could result in a reduction in respiratory hospital admissions as well as reduction in respiratory symptoms, cardiovascular admissions and even mortality for very vulnerable patients. The authors note that the incremental costs of air alert messaging are low.[68]

Daily Air Quality Index

The daily air quality index published online by Defra covers all localities within England. This can be used as an alerting system for those with increased susceptibility (with heart and respiratory conditions) who may alter their day to day activities to ensure they minimise exposure during

particularly high pollution events. The American Heart Association supports the use of such daily air quality information, paired with health advice, as a guideline to restrict activity of those with known heart conditions, due to the increased risk of acute myocardial events following short term exposure to elevated air pollution.[69]

Urban Greening

Individual studies have found that the use of street level trees, green walling (growing of any type of green vegetation over street canyon walls) and other urban vegetation has some modest impact on reducing levels of air pollution.[70, 71, 72]

Walking Route Planners

Online resources such as Walkit.com are developing which allow users to plan walking routes. Residents in London are able to search for low pollution walking routes.[73]

Use of planning regulations

The Environmental Audit Committee has recommended that "new schools, care homes or health clinics near existing air pollution hotspots, and any redevelopment of such existing buildings should only be approved if they reduce pollution exposure for their users. Building regulations should provide for existing schools sited near pollution hotspots to be fitted with air filtration systems."[74]

Health Awareness

Defra commissioned research in 2014 which included workshops with members of the public on understanding and response to new information about air pollution.[75] This research concluded:

"Over and above the fact that people *ought* to be informed about risks to their health, participants in research workshops… were clear that they *wanted* and *expected* to be informed. Members of the public can also play a critical role in realising opportunities for health improvement, whether by reducing their personal exposure to air pollution, reducing their personal contribution to air pollution, or supporting and advocating actions to tackle air pollution locally. Through citizen science initiatives, people can even get involved in the measurement of air pollution or evaluation of interventions."

This research commissioned by Defra has highlighted 6 key principles for public communication about air pollution

A. Use information about what particulate matter is made of and where it goes to get air pollution onto the agenda – not statistics about health consequences.

B. Don't raise public concern about air pollution unless you can at the same time satisfy people's desire to do something to reduce their exposure.

C. Focus on what is known for certain about the health consequences of air pollution.

D. Talk about air pollution as a problem linked to specific places – and not as a general problem of the atmosphere.

E. Keep the focus on practical improvements – not long-term solutions.

F. Demonstrate leadership and empower communities, instead of just expecting individuals to change their behaviour.

6) What is on the Horizon

Amendments to the Clean Air Act

The Clean Air Acts of 1956 and 1968 were instrumental in reducing emissions of coarse smoke/particles and sulphur dioxide and preventing further 'great smogs'.

In 2012 as part of this Government's Red Tape Challenge, DEFRA commissioned AEA Technology plc to undertake a review of the effectiveness of the Clean Air Act, followed up in 2013 by a 'call for evidence' to support a policy review.

In July 2014 DEFRA published the Review of the Clean Air Act Call for Evidence Summary of Responses. The review recognised the need for continuing regulation of emissions from domestic and industrial plant and the potential need to introduce tighter particle emission controls for exempt appliances in Smoke Control Areas.

Local Authorities are currently awaiting the publication of draft legislation amending the Clean Air Act 1993.

Take up of alternative vehicle technology

The Department for Transport currently publishes figures regarding the total number of Low Emission Vehicles (LEVs) registered, of which 26,247 vehicles were registered as of September 2014. A total of 104 vehicles are registered within Nottingham, which is 5.7% of the total LEV registrations within the East Midlands (1,796 vehicles). The average percentage take-up across the country of electric vehicles, in proportion to total vehicle registrations is now increasing, currently at 0.53% of total registrations nationally (2014 figures). If using this proportion applied to the total vehicles at a local level (100,544 vehicles, 2013 vehicle registrations), a total figure of 537 vehicles should be registered in Nottingham. This indicates that there is suppressed demand within Nottingham for electric vehicle infrastructure and uptake of low emission vehicles. (NCC ULEV bid Feb 2015)

Environmental Audit Committee Action on Air Quality Report

The Environmental Audit Committee published its most recent report on air quality in November 2014. This report highlighted failures to meet EU air quality targets in some UK cities and called on government to take urgent action to address air quality. The summary and full report can be found **here.**

Health Effects of Exposure to Nitrogen Dioxide

In March 2015, COMEAP published a statement on the evidence of health effects from exposure to nitrogen dioxide (see section "Who is at risk and why?"). Public Health England plans to develop estimates of mortality due to NO_2, similar to those provided for PM2.5 in 2014.

Public Health England

PHE are developing a national work plan to support both local and national work and effective local action on air quality. As part of this work, the East Midlands PHE centre is co-ordinating the establishment of an East Midlands Air Quality Network.

Guidance

NICE guidance on "Air pollution - outdoor air quality and health" is planned, but a publication date is not yet confirmed.[76]

Court Order on Air Pollution

ClientEarth, a group of environmental lawyers, has won a ruling in the UK Supreme Court, which orders that the government must prepare and consult on new air quality plans for submission to the European Commission no later than December 31st 2015. Legal action was started by campaigners after the UK breached EU limits for NO_2.[77]

7) Local views

No work to determine local views on air pollution has been completed since the development of the Air Quality Strategy in 2008.

What does this tell us?

8) Unmet needs and service gaps

Nottinghamshire Air Quality Strategy

Nottinghamshire (including its Borough, District, City and County Councils, and wider partners) are well placed to build on the comprehensive and effective work laid out in the existing air quality strategy. This is particularly the case now, given the opportunities presented by building momentum and support for the air quality agenda regionally and nationally (refer to “On the Horizon” section).

However there is now a gap at a strategic level in that the Air Quality Strategy needs to be updated. In order to continue to work effectively and coherently across agencies an update to the air quality strategy would need to address:

- The new evidence of health impacts now known to occur at much lower ambient concentrations than set out in current air quality objectives
- Emerging evidence of effective technological, strategic, regulatory and transport modal shift based actions to address air pollution
- The cost effectiveness, feasibility and likely impact of the range of possible interventions to tackle air pollution.
- Renewed engagement with partners including transport, planning, environment, health and the commercial sector, taking into account new roles and accountabilities where relevant.
- The development and implementation of an action plan with multi-agency accountability.

There are existing examples of initiatives undertaken with clear and appropriate objectives which have had unintended impacts on air quality. These include the promotion of the use of diesel engine motor vehicles, and potentially the promotion of renewable heating initiatives which involve less clean energy sources such as biomass burning.

There is significant good work being undertaken across Nottinghamshire to tackle air pollution. An updated air quality strategy will reduce the likelihood that wider policy decisions taken locally will have unintended negative consequences for air quality by taking a cohesive, multi-agency approach. The strategy would also enable local initiatives to have maximum impact, driven by an understanding of both shared objectives and the co-benefits of action on air quality for the economy, health and environment.

Regional Collaboration and Sharing of Best Practice

Air quality has been noted as both a highly localised issue, requiring tailored local action to address exceedances, and a regional or national issue, in terms of the distributed road networks and

weather events which contribute to pollution hotspots and episodes. There is currently a gap in forums that promote wider regional working between stakeholders to improve air quality.

Local Authority-Led Initiatives

Local Authorities also have powers which provide local avenues to reducing emissions, concentrations or exposure to pollution, including:

- traffic and parking management
- street design and road layouts
- planning
- public and school transport policies
- restricting the dirtiest vehicles or favouring clean vehicle fuels like petrol, liquid petroleum gas (LPG) or compressed natural gas (CNG) over diesel and bio-diesel
- freight consolidation, delivery management and low or zero emission last mile services
- fleet management and car clubs
- vehicle and building air conditioning
- building energy efficiency

However anecdotal evidence suggests:

- A lack of effective mechanisms to influence local developments in favour of improving air quality and reducing health impacts.
- A lack of clarity on the extent to which the existing powers of local authorities can be utilised to ensure good air quality is prioritised locally.
- Barriers to working across agencies to identify and implement effective local action.

9) Knowledge gaps

Impact and Effectiveness

There are a wide range of interventions that have been suggested in the literature to tackle air pollution. However, developing evidence of effectiveness is complicated by difficulties in linking specific interventions to subsequent improvements in air quality, and by difficulties in generalising the findings of studies, due to the localised nature of air pollution hotspots.

Whilst a limited number of interventions are supported by guidance or evidence review, a number of innovative approaches are developing as individual case studies.

A further review of the existing evidence base would help to establish the effectiveness, impact and cost-benefit of specific interventions, in order to prioritise these for local action.

Evaluation of the Existing Air Quality Strategy

No evaluation of the current Nottinghamshire Air Quality Strategy has been undertaken to establish effectiveness, extent of implementation and any key learning points for future strategy development.

The NHS Role

As holder of the biggest property portfolio in Europe and employer of over one million people, the NHS has a considerable carbon footprint. In 2008 it was estimated that 5% of all the UK's emissions from road transport were attributable to NHS related journeys.[78]

It is not clear locally what contribution NHS activity makes to existing air quality issues. Evidence is needed on effective actions that can be taken by the NHS to contribute to improving air quality.

What should we do next?

10) Recommendations for consideration by commissioners

The key recommendation for commissioners is that the Nottinghamshire Air Quality Strategy should be reviewed and updated. As part of this process, some further recommendations should be considered

Recommendation	Lead Authority
Review and update the Nottinghamshire Air Quality Strategy	Nottinghamshire Environmental Protection Working Group
Evaluate the impact of the existing Nottinghamshire Air Quality Strategy	Nottinghamshire Environmental Protection Working Group
Consider whether air quality should be included as a priority within the Health and Wellbeing Strategies of Nottingham City and Nottinghamshire County Councils, given the new evidence of health impacts and the overlaps with key public health agendas.	Health and Wellbeing Boards
Conduct further evidence review in order to prioritise actions on the basis of cost-effectiveness and likely impact	Public Health
Consider incorporation of revised air quality aspirations into the Local Development Plans	Planning & Environmental Health
Identify further opportunities, through policy, strategy and interventions, to improve the take up of active travel, low emission vehicles and public transport across Nottinghamshire County and Nottingham City.	Environmental Health, Transport & Planning
Identify opportunities for councils to lead by example in their sustainability policy, vehicle fleet management and use of local powers to improve air quality.	Nottinghamshire Environmental Protection Working Group
Incorporate information and action on air quality into NHS sustainable development management plans.	Clinical Commissioning Groups
Engage with the newly formed East Midlands Air Quality Network	Environmental Health, Public Health
Develop a communication strategy to provide key messages on air pollution to the public.	Public Health.

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