Department for Environment Food & Rural Affairs

Public Health England

Local Government Association

Air Quality

A Briefing for Directors of Public Health

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Air pollution can damage lives with harmful effects on human health, the economy and the environment. It is the largest environmental risk to the public's health, contributing to cardiovascular disease, lung cancer and respiratory diseases. It increases the chances of hospital admissions, visits to Emergency Departments and respiratory and cardiovascular symptoms which interfere with everyday life, especially for people who are already vulnerable. Bad air quality affects everyone and it has a disproportionate impact on the young and old, the sick and the poor.

Air quality in the UK has improved significantly over recent decades: since 1970 sulphur dioxide emissions have decreased by 95%, particulate matter by 73% and nitrogen oxides by 69%. The government is firmly committed to seeing further improvements in the UK's air quality and cutting harmful emissions. The government has committed more than £2billion since 2011 to increase the uptake of ultra-low emission vehicles and support greener transport schemes. The government has also set out how they will improve air quality through a new programme of Clean Air Zones and is committed to doing more.

The air quality impacts of driving are already widely discussed and understood, but vehicles aren't the only source of air pollution. All sorts of other everyday activities, such as industrial processes, farming, heating homes and generating energy also affect air quality. These activities can't stop. They are an essential part of our daily lives and our economy. But there are cost-effective changes that can be implemented both locally and nationally to secure cleaner cities and a clean, green economy. That's why the UK has signed up to tougher legally binding ceilings for emissions of five major pollutants with the goal of halving the number of deaths from poor air quality by 2030.

Alongside national measures, local leadership is essential. Local authorities have a central role in achieving improvements in air quality; their local knowledge and interaction with the communities that they serve mean that they know the issues on the ground in detail. They are best placed to decide and work with partners to implement the appropriate solutions in regards to local transport, smoke control, planning and public health. Directors of Public Health have a crucial role to play as leaders and influencers, shaping how local approaches can help clean up air in their area most effectively.

Introduction by Dr Andrew Furber and Councillor Izzi Seccombe

Dr Andrew Furber
ADPH President, Director of Public Health in Wakefield.

Councillor Izzi Seccombe
Chair of the Local Government Association's Community Wellbeing Board

Taking action to improve air quality is crucial in order to improve population health. There is growing evidence that air pollution is a significant contributor to preventable ill health and early death. These health impacts impose a cost on the UK economy that has been estimated to run into billions. Although significant progress has been made in improving air quality over previous decades, further progress is necessary and possible. This will require a combination of innovative national and local approaches.

Local authorities have a major role to play. The transfer of additional responsibilities for public health to local government in 2013 has presented a major opportunity for Directors of Public Health and Councillors to take action to enhance this leadership on air quality. Progress will be seen by designing and implementing the right policies and interventions and raising awareness of the issue. They will be able to do this even more effectively when equipped with the right data and tools. We look

forward to seeing this toolkit put to good use to make a difference to the quality of the air across the country. We hope that it will be helpful for enabling local authorities to adopt a robust and effective local approach that will complement a national strategy from the government.

We are delighted that ADPH and the LGA have worked collaboratively with Defra and PHE to generate this updated suite of tools which will help local authorities to take action to improve air quality. Local authorities are already well positioned to improve air quality but their role and ability needs to be strengthened. The toolkit is designed to make it easier for local authorities to be as effective as possible in improving it.

1. Getting to grips with air pollution – the latest evidence and techniques

Introduction

This briefing provides Directors of Public Health with the information you need to help you consider the appropriate public health response to air pollution in your area. There is extensive evidence about the health impacts of air pollution, growing media and public interest and an indicator on mortality attributed to particulate matter (PM) air pollution in the Public Health Outcomes Framework.

This guide describes the latest evidence, outlines the role that Public Health officials can play, highlights techniques to get a better understanding of the local issues, and presents evidence-based principles for communicating with the public on air pollution. This document is part of a resource pack for Public Health teams. The resource comprises of a further "Briefing for Elected Members" as well as four short guides to help Directors of Public Health and their teams to take action.

Briefing:

- Air Pollution: a public health issue. A Briefing for Elected Members

Guides:

- Understanding air pollution in your area
- Engaging local decision-makers about air pollution
- Communicating with the public during air pollution episodes
- Communicating with the public about air pollution

The briefings and guides have been informed by research with Directors of Public Health and their teams about their information needs, and research with the public to inform approaches to public communication. This resource was originally commissioned by Defra and its development was steered by Defra, Public Health England, the Department of Health, Department for Transport, Local Government Association and the Healthy Air Campaign. The work was reviewed and updated in early 2017 by Defra, Public Health England, the Local Government Association and the Association of Directors of Public Health.

Key points:

- Air pollution is a serious public health issue. The Department of Health's (DH) Committee on the Medical Effects of Air Pollutants (COMEAP) estimated the burden of particulate matter (PM) air pollution in the UK in 2008 to be equivalent to nearly **29,000 deaths** and an associated loss of population life of **340,000 life years lost**. Defra has made an initial estimate that nitrogen dioxide (NO_2) contributes to shortening lives by an average of around 5 months – ranging from healthy individuals experiencing negligible effects to susceptible individuals whose poor health is seriously exacerbated by NO_2 pollution. This overall population burden is estimated to be equivalent to **nearly 23,500 deaths in the UK per year**. There is likely to be an overlap in the health burden associated with ambient concentrations of particulate matter (PM) and NO_2, so it is not possible to reliably estimate the combined health burden of multiple pollutants from the same sources, although it is reasonable to assume that some individuals will be adversely affected by exposure to both pollutants at the same time and that the total burden across the population will be increased to a certain extent. Further work is being undertaken to understand and quantify this overlap.
- Tackling air pollution is a priority for this government and that is why we have agreed legally binding UK targets to reduce emissions of the five key primary air pollutants[1] by 2020 (through the UNECE Gothenburg protocol) and 2030 (as part of the National Emission Ceilings Directive).
- Legal limits are in place to protect human health. However, it is recognised that there are no absolutely safe levels of PM, one of the main pollutants of concern. Evidence suggests that health effects can still occur well below these limits. Any improvement in air quality will have positive health consequences[2] and the UK has a target to reduce average concentrations of $PM_{2.5}$ at urban background locations by 2 µg/m^3 (a reduction of 15% on 2010 levels)" by 2020[3].
- Population exposure to particulate matter. $PM_{2.5}$ has been used as the basis of the Public Health Outcomes Framework (PHOF) Indicator 3.01[4]. The indicator provides a starting point but it is not hard to gain a more accurate and detailed picture of the local situation.
- The local nature of pollution hotspots creates scope for local action to reduce local concentrations and reduce people's exposure to air pollution. Local authorities have a range of powers which can be deployed effectively to improve air

1 Fine particulate matter, nitrogen oxides, sulphur dioxide, ammonia and non-methane volatile organic compounds

2 Review of evidence on Health Aspects of Air Pollution – REVIHAAP: final Technical Report, World Health Organization Office for Europe, 2013 http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report

3 This is called the National Exposure Reduction Target (NERT), and is determined on the basis of the population's average exposure to $PM_{2.5}$ at urban background sites, the Average Exposure Indicator (AEI). Urban background sites are measurement sites in town and cities that are not significantly influenced by emissions from specific local major roads, industry or other pollution sources. For more information on site types see: http://uk-air.defra.gov.uk/networks/site-types

4 http://www.phoutcomes.info/

quality – for example on transport, smoke control areas, environmental permitting, and planning.

- Local actions to address the health impacts of air pollution on local populations can play a critical role in supporting other local priorities such as active travel, health inequalities, integrated care, sustainability, growth and regeneration, and localism and community engagement.
- Public Health officials have a crucial role to play in assessing the public health impacts of air pollution and providing advice and guidance on taking appropriate action to the public and their colleagues in local authorities.

The new evidence putting air quality on the agenda

In 2010 COMEAP undertook a study to quantify the effects of long term exposure to PM. In doing so, COMEAP estimated the burden of PM air pollution in the UK in 2008 to be equivalent to nearly 29,000 deaths and an associated loss of population life of 340,000 life years lost[5]. In comparison, a study in 2006 found that reducing PM by 10 $\mu g/m^3$ would extend lifespan in the UK by five times more than eliminating casualties on the roads, or three times more than eliminating passive smoking[6]. The main outcomes of PM air pollution are cardiovascular (CVD) and respiratory diseases. There are no safe levels of PM and impacts are observed below levels permitted by current legal limits.

Since 2005 when the most recent wave of EU air pollution policy was launched with the Thematic Strategy on Air Pollution, scientific understanding of the health effects of everyday air pollution has changed dramatically due to several thousand epidemiological panel, time-series and cohorts studies, backed up by laboratory and toxicological studies.

In 2011, the Department of Health (DH) included an indicator based on annual average $PM_{2.5}$ concentrations in the new PHOF. In 2012, the International Agency for Research on Cancer listed diesel exhaust pollution as a Class 1 carcinogen[7] and extended this to all ambient air pollution in 2013[8]. In 2013, the World Health Organization (WHO) published a review[2] of 2,200 studies concluding that:

- Annual $PM_{2.5}$ concentrations are associated with all-cause mortality to a high level of confidence, and with much greater certainty than in 2005
- "There is no evidence of a safe level of exposure to PM or a threshold below which no adverse health effects occur". Negative health impacts have been found well below current EU & UK limits

5 The mortality effects of long-term exposure to particulate air pollution in the UK, Committee on the Medical Effects of Air Pollution, Dept of Health, 2010 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304641/COMEAP_mortality_effects_of_long_term_exposure.pdf

6 B Miller & F Hurley, Comparing estimated risks for air pollution with risks for other health effects, Institute of Occupational Medicine, Report TM/06/01, 2006 http://www.iom-world.org/pubs/IOM_TM0601.pdf

7 IARC: Diesel engine exhaust carcinogenic, WHO International Agency for Research on Cancer, Press release No 213, June 12, 2012. http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

8 IARC: Outdoor air pollution a leading environmental cause of cancer deaths, WHO International Agency for Research on Cancer, Press release No 221, October 17, 2013. http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

- Nitrogen dioxide (NO_2) was associated with "adverse health effects at concentrations that were at or below the current EU limit values"

The report considered detailed epidemiological, toxicological and laboratory evidence answering a series of policy and health questions. A further WHO report[9] made recommendations for Health Impact Assessments of air pollution for policy purposes.

In 2015, the Royal College of Physicians and the Royal College of Paediatrics and Child Health published a report on the lifelong impact of air pollution. It considered the effects of chronic and persistent pollution exposure from conception to old age, taking into account both outdoor and indoor pollution exposure sources. It also viewed air pollution as a stressor that interacts with many other stressors such as diet, socio-economic deprivation and climatic conditions to create adverse health impacts and increased susceptibility to disease[10].

The result is that the population effects of air pollution are now increasingly quantifiable for some of the key pollutants. This has allowed the resulting burden of disease to be assessed for public health policy purposes and has driven the development and implementation of new international and European commitments to reduce air pollution.

In November 2016 the European Parliament voted to support the revised National Emission Ceilings Directive. The Council of the European Union adopted the revised Directive on 8 December and it entered into force on 31 December 2016; the UK has supported the revision of this legislation. The revised National Emission Ceilings Directive has stricter national emission ceilings for the 5 main air pollutants: sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and fine particulate matter. Implementing these ceilings will save lives. The government is committed to ensuring that the UK is ready to meet these ceilings during this Parliament, including publishing an Air Pollution Emissions Reduction Plan for the UK by March 2019.

9 Health Risk Assessment of Air Pollution http://www.euro.who.int/__data/assets/pdf_file/0006/298482/Health-risk-assessment-air-pollution-General-principles-en.pdf?ua=1

10 Royal College of Physicians. Every breath we take: the lifelong impact of air pollution. Report of a working party. London: RCP, 2016.

What are the main air pollutants?

Air pollution is a mixture of particles and gases that can have adverse effects on human health. The most important primary air pollutants are particulate matter (PM) and nitrogen dioxide (NO_2).

Particulate matter (PM)

PM comprises micron sized particles (a micron is 1000th of a millimetre) and is studied in three main size fractions; PM_{10}, $PM_{2.5}$ and $PM_{0.1}$. **PM_{10}** includes all particles smaller than 10 microns[11] (i.e. including $PM_{2.5}$ and $PM_{0.1}$) and **$PM_{2.5}$** comprises all particles smaller than $_{2.5}$ microns (including $PM_{0.1}$).

$PM_{2.5}$ has the highest epidemiological link to health outcomes[4] and is used for the Public Health Outcomes Framework indicator 3.01. At this size **the particles can be inhaled deep into the lungs**.

The very smallest particles, ultrafine $PM_{0.1}$ (the smallest fraction of $PM_{2.5}$) are nano-particles smaller than 0.1 microns and are thought, once inhaled, to be able to **pass directly into the bloodstream**. *See diagrams on pages 16 and 23.*

PM can be composed of particles from combustion products, products from abrasion of engine components, brakes and tyres on road surfaces, generated during construction and agricultural processes, as well as components generated by chemical reactions in the air. Much of the PM in urban pollution hotspots, particularly those close to roads, can come from traffic sources and comprises soot, part burnt diesel and petrol compounds that form benzene-based carcinogens, heavy metals, silica, bitumen, rubber and organic and other waste matter from road surfaces.

The proportions of each component vary strongly depending on location. In cities and along roads where highest concentrations tend to occur, traffic generated compounds make up a large or dominant portion of the overall composition. In the countryside, agriculture and upwind industry make a bigger contribution. However, nationally UK emissions only contribute around 50-55% of total annual average **$PM_{2.5}$** concentrations in the UK, with the rest coming from transboundary continental sources[12].

In national emission terms (as opposed to urban pollution hotspots) approximately 38% of particulate matter ($PM_{2.5}$) is produced by UK householders burning wood, coal and other solid fuels in open fires and stoves. If they have an open fire householders can reduce PM emissions by using seasoned wood or smokeless fuel. Householders can also switch from open fires to stoves and make sure they burn the right type of fuel for the appliance they use and the area they live in.

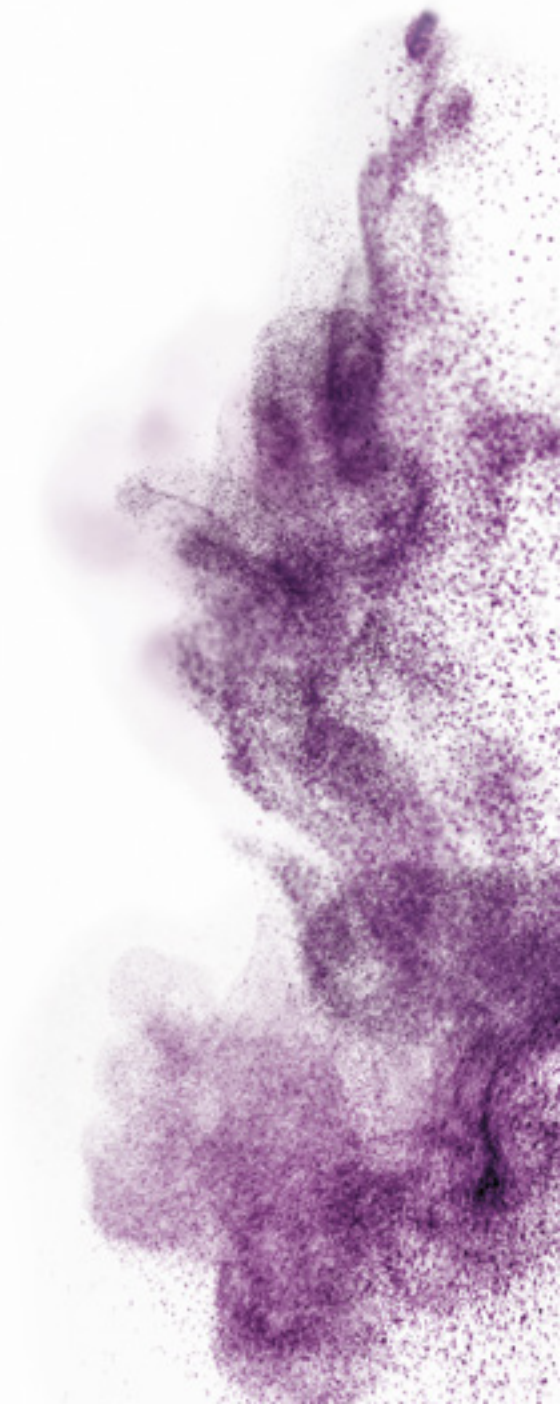
The Clean Air Act of 1956, establishing Smoke Control Areas, cleaned up the smogs of the 1950s and saw a shift away from domestic combustion of coal. However, the latest evidence

11 A micron is 1 millionth of a metre, or 1000th of a millimetre.
12 Mitigation of UK $PM_{2.5}$ Concentrations http://uk-air.defra.gov.uk/library/reports.php?report_id=827

shows a shift back towards domestic combustion of solid fuel such as wood and coal. 15% of wintertime $PM_{2.5}$ in London is attributed to wood smoke and domestic wood burning has made a significant contribution to recent high pollution episodes in London. Smoke Control Areas can be declared by local authorities. In such areas people are only allowed to burn wood or house coal in an authorised appliance such as a stove and if using an open fire they are only allowed to burn authorised fuels such as smokeless coal.

Nitrogen dioxide (NO_2)

Nitrogen dioxide is a gas that is produced with nitric oxide (NO) by combustion processes and together they are often referred to as oxides of nitrogen (NO_x). On average around 80% of oxide of nitrogen (NO_x) emissions in areas where the UK is exceeding NO_2 limit values are due to transport, although urban and regional background, non-transport sources are still considerable[13]. The largest source is emissions from diesel light duty vehicles (cars and vans) and there has been significant growth in these vehicle numbers over the last ten years in the UK.



13 Defra (2015). Improving air quality in the UK: Tackling nitrogen dioxide in our towns and cities. UK, Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486636/aq-plan-2015-overview-document.pdf

Other important air pollutants include:

Sulphur dioxide (SO_2)

SO_2 is a respiratory irritant that can cause constriction of the airways. People with asthma are considered to be particularly sensitive. Health effects can occur very rapidly, making short-term exposure to peak concentrations important.

Sulphur dioxide also contributes to acidification of terrestrial and aquatic ecosystems, damaging habitats and leading to biodiversity loss. 46% of total sulphur dioxide emissions come from the power generation sector. The principal mitigation measures are changes in fuel use (such as switching from coal to gas), reducing fuel use, changes to industrial processes, pollutant capture and flue gas desulphurisation.

Non-Methane Volatile Organic Compounds (NMVOCs)

NMVOCs are ozone precursor pollutants. In the vicinity of their release many VOCs react with other air pollutants to produce ground level ozone (see below). Industry, both large and small, is responsible for 71% of VOC emissions. The principal mitigation measures include removing and reducing solvents from paints and coatings, as well as switching away from coal and oil for domestic energy generation.

Ammonia (NH_3)

Ammonia reacts in the atmosphere to produce secondary particulate matter (PM) (pollutants that are transformed into particles by photo-chemical reactions in the atmosphere). Ammonia can also cause damage to terrestrial and aquatic ecosystems by contributing to acidification and eutrophication. Farming, specifically the use and storage of slurries, manures, digestate from Anaerobic Digestion and fertilisers, is the biggest source of ammonia emissions (81%). Improvements to fertiliser use and storage are the principal means of reducing ammonia emissions.

Ozone (O_3)

Ozone (O_3) comes from a combination of natural and human processes. Ozone is a secondary air pollutant. Secondary air pollutants are not emitted directly to the environment; they are synthesized in the environment by chemical reactions involving chemicals and other air pollutants. During some weather conditions that lead to acute air pollution episodes, nitrogen dioxide, ozone and other pollutants react and condense into PM, adding to that which has been directly emitted.

Unlike the five primary pollutants above, ozone cannot be managed locally, but forecasting services can help alert vulnerable individuals.

What is the current understanding of the health outcomes and impacts?

Air pollution damages lives with harmful effects on human health, the economy and the environment. It is the largest environmental risk to the public's health, contributing to cardiovascular disease, lung cancer and respiratory diseases. It increases the chances of hospital admissions, visits to Emergency Departments and respiratory and cardiovascular symptoms which interfere with everyday life. In the most severe cases it increases the risk of death, especially for people who are already vulnerable. Poor air quality affects everyone. It can have long term impacts on all and immediate effects on vulnerable people, with a disproportionate impact on the young and old, the sick and the poor.

There is now an extensive body of evidence that long-term exposure to everyday air pollutants over several years contributes to the development of cardiovascular disease (CVD), lung cancer, and respiratory disease. PM is inhaled into the lungs and ultrafine $PM_{0.1}$ is thought to pass into the blood causing many adverse outcomes including systemic inflammation. Air pollution is strongly associated with all-cause mortality statistics. The all-cause mortality statistic captured in PHOF indicator 3.01 ranks air pollution in the top 5-7 causes of mortality in polluted areas, ahead of many other PHOF preventable mortality indicators like road deaths, excess winter deaths or communicable diseases[14]. New evidence also points to other damaging effects.

14 http://webarchive.nationalarchives.gov.uk/20130123231223/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_132373.pdf

Where air pollutants go in our bodies and what they do

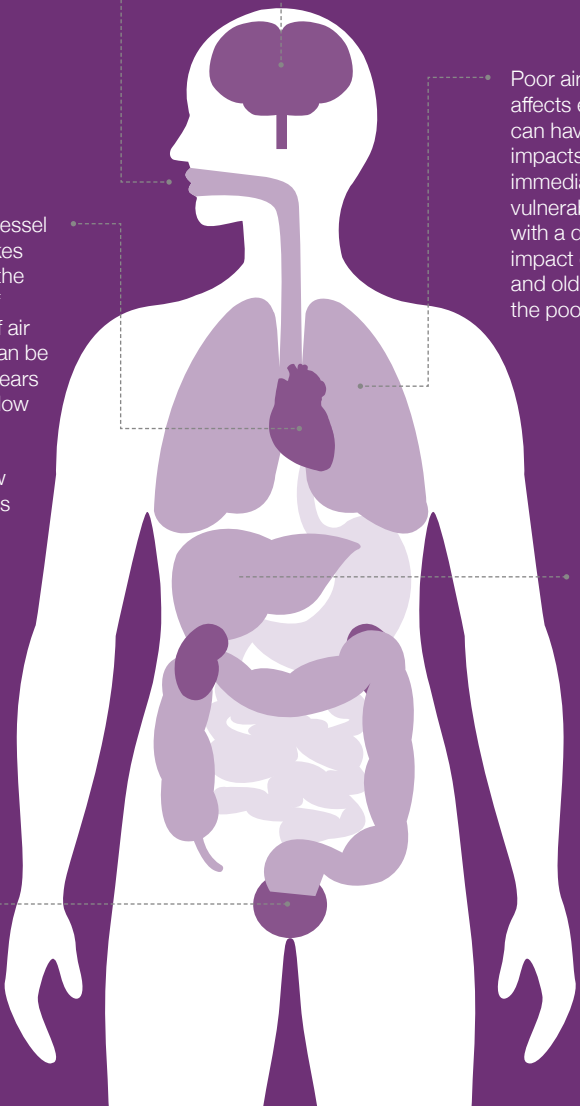
A few hours of $PM_{2.5}$ over 35 µg/m^3 or NO_2 over 200 µg/m^3 irritates the eyes, nose and throat.

PM can cause strokes. Ultrafine PM has been found in samples of brain and central nervous system tissue.

Poor air quality affects everyone. It can have long term impacts on all and immediate effects on vulnerable people, with a disproportionate impact on the young and old, the sick and the poor.

Heart and blood vessel diseases like strokes and hardening of the arteries are one of the main effects of air pollution. These can be caused by a few years exposure to even low levels of $PM_{2.5}$.

Exposure for a few hours to high levels of $PM_{2.5}$ can bring on existing illness or strokes and heart attacks in ill people.



Ultrafine PM can get into the blood then throughout the body. Ultrafine particles have been found in body organs.

PM has been found in the reproductive organs and in unborn children.

Long term exposure (over several years) to elevated concentrations of $PM_{2.5}$ at levels typically experienced in urban areas reduces life expectancy by several months to a few years[9]. It is likely that air pollution acts as a contributory factor - along with many others - in affecting mortality with the major effect on deaths from CVD. It contributes to the development of atherosclerosis (thickening of arterial intima media are apparent after as little as six months' exposure[9]), increased incidence of coronary events[16], lung cancer[7,17] and other respiratory diseases[7].

Short-term exposure to $PM_{2.5}$ episodes over a period of a few hours to weeks can cause respiratory effects such as wheezing, coughing and exacerbations of asthma and chronic bronchitis. It can trigger CVD-related mortality and non-fatal events including myocardial ischemia and myocardial infarctions (MI), acute decompensated MI, arrhythmias and strokes[13].

NO_2, particularly at high concentrations over a short time (hours), is a respiratory irritant that can cause inflammation of the airways leading to, for example, coughing, production of mucus and shortness of breath. Studies have shown associations of NO_2 in outdoor air with reduced lung development (lung function growth) and respiratory infections in early childhood and effects on lung function in adulthood.

A number of studies have reported associations with long-term exposure to NO_2 and adverse effects on health, including reduced life expectancy. It has been unclear whether these effects are caused by NO_2 itself or by other pollutants emitted by the same sources (such as road traffic). Evidence associating NO_2 with health effects has strengthened substantially in recent years and it is now thought that, on the balance of probabilities, NO_2 itself is responsible for some of the health impacts found to be associated with it in epidemiological studies[18]. COMEAP is currently finalising a report on the mortality effects associated with long-term average concentrations of NO_2.

Respiratory health effects and effects on mortality are associated with short-term exposure to O_3. The effects from long term exposure to O_3 are uncertain.[7,19]

The health effects of air pollution are distributed unequally across the population, with the heaviest burden borne by those with greatest vulnerability and/or exposure. The elderly, children and those with cardiovascular and/or respiratory disease are at greater risk

15 http://webarchive.nationalarchives.gov.uk/20130123231223/http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_132373.pdf

16 Long term exposure to ambient air pollution and incidence of acute coronary events: prospective cohort study and meta-analysis in 11 European cohorts from the ESCAPE Project, BMJ, January 22, 2014 http://www.bmj.com/content/348/bmj.f7412

17 Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE), Lancet Oncology, July 13, 2013 http://www.thelancet.com/journals/lanonc/article/PIIS1470-2045(13)70279-1/abstract

18 COMEAP (2015). Statement on the evidence for the effects of nitrogen dioxide on health, 2015. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411756/COMEAP_The_evidence_for_the_effects_of_nitrogen_dioxide.pdf

19 COMEAP 2015 Quantification of mortality and hospital admissions associated with ground-level ozone https://www.gov.uk/government/collections/comeap-reports

from the health effects of air pollution. Those who spend more time in highly polluted locations will be affected more. Since air pollution levels are typically as high within vehicles as just outside, this is likely to include not only those who live and work near busy roads, but also those who drive for a living.

Deprived communities are more likely to be situated near polluted busy roads, and are more likely to experience adverse health impacts. Analysis of environmental quality and social deprivation carried out for the Environment Agency (2003) looked at the social distribution of the wards with the highest pollutant concentrations, and concluded that more than half of the most exposed 5% of the population (2.5 million people) were resident in the 20% most deprived wards. In London, research has shown that primary schools which are in areas of nitrogen dioxide exceedance are more likely to be in deprived areas.

There is also emerging evidence of links between long term $PM_{2.5}$ exposure and the health of the central nervous system, the progression of Alzheimer's and Parkinson's diseases, developmental outcomes in children, and such reproductive health outcomes as low birth weight, as well as other chronic conditions such as diabetes.

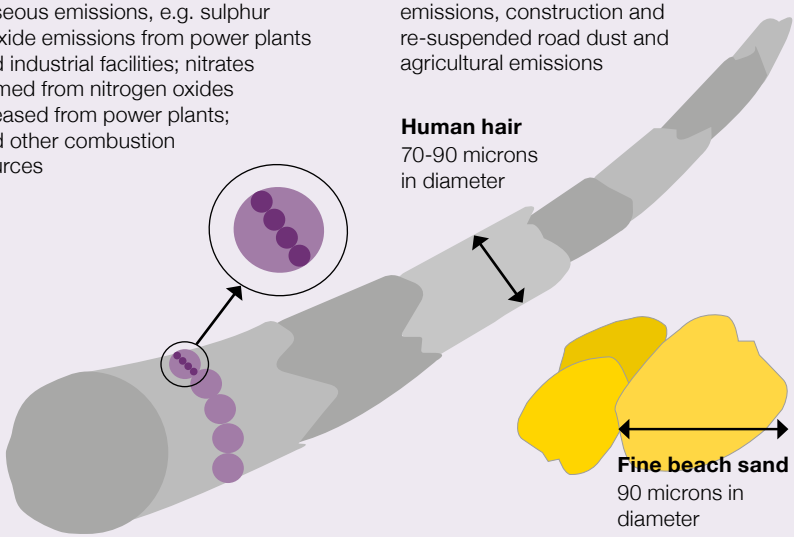
The UK's Daily Air Quality Index[20] and air quality forecast[21] routinely provides air pollution forecasts and real-time monitoring data, which shows air pollution levels across the UK. Daily tweets are also issued from the UK-Air Twitter account, which provide the latest information about current air pollution levels and health advice. These are followed by journalists who use this to inform their reporting, as well as health charities and campaign groups who regularly retweet information to vulnerable populations. In some local areas, vulnerable people can sign up to air pollution information services, which send text messages via mobile phones to alert them when air pollution is high, e.g. airAlert[22] in Sussex and airTEXT[23] in London.

20 http://uk-air.defra.gov.uk/air-pollution/daqi
21 http://uk-air.defra.gov.uk/air-pollution/daqi
22 http://www.airalert.info/
23 http://www.airtext.info/

Comparing size

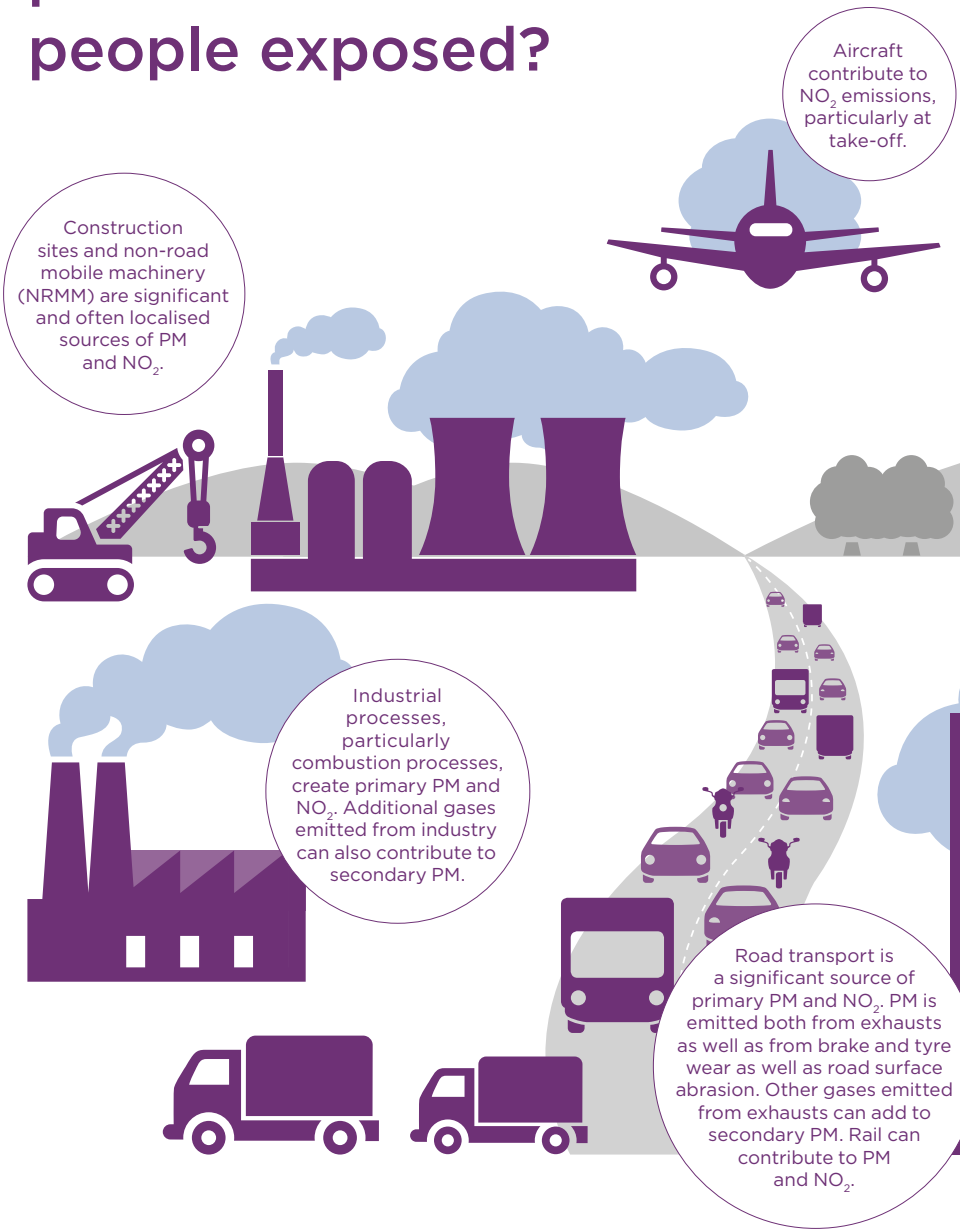
$PM_{2.5}$
Includes secondary particles, formed in the atmosphere from chemical reactions involving primary gaseous emissions, e.g. sulphur dioxide emissions from power plants and industrial facilities; nitrates formed from nitrogen oxides released from power plants; and other combustion sources

PM_{10}
Includes particulate matter from road transport (tyre wear, brake wear), wood burning, bonfires, shipping emissions, construction and re-suspended road dust and agricultural emissions



$PM_{2.5}$ (2.5 microns) leads to high plaque deposits in arteries, which contribute to hardening of the arteries, which can lead to heart attacks and other cardiovascular problems.

What are the sources of air pollution and where are people exposed?



Road vehicles are the main pollution source that people are exposed to in the most populated urban environments and the pollutants they cause and emit have the greatest health impacts. Combustion for heating, farming activities and certain industrial processes also contribute to air pollutant emissions, but these tend to be more dilute contributing to background levels of air pollution. Small changes in distance from the source, street layouts and physical barriers can make a big difference to exposure because air pollution levels can decrease over very short distances depending on the sources and the local situation.

Combustion of fuels, agriculture and industrial processes all contribute to total emissions of air pollutants. However, road transport and combustion of solid fuels (wood and coal) are particularly important as a source of contemporary air pollution in urban hotspots because the emissions are often co-located with exposed pedestrians, homes, hospitals, schools, shops and other places where people congregate. There are considerable differences in emissions between different vehicles and fuels. In general, diesel exhaust contains up to 30 times more PM than petrol or LPG/CNG, but all vehicles generate additional PM from friction of brakes and tyres and through re-suspension of dust from road surfaces.

Air pollution varies substantially over small distances. It is typically highest near to emission sources and the amounts can decline rapidly as you move further away from the source. For example, pollution levels next to a busy road can vary from the part of the pavement nearest to the traffic to the part of the pavement farthest away. Intense sources, such as busy roads and junctions, lead to the creation of localised pollution 'hotspots' where very high levels of pollution can occur.

The proximity to an emissions source is not the only factor that affects the amount of pollution in a given locale. Tall buildings along narrow streets can lead to the 'canyon effect' where pollution is trapped along the street, which can intensify hotspots. Air pollution reaches people from every source that is upwind. However, it will be heavily diluted if more than a few hundred metres away, especially in windy conditions. Nonetheless in dense or heavily polluted conurbations these many dilute sources can add up to a significant background concentration. Sometimes weather patterns encourage this background to accumulate over hours or days to cause an air pollution 'episode.' During this time changes in the chemical composition of the air can also take place, creating more nitrogen dioxide, ozone and particulate matter.

The highly localised distribution of air pollution leads to highly unequal patterns of exposure to different individuals resulting from their day-to-day behaviour. For example ambulance drivers, taxi drivers and other professional road users will inhale significantly higher amounts of pollution compared to those working outside but away from a busy road. Similarly, those close to an open fire will be most affected by small particles of soot and dust. Building design can also influence the amount of pollution individuals are exposed to. School children in a passively ventilated school will be exposed to much higher levels of pollution compared to office workers in a well air-conditioned office block, even if both are the same distance downwind of the same emissions source.

Can local action on air pollution improve public health?

Local knowledge, the ability to make local decisions and local interaction with the communities that local authorities and Public Health officials serve means that by working together you can determine the issues on the ground in detail and the solutions that are best suited to local circumstances. Where local authorities identify an issue with air quality they can declare an Air Quality Management Area (AQMA) and put in place an action plan to reduce concentrations.

Regardless of whether you currently have AQMAs declared in your area, any improvement in air quality (either following an intervention or as a result of unplanned external factors) will have positive health consequences. Improvements to air quality are also an important co-benefit of interventions targeting other health outcomes, such as active travel and increased physical activity.

Opportunities exist for local action on air pollution. Local authorities have many powers that can reduce local air pollution concentration or exposure. In any given local area, much of the air pollution will derive from local sources, in particular road transport, creating significant scope for local action. Local authorities have opportunities to improve air quality for the protection of public health and the environment through their decisions on local land use planning, environmental health, Smoke Control Areas, roads, highways, environmental permitting and local air quality management.

Actions to address the health impacts of air pollution can play a critical role in supporting other local priorities, such as active travel, health inequalities, localism and community engagement, sustainability and growth and regeneration.

While overarching regulations like vehicle emissions standards are controlled by governments and the EU and new vehicle designs by industry, local authorities have many powers in:

- traffic and parking management
- street design and road layouts
- planning
- public and school transport policies
- restricting access to the dirtiest vehicles
- idling of vehicles
- favouring clean vehicle fuels like petrol, LPG or CNG over diesel and bio-diesel
- freight consolidation, delivery management and low or zero emission last mile services
- fleet management and car clubs
- installation and maintenance of electric vehicle charging points
- vehicle and building air conditioning
- building energy efficiency
- permitting and regulation of certain types of industrial processes, factories and other activities that can cause pollution (Environmental Permitting)
- location and enforcement of Smoke Control Areas (SCA)

All these actions are potential avenues to reducing emissions and thus decreasing public exposure to pollution.

The business case for public health action on air pollution

The King's Fund (2013) report on *Improving the Public's Health*[24] 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[25] 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". Cost-beneficial options for reducing air pollution include measures to encourage people to make more journeys by bike or on foot, and other studies have produced similar findings.[26]

24 http://www.kingsfund.org.uk/publications/improving-publics-health
25 Cost Effective Actions to Reduce Air Pollution In Central London, I. Kilbane-Dawe, Parliament Hill Research, 2012 http://www.rbkc.gov.uk/pdf/air_quality_cost_effective_actions_full_report.pdf
26 Air Quality And Road Transport, RAC Foundation, 2014 http://www.racfoundation.org/research/environment/air-quality-road-transport-report-ricardo-aea

Case studies of local action

- A number of councils have **retrofitted some or all of their vehicles to run on gas fuels** (LPG, CNG or biogas). These emit as little as 1/30th of the PM as diesel and can have positive impacts on NO_2 emissions. It is also cheaper to run as the fuel costs less.

- Plymouth Hospital **Travel Plan** resulted in a reduction in staff arriving by car (from 90% to 54%). The plan included restricted and charged parking permit allocation, supplemented with improved Public Transport services, discounted Public Transport tickets and promotion of car sharing.

- City of York Council is **retrofitting all the sightseeing buses from diesel to electric**. This will not only provide significant improvements in air quality but also reduce fuel costs by £15k a year. The council have also paid to retrofit some passenger service buses, as part of the council's Low Emissions Strategy.

- California has introduced restrictions on where new schools can be sited in relation to the major sources of air pollution. Since **2003 state law prohibits new schools being sited within 500 feet of a highway**. Guidance suggests how the siting of new schools, day care centres, and other public buildings needs to be considered to reduce the exposure of vulnerable young people to high levels of air pollution.

- **Camden Council has installed a series of cycle-friendly measures on a key route in the borough**. Two metre-wide lanes along Royal College Street are separated from the rest of the highway by round rubber blocks or 'light segregation,' making the cycle lane safer for cyclists and reducing air pollution by encouraging more cycling. Light segregation methods are used more extensively in many European cities, such as Barcelona, and are considerably cheaper to install than many of the types of cycle lanes typically seen in this country.

- In several areas **local communities are taking control of the measurement of local air pollution**. The East End Quality of Life Initiative community group works with Sheffield City Council to run local monitoring using low cost diffusion tubes. This has built local understanding of air pollution and engaged local communities in assessing and taking action on local issues. Similar programmes are underway in the City of London, Kings Lynn and elsewhere.

- Local authorities can encourage local businesses to reduce their emissions. A **Zero Emissions Network (ZEN) has been established by local businesses in Shoreditch with the help of Hackney Council**. The network offers advice to businesses who wish to reduce their emissions, free trials of electric vehicles and cargo bikes, consultation on reducing energy demand and on reducing emissions resulting from supply chains.

- Oxford City Council and Oxfordshire County Council have implemented a **Low Emission Zone (LEZ) for buses in Oxford city centre**. An LEZ encourages the uptake of less polluting vehicles by banning highly polluting vehicles from highly polluted areas, usually a city centre. In Oxford this has targeted the highly polluting local buses.

- Wandsworth Council reviewed all its Smoke Control Areas, merged them into a single borough-wide **Smoke Control Area**, and put in place a communications campaign locally to raise awareness of the rules.

- Some local authorities have set up **SMS messaging services** that warn vulnerable individuals that air pollution levels are high so that they can take steps to reduce their exposure or ensure they have medication. Examples include airAlert[17] which is run by a partnership of councils in Sussex and airTEXT[18] which covers Greater London.

So what can I do next?

1. Assess and appropriately prioritise air pollution in your local area

Directors of Public Health can conduct a basic assessment of comparing rates of mortality attributable to air pollution with other mortality rates locally. By taking this simple step it is not hard to gain a more detailed picture of the local situation.

An additional guide in this pack "Understanding air pollution in your area" explains how to conduct the basic assessment and more on how you can use air pollution measurements and model data to determine:

- Higher risk locations, and thus potential vulnerable groups
- Local sources of air pollution
- How to rank and prioritise air quality in your Joint Strategic Needs Assessment.

In most cases these depend on air pollution information that can be supplied by your council's Environmental Health Team. They will be very familiar with air pollution due to their responsibilities under Local Air Quality Management (LAQM) regulations. However, it is important to be aware that health effects from air pollution occur at air pollution concentrations well below those permitted under LAQM.

Please refer to resource pack guide **"Understanding air pollution in your area"** for more information.

2. Engage senior local decision-makers to take action on air pollution

Every Director of Public Health will want to ensure that local air pollution is assessed and appropriately prioritised. What action you take next, however, will depend on your assessment of the scale of the air pollution problem in your area and how this compares to other public health issues.

In areas with significant air pollution, Directors of Public Health can play a critical leadership role in making air pollution a strategic priority for senior local decision makers with shared goals and purposeful, co-ordinated action across local government and local health services, working closely with the community. Directors of Public Health can promote the active scrutiny of local policies for their impact on air quality and galvanise action across local government on local pollution hotspots.

Strategic focus	You can make reducing air pollution a local priority and get agreement for goals and programmes for improving air quality from senior local decision makers
Championing action	You can bring senior decision makers and the public together to devise effective solutions for local problems
Scrutiny	You can encourage the scrutiny of local authority policies for their impacts on air pollution
Recognising AQ co-benefits	You can celebrate things you, your local partners and the public are already doing to improve air quality
Informing	You can educate the local authority, Clinical Commissioning Group (CCG) and the public about the local issues and possible solutions
Assessing	You can lead the assessment of the local air pollution public health risks and possible interventions

Whatever level of involvement you judge appropriate in your local area, action to reduce the local health impacts of air pollution will require co-ordinated effort by multiple partners. It will be important to give people the facts about contemporary air pollution in the UK, and correct some common myths.

Please refer to resource pack guide **"Engaging local decision-makers about air pollution"** for more information.

3. Communicate with the public about local air pollution

Whatever the level of your local involvement, public health teams can play a critical role in ensuring that the health impacts of air pollution are effectively communicated to public audiences – especially as air pollution continues to move up the agenda.

There are many reasons why effective public communication of the health impacts of air pollution is important. Over and above the fact that people ought to be informed about risks to their health, people want and expect 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.

As with so many public health issues care is needed around how information is communicated. Air pollution has many of the characteristics that make a threat to health more worrying, creating a real risk of counter-productive reactions if communication is poorly handled.

Six principles for public communication about air pollution
Based on qualitative research in 2013 for Defra

A. **Explain what air pollution is:** Use information about what particulate matter, and other air pollutants are made of and where they can go to get air pollution onto the local agenda – not statistics about health consequences.

B. **Help people understand how they can protect themselves:** 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. **Explain the health impacts:** Focus on what is known for certain about the health consequences of air pollution.

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

E. **Explain how individuals can make a difference:** Keep the focus on practical improvements – not long-term solutions.

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

Please refer to resource pack guide **"Communicating with the Public about Air Pollution"** for more information.

Where can I get more information?

This guide is part of a resource pack for Public Health teams. The resource comprises a further "Briefing for Elected Members" as well as three short guides to help Directors of Public Health and their teams to take action.

Briefing:

- Air Pollution: a public health issue. A Briefing for elected members

Guides:

- Understanding air pollution in your area
- Engaging local decision-makers about air pollution
- Communicating with the public during air pollution episodes
- Communicating with the public on the long-term impacts of air pollution

This guide and the above resources were developed as part of a 2013 Defra-commissioned project led by Parliament Hill Research Ltd, aided by Defra, the Department of Health, Public Health England, the Department for Transport and the Healthy Air Campaign. The final project reports, including the conclusions of a public workshop, can be found here: http://randd.defra.gov.uk/Default.aspx-?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18580.

Estimates of the number of deaths in UK local authorities that can be attributed to long term exposure to particle air pollution have been published by PHE.

- Public Health England – Estimating Local Mortality Burdens associated with Particulate Air Pollution https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution

Information on the Public Health Outcomes Framework Indicator 3.01 can be found here:

- http://www.phoutcomes.info/
- http://www.phoutcomes.info/public-health-outcomes-framework#gid/1000043/pat/6/ati/102/page/6/par/E12000004/are/E06000015

The Office for National Statistics has published a bulletin on air pollution in the UK over the last three decades:

- Air quality statistics in the UK, 1987 to 2013: http://www.gov.uk/government/publications/air-quality-statistics

The Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) has published a series of reviews of the effects of air pollution on health:

- http://www.comeap.org.uk

Defra has produced a series of resources for Local Authorities on air pollution, which are available from its website:

- http://laqm.defra.gov.uk/public-health/roleforlas.html

Air quality forecasts, near real time measurement data, national modelling data as well as general information on air pollution, published research reports and reports on national compliance can be found on Defra's Air Information Resource website - UK Air.

- http://uk-air.defra.gov.uk/

Information on local air pollution campaigns is provided by the Healthy Air Campaign

- http://healthyair.org.uk

2. Understanding air pollution in your area

Introduction

This guide supports a briefing produced for Directors of Public Health - 'Getting to grips with air pollution – the latest evidence and techniques.'

It provides simple steps required to understand the health impacts of air pollution in your Local Authority area. These range from the most basic assessment that all Directors of Public Health can conduct, to more detailed options to identify key locations of concern, sources of pollution and how to correctly rank air pollution in your Joint Strategic Needs Assessment (JSNA).

In general, the effort required to take any of the steps mentioned above is small, not least as much of the work has already been done by Public Health England for the Public Health Outcomes Framework (PHOF) 3.01 air pollution indicator: *the fraction of mortality attributable to particulate air pollution* and in recent studies, or through the Local Air Quality Management (LAQM) process set out in Section (IV) of the Environment Act 1995. Under this process, Local authorities Environmental Health Teams have monitored air pollution and its causes locally for 10-15 years, and will have produced most of the data you need to get a detailed picture.

It is important to be aware of the discrepancy between the pollution limits set under LAQM and concentrations of air pollution at which public health effects are observed, as given in the 3.01 indicator. Health effects from air pollution are observed at air pollution concentrations well below those permitted under LAQM. In particular this means that areas that do not exceed LAQM limits could still have a public health problem relating to air pollution. It should also be noted that within the PHOF indicator, deaths are not individually attributed to air pollution, rather, air pollution is considered to be a contributory factor in many deaths, including other causes, such as respiratory disease or cardiovascular disease (CVD).

Thus the first datum to study is the 3.01 indicator and its ranking against other mortality indicators. Thereafter, and if air pollution appears to be ranked as a high priority, the LAQM data can be used to develop a more detailed picture.

The steps on the following pages use both data from the PHOF indicator set, and data from various national and local air pollution databases. In the vast majority of situations, there will not be a requirement for new measurements

or new local air pollution mapping, since the UK has urban background[27] monitoring stations in most cities and full coverage using modelled data, and because under the LAQM regime maps of local air pollution concentrations are likely to have been updated regularly.

27 Urban background stations are located to reflect the average exposure of the population to air pollution, avoiding significant contributions from local hotspots or key air pollution sources.

How to conduct the basic assessment

The most basic assessment possible is to rank the local mortality attributed to air pollution (particulate matter) against local mortality due to other sources of disease. The PHOF Data Tool contains most of the data required to do this, although some minor manipulation is required using local population data.

The key to conducting the ranking is to convert the 3.01 indicator, which is expressed as a percentage of the adult mortality in a given year, as found in the PHOF Data Tool[28] into the same statistical units as most of the other mortality indicators in the PHOF, that is age-standardised (<75 years) premature **mortality per 100,000 population per year**[29]. A crude conversion is simple: multiply the 3.01 indicator[30] by the age standardised premature mortality rate per 100,000 population. For example, using 2013-2015 data on premature deaths per 100,000 for districts & unitary authorities obtained from Public Health England[31], in Camden, East Devon and Leicester:

Camden: 6.3% x 289 = 18.2 attributable deaths per 100,000 pa

East Devon: 3.8% x 268 = 10.2 attributable deaths per 100,000 pa

Leicester: 5.4% x 427 = 23.1 attributable deaths per 100,000 pa

This simple method is suitable to set the burden of air pollution in the context of other mortality indicators in the PHOF, for example those shown in Example 1. However, it is important to note that unlike the other indicators that are based on recorded mortality data for specific causes of death, the figures for air pollution are estimates of mortality attributable to a risk factor. Deaths are not individually attributed to air pollution, rather, air pollution is considered to be a contributory factor in many deaths, including other causes, such as respiratory disease or cardiovascular disease.

These tables can also be used as a powerful communication tool when speaking to colleagues.

28 www.phoutcomes.info

29 Many of the other PHOF indicators are based on recorded mortality data and are for mortality rates in those aged under 75 whereas the air pollution estimates are for the whole population. For this calculation, age standardised mortality rates for under 75 have been used for air pollution.

30 www.phoutcomes.info Fraction of mortality attributable to particulate air pollution (indicator 3.01) Accessed February 2017

31 Under 75 mortality rankings: premature deaths per 100,000 for districts & unitary authorities obtained from http://healthierlives.phe.org.uk/topic/mortality/comparisons#are//par/E92000001/ati/101/pat/101 Accessed February 2017

Example 1. Ranking of PHOF mortality indicators for three Local Authorities[32]

Camden		East Devon		Leicester	
Indicator in PHOF	Mortality rate, per 100,000	Indicator in PHOF	Mortality rate, per 100,000	Indicator in PHOF	Mortality rate, per 100,000
Preventable mortality (4.03)	159.7	Preventable mortality	146.1	Preventable mortality	241.0
Preventable cancer <75(4.05ii)	74.4	Preventable cancer <75	67.6	Preventable cancer <75	90
Preventable CVD <75 (4.04ii)	34.7	Preventable CVD <75	28.2	Preventable CVD <75	77.8
Preventable Respiratory disease <75(4.07ii)	19.0	Suicide	10.9	Preventable Liver disease <75	24.2
Mortality attributable to $PM_{2.5}$ <75 (3.01)	**18.2**	Communicable diseases	10.7	**Mortality attributable to $PM_{2.5}$ <75**	**23.1**
Preventable Liver disease <75 (4.06ii)	15.9	Preventable Liver disease	10.5	Preventable respiratory disease <75	22.0
Communicable diseases (4.08)	12.0	**Mortality attributable to $PM_{2.5}$ <75**	**10.2**	Communicable diseases	11.2
Suicide rate Persons (4.10)	11.3	Preventable respiratory disease <75	10.2	Suicide	9.6

32 Data from www.phoutcomes.info accessed February 2017. Mortality rates calculated using age standardized mortality rates for <75 years (except for preventable mortality, communicable diseases and suicide rate which are age standardized for 'all ages')

Mortality burden estimates and the PHOF indicator 3.01

This section outlines the strengths and limitations of the available estimates of mortality burdens attributable to air pollution, and discusses the implications for their use.

Calculation:

Estimates of mortality associated with particulate air pollution are usually calculated by combining three types of information:

a. level of $PM_{2.5}$ in outdoor air (long-term average concentrations)
b. relationship between long-term average concentrations of $PM_{2.5}$ in outdoor air and mortality risk
c. Mortality statistics in the population of interest

Metrics:

The mortality burden can be expressed as: attributable fraction, attributable deaths; years of life lost; or loss of life-expectancy from birth. These estimates describe the effect of air pollution on mortality across the population: long-term exposure to air pollution is a contributory factor to deaths from respiratory and cardiovascular disease and is unlikely to be the sole cause of death.

The PHOF indicator is expressed as the fraction of adult mortality attributable to long-term exposure to particulate air pollution, i.e. as a percentage[33]. PHE has also published estimates of local mortality burdens expressed as attributable deaths and years of life lost[34]. These are calculated by applying the attributable fraction to adult mortality statistics in the local area.

Although 'percentage of mortality' or 'number of deaths' are widely used in communicating public health risks, 'attributable deaths' is not the number of individuals who have died prematurely. Air pollution contributes a small amount to the deaths of a large number of exposed individuals rather than being solely responsible for a certain proportion, or number, of deaths. Attributable deaths can be described as 'an effect on mortality equivalent to 'X' deaths at typical ages' while 'Years of life lost' combines both attributable deaths and age at death[35,36]. Methods and metrics are discussed in more detail elsewhere[36],[37],[38].

The PHOF indicator and other mortality burden estimates should not be used to evaluate policies or interventions to reduce air pollution. These are best assessed using life-table methods to estimate years of life gained from the reduction in exposure of the population[37].

Local initiatives to reduce air pollution, or exposure to it, are likely to improve health of the population. However, the PHOF indicator is not well suited to tracking progress in addressing air pollution within local areas. It is intended to inform Directors of Public Health and other local decision makers about the scale of the public health impact of air pollution in their local area and to enable them to prioritise action on air pollution appropriately. Caution is also needed when considering trends over time. Some of the reasons for this are outlined below.

Meteorological and atmospheric influences

Concentrations of $PM_{2.5}$ vary from year to year due to the weather. This variation due to weather is generally greater than the year to year variation from changes in emissions.

Modelling of $PM_{2.5}$ concentrations

The PHOF indicator is calculated using modelled concentrations of $PM_{2.5}$ using information from the national atmospheric emissions inventory (NAEI). As a national inventory is used, local initiatives to reduce emissions are unlikely to alter the modelled $PM_{2.5}$ concentrations for that local area although they may have an important impact on the local population's exposure and health.

Steps to develop a better understanding of a local air pollution problem

Where air pollution is agreed to be a priority issue, there are additional steps you can take to improve your understanding of your local air pollution problem. In most cases your Environmental Health Team will be familiar with the data required. These steps are:

- Testing whether local air quality is below the UK/EU air quality standards and the WHO air quality guidelines
- Reducing uncertainty in the indicator estimate of the public health effects
- Identifying locations where the risks to health are likely to be greatest
- Identifying key sources of air pollution
- Broadening the scope of the health impacts considered
- Correctly scoring air pollution in your Joint Strategic Needs Assessment.

33 Department of Health Public Health Outcomes Framework 2013 to 2016 https://www.gov.uk/government/publications/healthy-lives-healthy-people-improving-outcomes-and-supporting-transparency. 2012 (and subsequent updates)
34 COMEAP, Long-Term Exposure to Air Pollution: Effect on Mortality. 2009, Committee on the Medical Effects of Air Pollutants
35 COMEAP, The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom. 2010, Committee on the Medical Effects of Air Pollutants
36 COMEAP, Statement on Estimating the Mortality Burden of Particulate Air Pollution at the Local Level. 2012, Committee on the Medical Effects of Air Pollutants.
37 WHO air quality guidelines global update 2005, World Health Organisation, 2005 http://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/
38 Air pollution concentration is often measured in micrograms per cubic meter, $\mu g/m^3$.

Consider whether UK objectives/ WHO air quality guidelines are being exceeded

The WHO guidelines for air pollution[37] are based on review of thousands of epidemiological, laboratory and toxicology studies. They are intended to minimize the public health impact of air pollution while still being economically achievable. Guidelines[38] for short-term and long-term exposure are given. For example, for long-term exposure, the WHO guideline is not to exceed annual average concentrations of PM of:

- 10 µg/m^3 of $PM_{2.5}$
- 20 µg/m^3 of PM_{10}.

Most major conurbations have at least one $PM_{2.5}$ or PM_{10} monitoring station that is used for LAQM and EU reporting. For population wide comparisons, only measurements from **urban background** monitoring stations should be used, although measurements at roadside or other locations can be used for sensitivity analysis. Annual averages of the data from these stations can be obtained from the Defra website[39], or from your Environmental Health Team. The WHO recently completed a major review of the health risks of air pollution[40]and this reinforced the findings of the 2005 assessment.

Example – Birmingham Tyburn

Measurements from the Birmingham Tyburn urban background monitoring station give an annual mean value of 16 µg/m^3 for $PM_{2.5}$ and 23 µg/m^3 for PM_{10}. These are both above the WHO guidelines, suggesting that reducing these levels to improve local public health should be a high priority.

39 These can be downloaded from Defra - http://uk-air.defra.gov.uk/data/exceedence

40 Review of Evidence on Health Aspects of Air Pollution - REVIHAAP Project: final technical Report, World Health Organization, 2013 http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report

Reducing uncertainty in the indicator's estimate of the local public health effect

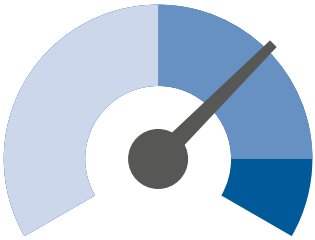
The 3.01 indicator is based on model data (see Box 1) generated for Defra by leading experts on air pollution. In most cases these are accurate to within ±20% or better, but the model cannot include all crucial local details so in some areas it may be less accurate. In order to reduce this possible uncertainty, the measured statistics discussed above can also be compared with Defra's model generated Background Maps for your area[41], which are the data used to calculate the 3.01 indicator.

Example – Birmingham Tyburn

In the example above, the annual mean of measurements at the site were 16 µg/m^3 for $PM_{2.5}$ and 23 µg/m^3 of PM_{10}. At the same location, Defra's model background map diagnosed an annual average $PM_{2.5}$ concentration of 14.6 µg/m^3, slightly lower than the measurements for the same period. This suggests that in this case, the indicator 3.01 slightly understates the local problem, though not by a large margin.

Box 1. Understand the different roles of modelled and measured pollution data

Many local, regional and national authorities perform air pollution modelling that produces maps of local, regional or national air pollution concentrations. Modelling is used because air pollution varies so strongly from place to place that it is impossible to install sufficient monitoring stations to accurately reflect the way the pollution is distributed. While air pollution models are inevitably weaker at determining the precise concentrations of pollutants at any given location, they are very good at capturing the variation of the pollutant concentrations from place to place, which is essential to understanding the problem. Pollution is also strongly affected by weather patterns, so models allow different weather scenarios to be considered. Models can also allow the effects of policy measures to be estimated, or pollution sources to be identified. In general, measurements and model data combined together give the best possible picture.



41 These maps are available from the website http://uk-air.defra.gov.uk/data/gis-mapping

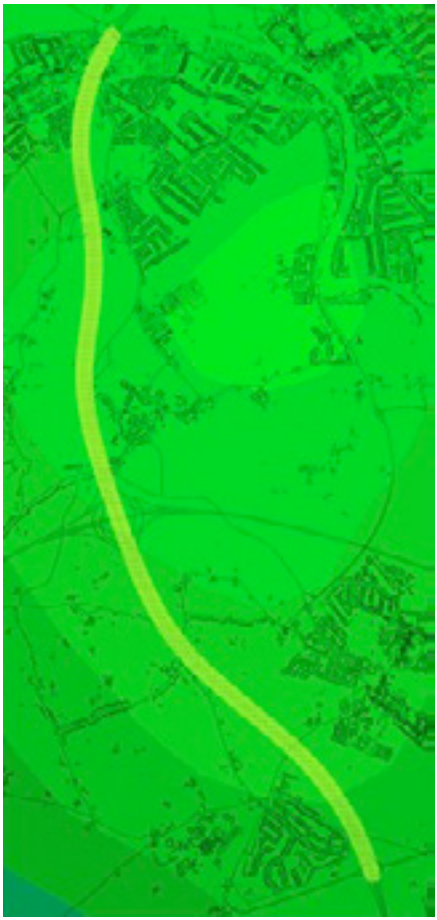
Identify higher risk locations using existing AQMAs

Areas that have an Air Quality Management Area (AQMA) designation are likely to be higher risk locations, as the pollution levels at which an AQMA is declared are well above the level at which health effects are observed for PM, and similar to the levels at which they are observed for NO_2. So locations that breach the LAQM limits will usually have air pollutant concentrations that significantly increase risks to health. By contrast, the absence of an AQMA does NOT necessarily mean that air pollution is not a public health issue.

Example – Runnymede, Surrey

A major contributor to air pollution in Runnymede is the M25 motorway. This has led to AQMAs being declared for NO_2 along sections of the M25, as shown in yellow in Map 1.

Map 1. AQMA for NO_2 and hourly PM_{10} (shown in yellow hatching) in Runnymede.



Identify higher risk locations using maps of local air pollution from models

As part of the LAQM process, local authorities often perform modelling of local air pollution to produce maps of its distribution. Most often these are for PM_{10} or NO_2, but in some cases $PM_{2.5}$ is mapped also. As PM_{10}, $PM_{2.5}$ and NO_2 tend to be highly correlated, maps showing high concentrations of any of these pollutants are likely to be indicative of higher risk locations for public health.

Model-generated maps, can be compared with the WHO annual mean objective of 10 µg/m^3 for $PM_{2.5}$, 20 µg/m^3 for PM_{10} and 40 µg/m^3 for NO_2.

Map 2. Annual average PM_{10} concentrations in Nottingham, estimated by modelling.

Identifying key sources of pollution using local source apportionment studies

Source apportionment uses air pollution models to estimate which local activities (e.g. buses, HGVs, cars, industry etc.) are responsible for the air pollution at a particular place. This can identify sources of pollution in several different ways, including

- By the geographic origin of the pollution e.g. local vs. non-local
- By the sector generating the pollution e.g. transport vs. industry
- By the sub-sector generating the pollution e.g. buses vs. HGVs
- By the activity in the source that generates the pollution e.g. exhaust emissions vs. brake wear & tyre wear of road surfaces.

These can be used to target actions to address specific sources.

Identifying other health outcomes using a Health Impact Assessment

The WHO HRAPIE[42] report provides concentration-response functions for $PM_{2.5}$, PM_{10}, NO_2 (and the non-local air pollutant ozone) for many pollutant-outcome pairs. If you have daily or hourly local measured data available for $PM_{2.5}$, PM_{10} and NO_2, you can use these to estimate other health outcomes than all-cause mortality, such as the acute effects of air pollution on hospital admissions and respiratory disease. This is likely to be a major exercise, and to be scientifically meaningful is likely to require considerable investment of suitably qualified manpower.

Assessing Air Pollution as part of a Joint Strategic Needs Assessment

JSNAs often use Multi-Criteria Decision Analysis (MCDA) methods, such as the modified Portsmouth Scorecard, to provide the evidence for priority setting for public health priorities. JSNAs rely on a comparative assessment of air pollution against other public health issues. Assessment criteria require air pollution to be scored according to how much evidence of the health effects of air pollution there is understood to be, by the person conducting the assessment.

Some typical MCDA assessment questions from JSNAs are listed below, along with details of where you can find further information in this resource pack to help you assess air pollution appropriately in your local area.

Is air pollution an issue that affects a significant proportion of the population?

All populations are exposed to air pollution. If your local area has an AQMA individuals are being exposed to levels of air pollution that are harmful. However the latest epidemiology demonstrates that harm occurs at pollution levels below EU limit values, so if your area doesn't have an AQMA it doesn't mean there isn't a public health issue to consider. Also, consider what proportion of your population is exposed to air pollution levels above the WHO annual guidelines for PM.

See *'The new evidence putting air pollution on the public health agenda'* in *'Getting to Grips with Air Pollution – a Briefing for Directors of Public Health'* for further information.

42 Health risks of air pollution in Europe, World Health Organization, 2013 http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/health-risks-of-air-pollution-in-europe-hrapie-project.-new-emerging-risks-to-health-from-air-pollution-results-from-the-survey-of-experts

How does air pollution affect the health of individuals? Which individuals are affected?

Air pollution is a contributory cause of cardiovascular disease (CVD) and respiratory diseases and vehicle exhaust is listed as a Class 1 carcinogen. As well as having an impact on mortality, air pollution is increasingly being associated with other conditions.

See section *'What is the current understanding of the health outcomes and impacts?'* in *'Getting to Grips with Air Pollution – a Briefing for Directors of Public Health'* for further information.

Does air pollution contribute to inequalities in health and wellbeing?

Air quality is often worse in areas of higher deprivation, i.e. in areas that have other poor health outcomes. This is partly due to geography, as in many localities deprived wards are near emission sources such as busy roads. However, there is evidence that the elderly, children and those with cardiovascular and/or respiratory disease are more susceptible to the harm from air pollution.

See section *'What is the current understanding of the health outcomes and impacts?'* in *'Getting to Grips with Air Pollution – a Briefing for Directors of Public Health'* for further information.

Is there evidence that the scale and impact of air pollution can be reduced through action by local authorities?

Local authorities can take cost-effective action to reduce emissions, to reduce the concentrations of air pollution, and to reduce individuals exposure to air pollution.

See section *'The business case for public health action on air pollution'* in *'Getting to Grips with Air Pollution – a Briefing for Directors of Public Health'* and case studies throughout this resource pack for further information.

What to do next?

Having correctly assessed the scale and location of any local problems, you can then go on to help set strategy or develop actions or communications on the local problem.

This guide is part of a resource pack for Public Health teams. The resource comprises two briefings, one for elected members and one for Directors of Public Health as well as three short guides to help Directors of Public Health and their teams to take action.

Briefings:

- Getting to grips with air pollution – a Briefing for Directors of Public Health
- Air Pollution: an emerging public health issue – a Briefing for Elected Members

Guides:

- Communicating with the Public during Air Pollution Episodes
- Communicating with the Public on the long-term impacts of Air Pollution
- Engaging Local Decision Makers

3. Engaging local decision-makers about air pollution

Introduction

This guide supports a briefing produced for Directors of Public Health - 'Getting to grips with air pollution – the latest evidence and techniques.'

Every Director of Public Health will want to ensure that local air pollution is appropriately assessed and prioritised (for more information see the accompanying guide "Understanding air pollution in your area"). What action you take next, however, will depend on your assessment of the scale of the problem.

In areas with significant air pollution, Directors of Public Health can play a critical leadership role in making air pollution a strategic priority for senior local decision makers with shared goals and purposeful, co-ordinated action across local government and local health services, working closely with the community. Directors of Public Health can promote the active scrutiny of local policies for their impact on air quality and galvanise action across local government on local pollution hotspots.

Strategic focus	You can make reducing air pollution a local priority and get agreement for goals and programmes for improving air quality from senior local decision makers
Championing action	You can bring senior decision makers and the public together to devise effective solutions for local problems
Scrutiny	You can encourage the scrutiny of local authority policies for their impacts on air pollution
Recognising air quality co-benefits	You can celebrate things you, your local partners and the public are already doing to improve air quality
Informing	You can educate the local authority, Clinical Commissioning Group (CCG) and the public about the local issues and possible solutions
Assessing	You can lead the assessment of the local air pollution public health risks and possible interventions

Is there evidence that the scale and impact of air pollution can be reduced through action by local authorities?

Whatever level of involvement you judge appropriate in your local area, action to reduce the local health impacts of air pollution will require co-ordinated effort by multiple partners across the Council, as in the following Case Study.

Case Study: City of London Health & Wellbeing Board Strategic Review

Recognising the new strategic role that public health officials can play in tackling air pollution, the City's environmental heath team decided to engage their Health and Wellbeing Board (H&WB). To prepare for this, they commissioned a scientific review of how air pollution affects public health in the City, and a review of the policies the H&WB would have powers to affect. The scientific review[43] gathered together the latest evidence on air pollution to determine the severity of the problem for the City. The policy review drew together the air quality elements embedded in the City's strategy documents, including public health, urban realm, transport, development and planning. It also examined how air pollution could affect local area enhancement strategies and other smaller scale plans, such as for gyratories. Taken together, these were developed into a set of strategic recommendations to the H&WB for how they could improve air quality in the City, along the following key themes:

- Ensuring their Joint Strategic Needs Assessment reflects the severity of the local air pollution problem;
- Ensuring air pollution impacts are considered in all transport planning in dealing with neighbouring transport authorities;
- Reinforcing planning policies to minimise pollution from new developments and keeping them up-to-date with best practice;
- Improving the urban realm to minimise exposure to pollution and – where possible – emissions and concentrations;

These were presented to the H&WB and accepted. The strategies were then converted to actionable plans through a series of workshops with officers from all departments and subsequent policy analysis.

43 The Impacts Of Air Pollution On Health - A Summary Of The State Of Current Knowledge, I. Kilbane-Dawe, L. Clement, Parliament Hill Research 2014. http://www.cityoflondon.gov.uk/business/environmental-health/environmental-protection/air-quality/Pages/air-quality-reports.aspx

On the following pages key stakeholders that you may need to engage and work with are listed along with the main ways in which they can play a role. These lie in several different domains of activity including:

- Members and officers in the Local Authority
- Officers, practitioners and service providers in the local Health Sector
- The wider community, including the general public, vulnerable groups and the local media.

While details vary between local authorities, the checklist also suggests the role each partner may typically play in tackling air pollution.

Stakeholders	Roles
Local Authority	
Local authority chief executive/other directors	Recognise the importance of air quality and the role that the local authority could play as an employer, through the services it commissions and delivers, its public health role, regulatory powers, community leadership and well-being power
Elected officials	Represent their residents if they raise concerns, find out about local pollution hotspots, raise the issue with the HWBB, encourage overview and scrutiny across the range of council strategies, consider the issues as part of local planning decisions, and ensure the council is encouraging others to act and informing the public
Planning policy & control	Ensure planning applications always consider the health impacts of air pollution Ensure local facilities and services are easily accessible by low-pollution means and promote ways of accessing them without polluting. Encourage installation of electric vehicle charging points and cleaner building heating wherever possible. Use development management policies and section 106 agreements for individual developments to mitigate against particulate matter generated from construction and demolition

Local transport authorities, transport planners	Ensure transport strategies encourage active travel and other low or zero pollution modes Recognise that reducing congestion also reduces air pollution
Street management & urban realm	Ensure that public squares and parks are designed and managed in such a way to ensure that those that use them are not exposed to high levels of pollution Provide cyclists and pedestrians with routes that are safe and clearly signed to encourage their use
Environmental Health Team (s)/ Environmental Protection Team (s)	Support the Council's Environmental Protection (EP) or Environmental Health (EH) team(s) in the work they do to reduce air pollution through a local Air Quality Action Plan, clear communication about and enforcement of Smoke Control Areas (SCAs) and the regulation and permitting of industrial activities. Work with the expertise within your EH team(s) to identify new ways of tackling air pollution and reducing exposure to emissions Share health outcomes data that will support the justification of the EH team(s) for action(s) that will reduce the harm caused by air pollution
Communications teams	Support the Council's Air Quality Managers in the EH team(s) and Public Health teams to build understanding of the issues
Local Authority	
Health & Wellbeing Board	Carefully consider the scale of air pollution and identify areas for action, using the latest evidence and information about effective actions Encourage action across the members of the board Consider the co-benefits of measures to improve air pollution Celebrate improvements in air quality

NHS England local area teams responsible for commissioning primary care services	When commissioning primary care services to prevent or treat conditions such as cardiovascular and respiratory disease, ensure advice on exposure to air pollution is incorporated into the care pathway, as recommended to clinicians by the American Heart Association Identify groups of the population who are disproportionately affected and develop strategies with them to address their needs
Primary care practitioners – exercise professionals, GPs, health trainers, health visitors, midwives, pharmacists and practice nurses	Understand the health impacts of air pollution, identify individuals who might be affected and use professional judgement to inform these individuals
Clinical commissioning group	Understand how air pollution could contribute to NHS Outcomes Framework indicators Also, how improving air quality could support the duty to address health inequalities Champion action on air pollution by public health and local government through the Joint Health and Wellbeing Strategy Build understanding of the impact of local air pollution on emergency admissions Ensure air pollution advice is incorporated into how community health services are commissioned e.g. health visiting and school nursing, community pharmacy, chronic disease management Raise awareness of the issues with primary care practitioners Ensure air pollution issues are built into local long-term disease management strategies

NHS providers	Encourage active travel and reduce emissions from their fleets and energy generation on site (e.g. reducing the use of diesel generators or biomass, and if these are used putting in place appropriate chimneys or other emission abatement measures)
Wider Community	
Industry	Work together to reduce the impact of air pollution created by economic development
Voluntary sector and community institutions	Get involved in community action to reduce air pollution and help raise awareness of local people and in particular vulnerable groups
Local people	Find out about local air pollution levels and measures to reduce their exposure Let their councillor know about concerns and get involved in community activities to make improvements
Vulnerable groups	Talk to their doctor or health professional about any concerns they may have and understand how they can reduce their exposure on high pollution days Utilise national and localised air pollution forecast services to minimise exposure and manage symptoms
Local media	Report on action being taken to improve air quality and encourage awareness of information

Making the case for action

Explaining contemporary air pollution

The phrase ‘air pollution’ can still bring to mind for some people the smogs of the early twentieth century, or of modern-day Beijing. It is important to give people the facts about contemporary air pollution in the UK, and correct some common myths.

Myth **Air pollution is not a significant public health problem in the UK**

Fact In the UK, the Committee on the Medical Effects of Air Pollutants (COMEAP) estimated the burden of particulate air pollution in the UK in 2008 to be equivalent to nearly 29,000 deaths and an associated loss of population life of 340,000 life years lost.

Myth **Air pollution just causes short-term symptoms for people with respiratory conditions**

Fact Everyone can be affected by air pollution – although it is true that some are more vulnerable and/or exposed. Exposure to air pollution contributes to the development of cardiovascular disease (including heart disease and stroke), and lung cancer, as well as exacerbating respiratory diseases such as asthma. In the short term, individuals with cardiovascular disease (as well as those with respiratory conditions) may be affected by episodes of high pollution, with increased risk of becoming ill and needing treatment. Adults and children with asthma may notice that they need to increase their use of inhaled reliever medication on days when levels of air pollution are higher than average. Follow your doctor’s usual advice about exercising and managing your condition.

Myth **There is nothing people can do to protect themselves from air pollution**

Fact People can take steps to reduce their exposure – for instance, by choosing to walk or cycle by routes that avoid pollution hotspots. Exposure to air pollution inside vehicles can be as high, or higher, particularly

in slow moving traffic. Therefore walking or cycling is a good way to reduce exposure and gain wider benefits. People can choose a lower emission vehicle, such as an electric vehicle, when they change vehicles. Reducing the use of wood and coal, switching to a cleaner modern wood stove, and burning quality wood or smokeless fuels on open fires instead of wet/green wood or house coal will reduce exposure to particulate matter. Vulnerable individuals can also take steps to manage symptoms in consultation with their GP, for example by managing their medication.

Myth **Air quality is bad in cities and good in the countryside**

Fact The amount of air pollution can vary over very small distances and does not just come from transport. For example open fires emit dangerous particles of soot and dust (particulates). On a broad pavement the amount of pollution found at the kerbside of a busy road is typically significantly higher than the amount of pollution found on the far side of the pavement away from the road. Also, as air pollution is so localised, many rural areas have pollution 'hotspots' around busy road junctions or industrial sources.

Myth **We don't have an Air Quality Management Area (AQMA), so we don't have a problem**

Fact AQMAs are very likely to be air pollution public health hotspots but health impacts will not be confined to designated AQMAs. There is no safe level for particulate matter (PM_{10} and $PM_{2.5}$), while NO_2 is associated with adverse health effects at concentrations at and below the legal limits. The World Health Organization proposes limit values that are lower than current European limit and target values for PM_{10} and $PM_{2.5}$.

Myth **We are already tackling air pollution with our carbon reduction strategy**

Fact The environmental problems associated with CO_2 emissions are completely different from the health problems associated with contemporary air pollution. Some measures to reduce CO_2 emissions, such as active travel schemes, will also have a positive effect on air pollution. But others – such as the use of diesel, biodiesel, Combined Heat and Power and biofuels – if not carefully controlled, often create air pollution problems.

Myth **Air pollution is primarily caused by road vehicles**

Fact Transport is an important source of pollution, especially in urban hotspots around roads. But there are many pollutants and many

other sources including biomass, domestic wood burning, agriculture and industry.

Myth **Air pollution is an inevitable by-product of economic growth**

Fact Tackling air pollution can be a key element of growth and regeneration policies. Town centres can benefit in many different ways from measures that reduce air pollution and increase their appeal as places to visit or do business.

Myth **Tackling air pollution will require fundamental – and very expensive – changes to our modern lifestyle**

Fact There are simple and cost-effective things we can do now to improve air quality – even if we can't completely eliminate air pollution. Any reduction in levels of pollutants such as particulate matter will lead to improvements in public health.

Air pollution and local priorities

Tackling air pollution may not be in itself a strategic priority in your area, either for the Public Health team or for the local authority as a whole. Nevertheless, actions to address the health impacts of air pollution can play a critical role in supporting other local priorities.

Active travel

Public health initiatives such as PHE's *Healthy People, Healthy Places*[44] encourage action by public health teams to increase cycling and walking to tackle obesity. People may be discouraged from cycling and walking in areas of high air pollution (even though the benefits of the physical activity in fact outweigh the risks of exposure by an order of magnitude). Tackling air pollution, or creating routes that avoid pollution hotspots, can help to make active travel more attractive as an option. Getting people cycling and walking can also in itself help to reduce air pollution. Walking and cycling are good for our physical and mental health. Switching more journeys to active travel will improve health, quality of life and the environment, and local productivity, while at the same time reducing costs to the public purse. These are substantial 'win-wins' that benefit individual people and the community as a whole[45].

44 https://www.gov.uk/government/news/healthy-people-healthy-places-building-a-healthy-future
45 https://www.gov.uk/government/publications/active-travel-a-briefing-for-local-authorities

Health inequalities

The greatest burden of air pollution often falls on the most deprived communities and the most vulnerable individuals. It is often (though not always) the most deprived communities that live closest to the busiest roads, therefore increasing their exposure to air pollution. Moreover, the Marmot Review[46] notes that individuals in deprived areas experience more adverse health effects at the same level of exposure compared to those from less deprived areas. The Marmot Review also highlights the role that action to tackle air pollution can play in addressing health inequalities. For example, although the London Congestion Charge was a population-wide intervention, it is areas of highest deprivation within the charging zone that have seen the biggest reductions in levels of NO_2 and PM_{10}.

Self-management and integrated care

Individuals with cardiovascular disease or respiratory conditions, such as chronic obstructive pulmonary disease (COPD), can be helped to manage the impact of air pollution on their health in a number of ways. Air pollution information services and Defra's daily air quality forecasts[47] enable such individuals to take mitigating action, such as increasing the use of their reliever inhaler medication (if appropriate[48]) or reducing exercise, on days when pollution is particularly high; while walking maps can enable exercise to be taken away from or minimise exposure to pollution hotspots.

Sustainability

Many local authorities have produced climate change strategies or CO_2 emission reduction plans, but the co-benefits for air pollution and health are rarely identified. Nor are the risks: not all interventions to reduce CO_2 emissions have a positive impact on air pollution and health. The use of diesel cars rose in the early 2000s. This was primarily due to technological advances in performance, their fuel efficiency and through the promotion of low CO_2 emissions vehicles whether they be petrol or diesel. However, diesel fuel produces four more times NO_2 and up to 30 times more PM_{10} than petrol. It is now known that both NO_2 and PM are damaging to people's health. Choosing a petrol vehicle over a diesel vehicle can significantly reduce the amount of harmful air pollution being emitted. Choosing a hybrid or electric vehicle would reduce harmful pollution emissions even further.

Similarly the location of combined heat and power (CHP) plants is important when considering impacts on air quality that might not be taken into consideration if considered purely as a CO_2 reduction measure. It is crucial then that sustainability plans have

46 http://www.local.gov.uk/health/-/journal_content/56/10180/3510094/ARTICLE
47 http://uk-air.defra.gov.uk/forecasting/
48 people with heart or lung conditions should follow their doctor's usual advice about exercising and managing their conditions

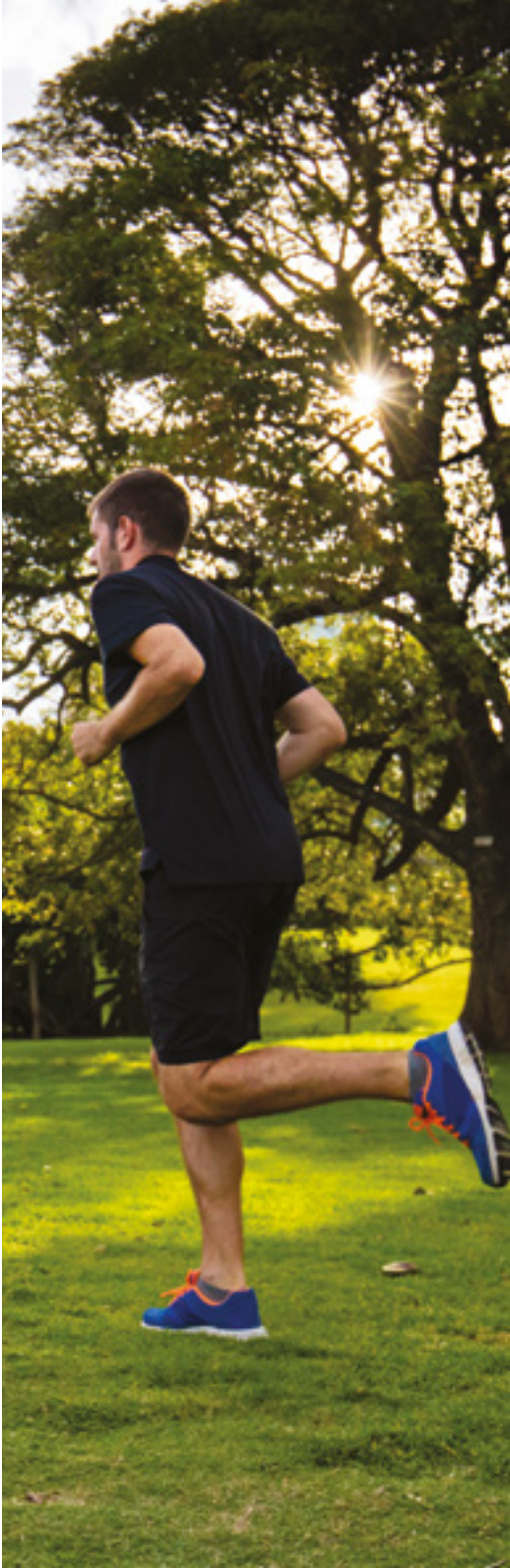
appropriate consideration to air quality and public health.

Growth and regeneration

People sometimes imagine, mistakenly, that air pollution is a necessary consequence of economic growth. In fact, tackling air pollution can be a key element of growth and regeneration policies. Local businesses and town centres can benefit in many different ways from measures that reduce air pollution. For example, pedestrianisation and creating green spaces can improve a town centre's appeal as a place to visit or do business; while taking action to reduce traffic emissions can also help save money on cleaning buildings.

Localism and community engagement

Many local authorities are looking at ways of involving local communities, neighbourhood groups and parish councils in decision-making processes as part of the localism agenda. Localised air pollution hotspots are a potential focal point for measures to encourage community engagement and ownership. For example, local community groups or schools can be equipped to measure NO_2 levels in their area using diffusion tubes.



Reasons and emotions

Even the most rational decision-makers are human. Local decisions about whether air pollution is a priority should be based solely on rational consideration of the evidence; but emotions can play a vital role in ensuring that the evidence gets properly considered in the first place.

A short guide is available in this resource presenting six principles for communicating with the public about air pollution.

In the final analysis, however, we are all members of the public and these principles are also applicable to communication with local decision-makers.

Where can I get more information?

This guide is part of a resource pack for Public Health teams. The resource comprises two briefings, one for elected members and one for Directors of Public Health as well as three short guides to help Directors of Public Health and their teams to take action.

Briefings:

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Guides:

- Understanding air pollution in your area
- Communicating with the Public during Air Pollution Episodes
- Communicating with the Public on the long-term impacts of Air Pollution

4. Communicating with the public during air pollution episodes

Introduction

This guide is part of a resource pack for Public Health teams and supports a briefing produced for Directors of Public Health - 'Getting to grips with air pollution – the latest evidence and techniques.'

Despite improvements in air quality in the UK over recent decades, current levels of air pollution continue to have a significant effect on our health. Both long and short-term exposure to air pollution are known to adversely affect health and air pollution is still the largest environmental risk linked to deaths every year. Short-term exposure (over hours or days) to elevated levels of air pollution can cause a range of effects including exacerbation of asthma, effects on lung function, increases in hospital admissions and mortality.

It is important to understand the associated short-term and long-term impacts of air pollution on health in order to communicate balanced and accurate public health messages. The long term impacts are explained in the accompanying guide to this one '*Communicating with the public on the long term impacts of air pollution*'.

Short-term air pollution episodes – background

Short–term ambient air pollution episodes routinely occur across the UK, particularly during spring and summer but also during autumn and winter. Short-term pollution episodes are associated with a number of adverse health effects including exacerbation of asthma, effects on lung function, increased daily mortality and admissions to hospital.

Directors of Public Health and their teams have a part to play in supporting and disseminating local health messages to the public during ambient air pollution episodes.

The evidence suggests that when levels of air pollutants are high, adults suffering from cardio-vascular disease, and adults and children with lung conditions, are at increased risk of showing symptoms and needing treatment. Only a minority of those who suffer from these conditions are likely to be affected but it is not possible to predict in advance who these people will be. Some people are aware that air pollution affects their health: adults and children with asthma may notice that they need to increase their use of inhaled reliever medication on days when levels of ambient air pollution are high.

At Very High levels of air pollution, some people amongst the general population may experience a sore or dry throat, sore eyes or, in some cases, a tickly cough even in healthy individuals.

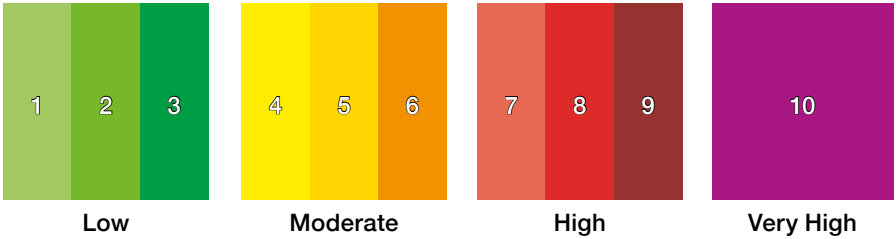
Short-term increases in levels of air pollutants have been shown to increase daily mortality rates. On average, mortality is a little higher on days of higher air pollution, or days immediately afterwards.

Clear public health messages enable the public to reduce their personal exposure by avoiding areas of higher pollution; this is beneficial for the general population and those with existing health conditions. Examples of successful implementation of health communication include air quality services such as airTEXT, airALERT and 'Know and Respond'. All of these services provide free information about the quality of outdoor air they breathe. The consideration of measures that foster awareness of the effects of air pollution in the local population can enable local residents to make informed decisions on how to reduce their exposure and if required, to better manage their health conditions[49].

49 Bradley, N., Harrison H., Hodgson, G., Kamanyire, R., Kibble, A. and Murray, V. (Eds) 2014, Essentials of Environmental Public Health Science: A Handbook for Field Professionals, Oxford University Press, Oxford

Air pollution is forecast by the Met Office and presented using the **Daily Air Quality Index (DAQI)**. Up to 5 day air pollution forecasts[50] can be found on Defra's UK Air website[51] along with the latest measured and summary air quality data[52]. Within the DAQI, air pollution is given a value from 1-10 with 1 being the lowest pollutant concentrations and 10 being the highest. These values are banded into Low (1 – 3), Moderate (4 – 6), High (7 – 9) and Very High (10)[53].

Index bands



The DAQI was developed by the Committee on the Medical Effects of Air Pollutants[54] and includes health advice for those more likely to be affected by short-term increases in pollution, in particular those with heart and lung problems.

Broadly, the following public health advice for an air pollution banding is the same whatever the pollutant and is publically available on the UK-Air website[55].

50 https://uk-air.defra.gov.uk/forecasting/
51 uk-air.defra.gov.uk
52 https://uk-air.defra.gov.uk/latest/
53 http://uk-air.defra.gov.uk/air-pollution/daqi
54 COMEAP (2011) Review of the UK Air Quality Index, A report by the Committee on the Medical Effects of Air Pollutants. Available at: http://webarchive.nationalarchives.gov.uk/20140505104658/http://www.comeap.org.uk/images/stories/Documents/Reports/comeap%20review%20of%20the%20uk%20air%20quality%20index.pdf
55 https://uk-air.defra.gov.uk/

Air Pollution Level (DAQI score)	Accompanying health messages for at-risk individuals*	Accompanying health messages for the general population
Low (DAQI 1-3) The 'Low' bands indicate air pollution levels where it is unlikely that anyone will suffer any adverse effects of short-term exposure, including people with lung or heart conditions who may be more susceptible to the effects of air pollution	**Enjoy** your usual outdoor activities.	**Enjoy** your usual outdoor activities.
Moderate (DAQI 4-6 The 'Moderate' band represents levels of air pollutants at which there are likely to be small effects for susceptible people only	Adults and children with lung problems, and adults with heart problems, **who experience symptoms**, should **consider reducing** strenuous physical activity, particularly outdoors.	**Enjoy** your usual outdoor activities.
High (DAQI 7-9) Values for the 'High' bands are associated with significant effects in susceptible people	Adults and children with lung problems, and adults with heart problems, should **reduce** strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also **reduce** physical exertion.	Anyone experiencing discomfort such as sore eyes, cough or sore throat should **consider reducing** activity, particularly outdoors.
Very High (DAQI 10) At 'Very High' levels of air pollution even healthy individuals may experience adverse effects of short-term exposure	Adults and children with lung problems, adults with heart problems, and older people, should **avoid** strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.	**Reduce** physical exertion, particularly outdoors, especially if you experience symptoms such as cough or sore throat.

*Adults and children with heart or lung problems are at greater risk of symptoms. They should follow their doctor's usual advice about exercising and managing their condition. It is possible that very sensitive individuals may experience health effects even on Low air pollution days. Anyone experiencing symptoms should follow the guidance provided above.

Health messages for short–term air pollution episodes

We are all exposed to low levels of ambient air pollution all the time but short-term episodes of increased air pollution can have pronounced effects on some particularly the old, the young and those with existing heart and lung conditions.

If an ambient air pollution episode is on-going/forecast it is important to know what the impact is in your area and, if appropriate, tailor your communication plans around it. People should not fear going outdoors, but some people may experience some noticeable symptoms.

The following messages are aligned to the DAQI advice and appropriate for episodes of High and Very High air pollution (which are the levels when action 'should' be taken, according to the DAQI):

Messages for High air pollution episodes

"While most people will not be affected by short-term peaks in ambient air pollution, some individuals, such as those with existing heart or lung conditions, may experience increased symptoms."

See http://uk-air.defra.gov.uk/latest/ for the latest UK air pollution data and maps.

"On occasions where levels are high, adults and children with lung problems, and adults with heart problems, should reduce strenuous physical exertion, particularly outdoors, and particularly if they experience symptoms. People with asthma may find they need to use their reliever inhaler more often. Older people should also reduce physical exertion. Anyone experiencing discomfort such as sore eyes, cough or sore throat should consider reducing activity, particularly outdoors."

Messages for Very High air pollution episodes

“Some parts of the country have recorded / are forecast to have very high levels of ambient air pollution. People in those areas should reduce physical exertion, particularly when outdoors and especially if they experience symptoms such as a cough or sore throat. Adults and children with lung problems, adults with heart problems, and older people, in areas where very high levels are recorded should avoid strenuous physical activity. People with asthma may find they need to use their reliever inhaler more often.”

See http://uk-air.defra.gov.uk/latest/ for the latest UK air pollution data and maps.

See *‘The new evidence putting air pollution on the public health agenda’* in *‘Getting to Grips with Air Pollution – a Briefing for Directors of Public Health’* for further information.

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- Understanding air pollution in your area
- Communicating with the public on the long term impacts of air pollution

5. Communicating with the public on the long term impacts of air pollution

Introduction

This guide is part of a resource pack for Public Health teams and supports a briefing produced for Directors of Public Health - 'Getting to grips with air pollution – the latest evidence and techniques.'

Participants in research workshops carried out in development of this resource were clear that they wanted and expected to be informed about the health impacts of air pollution. Members of the public can 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. As with so many public health issues, care is needed around how information is communicated. Air pollution – including the main pollutants of particulate matter (PM), nitrogen dioxide (NO_2) and ozone (O_3) - has many of the characteristics that make a threat to health more worrying – so-called 'fright factors' – creating a real risk of counter-productive reactions if communication is poorly handled. With air pollution high on the national and local media agenda, it is important that local communities have access to balanced and accurate information about the sources and consequences of air pollution in their local areas. Defra has commissioned focus group research to test the health messaging in this document with members of the public. The messages will be initially tested with vulnerable groups and then non-vulnerable groups. Defra will use the results of the focus groups to produce an insight pack which will help to inform future messaging in the toolkit.

Fright Factors:
Risks are generally more worrying, and less acceptable, if perceived[56]:

- to be **involuntary** (e.g. exposure to pollution) rather than voluntary (e.g. dangerous sports or smoking)
- as **inequitably distributed** (some benefit while others suffer the consequences)
- as **inescapable** even by taking personal precautions
- to arise from an **unfamiliar or novel** source
- to result from **man-made, rather than natural** sources
- to cause **hidden and irreversible** damage, e.g. through onset of illness many years after exposure
- to pose some particular danger to **small children or pregnant women** or more generally to **fertility issues**
- to threaten a form of death (or illness/injury) arousing **particular dread**
- to damage **identifiable rather than anonymous victims**
- **to be poorly understood** by science
- as subject to **contradictory statements** from responsible sources (or, even worse, from the same source)

Despite improvements in air quality in the UK over recent decades, current levels of air pollution continue to have a significant effect on our health. Both long and short-term exposure to air pollution is known to adversely affect health and air pollution is still the largest environmental risk linked to deaths every year.

Studies have shown that long-term exposure **(over several years)** reduces life-expectancy, mainly due to increased risk of mortality from cardiovascular and respiratory causes and from lung cancer. Air pollution is now associated with much greater public health risk than was understood even a decade ago, and more associated adverse health effects are emerging.

It is important to understand the long-term and short term impacts of air pollution on health in order to communicate balanced and accurate public health messages. The short term impacts are explained in the accompanying guide to this one *'Communicating with the public during air pollution episodes'*.

56 RCP (2016). Every breath we take: the lifelong impact of air pollution. Report of a working party. London: Royal College of Physicians. Available at: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

Long-term air pollution - background

Long-term exposure (over several years) to elevated concentrations of particulate matter ($PM_{2.5}$) at levels typically experienced in urban areas reduces life expectancy between several months and a few years. Air pollution acts as a contributory factor - along with many others - in affecting mortality with the major effect on deaths from cardiovascular disease (CVD) and to a lesser extent lung cancer and other respiratory diseases.

There is strong scientific evidence linking air pollution with increased mortality and ill health. Health effects associated with air pollution include exacerbation of asthma, effects on lung function and increases in respiratory and cardiovascular hospital admissions. There is evidence that older people, children and those with pre-existing illness are more vulnerable to the adverse health effects of air pollution.[56] For example, long-term exposure to air pollution impairs lung development in children. Reducing exposure to air pollution minimises this effect, thereby allowing more young people to achieve their maximum lung function growth potential[57].

57 Gauderman WJ, Urman R, Avol E, Berhane K, McConnell R, Rappaport E, Chang R, Lurmann F, Gilliland F. Association of improved air quality with lung development in children. N Engl J Med. 2015 Mar 5;372(10):905-13. doi: 10.1056/NEJMoa1414123

Explaining long-term air pollution

Risks

Nearly 5% of 'deaths' in England are attributable to long-term exposure to particulate air pollution, according to the latest data published in the Public Health Outcomes Framework (PHOF)[58].

This estimate makes air pollution the largest environmental risk linked to deaths every year.

It is estimated that long-term exposure to particulate air pollution has 'an effect equivalent to' around 25,000 deaths a year in England (29,000 in UK).

Note: mortality numbers for each local authority have been calculated in the PHE report: Estimating Local Mortality Burdens Associated with Particulate Air Pollution[59].

The Committee on the Medical Effects of Air Pollutants (COMEAP) published its assessment of the effects on mortality of long-term exposure to air pollution in the UK in December 2010.

But action can lead to improvements. If the annual average concentration of particulate matter (measured as $PM_{2.5}$) were to be reduced by just 1 microgram per cubic metre, there would be an increase in life expectancy from birth of about 20 days.

58 https://www.phoutcomes.info/search/air%20quality#page/3/gid/1/pat/6/par/E12000007/ati/102/are/E09000002/iid/30101/age/230/sex/4 While this is the fifth year of PHOF data, it is too early to read a trend into the data because individual years are likely to fluctuate due to changes in weather conditions. The calculation is based on human-made particulate air pollution less than 2.5 microns in size (a micron is 1000th of a millimetre) called $PM_{2.5}$.

59 https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution

Explaining the mortality effect of long term exposure to particulate air pollution

It is important to understand that long-term exposure to air pollution is not thought to be the sole cause of deaths. Rather, it is considered to be a contributory factor.

There is evidence that outdoor air pollution causes lung cancer. Diesel engine exhaust, outdoor air pollution and particulate matter have all been classified by the World Health Organization as carcinogenic to humans.[60,61]

Air pollution affects our daily quality of life as it can exacerbate lung conditions such as Chronic Obstructive Pulmonary Disease (COPD) and asthma. People with COPD have difficulties breathing, primarily due to the narrowing of their airways.

Additionally, air pollution can reduce lung development in children, which may increase symptoms in children who develop conditions such as asthma.

Sources of air pollution

In the 1990s it was felt that air pollution was no longer a major health issue in the United Kingdom. Legislation had made the great smogs of the 1950s a thing of the past.

But evidence started to emerge that small particles emitted to the air from various sources, such as road transport, industry, agriculture and domestic fires, were still having a considerable effect on health. This type of air pollution is so small that it can't be seen by the naked eye, but can get into our respiratory system. Other air pollutants, such as the gases nitrogen dioxide, sulphur dioxide and ozone, can also affect our health. Nitrogen dioxide and sulphur dioxide are produced by burning fuel, whilst ozone is formed by chemical reactions in the air.

Working together – Everyone can do their bit

National and local government can help reduce air pollution by promoting a shift from cars to walking and cycling.

In addition, they can promote integrated public transport systems to help reduce congestion; the introduction of Clean Air Zones and parking restrictions; ensuring that new developments reduce the dust and other emissions produced during

construction and put in place cleaner infrastructure such as electric charging points and lower emission building heating; and actively enforcing existing regulatory measures such as smoke control areas.

Businesses also have an important role to play by introducing incentives for staff to walk or cycle to work, take up car sharing or work from home.

We can all do our bit to improve air quality. For example, by walking or cycling to work and school we can improve our health through exercise, limit air pollution and reduce carbon dioxide emissions which are responsible for climate change.

We can choose lower emission fuels and heating appliances for our homes, like gas central heating, or modern wood stoves rather than open fires, smokeless coal rather than house coal or dry high quality wood rather than green wood. We can also move to lower emission vehicles.

Everyone will need to take some action if we are to significantly improve air quality. While the impact of the individual household or business may be small, the combined impact of actions taken by national and local government, large and small businesses and individuals could be great.

60 IARC: Diesel engine exhaust carcinogenic, WHO International Agency for Research on Cancer, Press release No 213, June 12, 2012. http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

61 IARC: Outdoor air pollution a leading environmental cause of cancer deaths, WHO International Agency for Research on Cancer, Press release No 221, October 17, 2013. http://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf

Six principles for public communication about air pollution – conclusions of a workshop

As part of the development of the briefing and guides, qualitative research[62] was undertaken with members of the public to understand more about their existing understanding of the nature, causes, and consequences of air pollution, their interpretation of and responses to new information about air pollution, and the implications for public communication about air pollution. Six principles were identified:

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

B. **Help people understand how they can protect themselves:** Don't raise public concern about air pollution unless you can at the same time s**atisfy people's desire to do something to reduce their exposure.**

C. **Explain the health impacts:** Focus on w**hat is known for certain** about the health consequences of air pollution.

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

E. **Explain how individuals can make a difference:** Keep the focus of communications on **actions people can take** – not long-term solutions.

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

62 For details see the Defra Project Report "AQ1010: Developing communication methods for localised air quality and health impact information." http://randd.defra.gov.uk/Default.spx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18580

These six principles – discussed in more depth below – reflect specific aspects of air pollution and its health impacts. The accompanying report covers the findings of these workshops in much more detail, including examples of how participants responded.[63]

Of course, public communication about air pollution should also follow generic best practice for communicating with the public, for instance:

- **Listen and empathise:** take emotions seriously, and remember that logic and evidence alone have limited impact when a topic prompts strong emotional reactions, as air pollution does.
- **Focus:** be clear about your situation, identify risks, set tight objectives around specific audiences, and don't confuse activity with results.
- **Exchange:** build relationships and involvement, because communication is a two-way process in which both sides have something to give and to learn.
- **Sustain:** build trust by ensuring communication is regular and consistent.
- **Honesty:** be open about what is known and any uncertainties.
- **Connect:** recognise you can't control communication, and that people talk to people.

It is particularly important to build an on-going two-way dialogue for persistent environmental risks.

63 Communicating with the public about air pollution - Findings from qualitative research with the general public on the topic of air pollution, S Christmas et al, Project AQ1010 Research Report, Defra, 2014. http://uk-air.defra.gov.uk/library/

Principle A: Explain what air pollution is

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

Insight	Hearing what particulate matter is made of prompts powerful emotional reactions of disgust. Hearing that the smallest nanoparticles can pass into one's body links this disgust to everyday conceptions of 'miasma' – bad air with unknown long-term impacts on one's health. These emotional reactions can help to get air pollution onto the agenda in the first place. They provide a 'hook' for powerful communications. Only once air pollution is on the agenda do statistics about health consequences have a vital role to play in establishing rationally the scale of the problem and the need for action.
Example messages	• Particulate matter is a type of air pollution made up of microscopic particles. The smallest are also called nanoparticles. • You can neither see nor smell particulate matter. • Particulate matter is made of lots of different sorts of things including: vehicle exhausts; smoke or soot from fires; particles of metal from engine chambers; bits worn from brake pads; bitumen, asphalt or concrete dust work from the road; biological and other waste ground up on the road; and it's formed by reactions between other pollution in the air too. • Particles can land and then be blown back up into the air: each time this happens they can pick up bits of whatever they landed on. • Larger (but still microscopic particles) stick in our throat and windpipe; smaller particles go down into our lungs; the smallest nanoparticles pass into our blood, transported around the body and may be found in organs of the body.
Watch-outs	Disgust is a powerful emotion, and people can easily switch off.

Principle B: Help people understand how they can protect themselves

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.**

Insight	People's instinctive response to hearing about what particulate matter is made of and where it goes is to look for ways to protect themselves. For instance, they wonder if wearing a mask could help. (Unfortunately it doesn't.) If this 'protection reflex' is not satisfied, then people may simply switch off. If there is nothing you can do to protect yourself from a threat, they reason, why waste time worrying about it? Raising concern without satisfying the 'protection reflex' could actually end up making it harder to engage people on air pollution issues. Because people imagine they are safer in their cars, there's also a risk that people try to 'protect' themselves by driving *more.*
Example messages	• Particulate matter levels vary over very short distances: in general, the closer you are to the sources, the more you breathe in. • If you're walking or cycling, you can easily avoid the worst pollution by travelling along quieter streets. • If you are burning wood on an open fire make sure it's well seasoned (less than 20% moisture content) quality fuel as this will reduce the particulate emissions, or use a smokeless fuel. • The health benefits of physical activity (walking or cycling) outweigh the risks from air pollution. If you're in a vehicle, you just get the risks with none of the benefits. *Also provide local information about air pollution hotspots, times of high pollution, and practical ways for pedestrians and cyclists to avoid these. This information is best provided in visual (map) form.*
Watch-outs	People's immediate responses to hearing about air pollution are focused on not breathing it in (e.g. wearing a mask). People don't typically think that choosing a different route can reduce exposure to pollution without being prompted.

Principle C: Explain the health impacts

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

Insight	Faced by a new threat, and uncertain how best to protect themselves from it, people look for ways to rationalise the problem away – for example, by questioning the motivations of the messenger. Scientific uncertainty can reinforce this questioning - especially provides an opportunity to do this – especially in a context when people are used to being bombarded by the media with dubious statistics about health.
Example messages	• Particulates are now known to contribute to heart disease and lung cancer. • Many years of life are lost each year in the UK as a result of air pollution. • Air pollution can affect some individuals who are more vulnerable to harm including those with heart and lung disease, children, the elderly. • People's behaviour can also affect their exposure to air pollution- for example, people could choose to walk or cycle on routes away from busy roads. *Also provide information to put the scale of the problem locally in context.*
Watch-outs	If you don't inform people about the health impacts of air quality, they may ask why you hid this information this information from them when they eventually find out.

Principle D: Make it local

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

Insight	Once the nature of air pollution and its strong links to road transportation are explained, there is a tendency for people to put the problem in the 'too hard to tackle' category. One possible reason for this is that, superficially, the problem sounds a bit like the ultimate 'too hard to tackle' problem, climate change. That too is associated with road transport. However, if the problem is firmly linked to specific locations – neighbourhoods, streets, junctions or schools – then it becomes possible to start discussing practical measures to improve air quality in those locations. Arguably, air pollution has more in common with road safety: air pollution 'hotspots' are like road safety 'blackspots'. Linking air pollution to specific places also helps to deal with the 'protection reflex' – see Principle B.
Example messages	• Air pollution is a local, national and international problem. We all need to do our bit to tackle it. • There are clear air pollution hotspots, where the problems of air pollution are at their worst. *Also provide local information about air pollution hotspots, times of high pollution, and practical ways for pedestrians and cyclists to avoid these. This information is best provided in visual (map) form.*
Watch-outs	Linking air pollution to specific places obviously raises particular problems for the communities living or working in those places. Helping these communities to take collective action is essential.

Principle E: Explain how individuals can make a difference

Keep the focus of communications on **actions people can take** – not long-term solutions.

Insight	As with Principle D, another reason people start to think air pollution is "too hard to tackle" is they start thinking of what would be necessary to completely eliminate particulate matter – and quickly realise that this would entail a radical transformation of our current lifestyles. They forget that any reduction in levels of particulate matter will lead to an improvement in health outcomes. For example, people tend to interpret 'cleaner vehicles' as referring to electric cars, and forget that the simple choice of a petrol car rather than a diesel can already make a big difference especially in towns and cities where nitrogen dioxide levels are likely to be highest. People may not know that dry wood rather than wet wood, smokeless fuel rather than house coal, or a modern stove rather than an open fire, can significantly reduce emissions.
Example messages	• Any reduction in levels of particulate matter will lead to improvements in health benefits • There are simple and cost-effective things we can do now to improve air quality. *Also provide simple examples of simple things that could be done locally to improve air quality. Ideally, talk about the simple things you are already doing.*
Watch-outs	Talk about longer-term solutions, such as electric vehicles, with great care and only in the right contexts. Debates about what may or not be practical in the long-term can easily distract people from the important things they could be doing now.

Principle F: Demonstrate leadership and empower communities

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

Insight	Many people argue strongly that individuals cannot change their transport behaviour in the absence of larger, systemic changes – affordable transport alternatives, planning decisions which do not assume road transport, more flexible working practices or school timetables, and so forth. They may react defensively to suggestions that they should change their own behaviour in the absence of these larger systemic changes. They may also point to those who could set a better example: polluting buses, local authority fleets, vehicles used by health providers, businesses, etc. By contrast, communities empowered to understand air pollution in their local area – for instance, by being equipped to monitor NO_2 levels – have become powerful advocates for local improvement.
Example messages	*Demonstrate what key players, including the local authority, are doing to reduce their own contribution to air pollution.* *Start talking up the air quality co-benefits of measures primarily targeted at other problems.* *Give local communities control of the agenda, by equipping them with evidence and information about air pollution in their areas.*
Watch-outs	Thanks to the way in which issues such as climate change have been presented, people are now primed to assume anyone telling them about a problem linked to road transport is trying to get them out of their cars. There is a risk of defensiveness even when individuals are not being asked to change their behaviour.

Case Study: Empowering local communities- Community Air Quality Groups in Wiltshire

Following a local government reorganisation which saw Wiltshire become a unitary council, eighteen Area Boards were set up across the county to ensure local communities had a say over issues that affect them. The development of the Wiltshire Air Quality Action Plan has enabled area boards to take more ownership of the air pollution 'hotspots' in their areas. 'Community Air Quality Groups' were set up in areas with AQMAs; with elected members, parish councils and members of the public meeting quarterly to decide how to tackle air pollution problems locally. These groups produce their own local action plans and then report back annually to their respective Area Boards on their progress.

In Bradford-on-Avon, where locals thought that the local air pollution problem was caused by commuters travelling through the town, the community air quality group decided to find out if this was true. The group commissioned an origin and destination study, a report that found out that over 80% of traffic air pollution in the town was caused by 'locally' generated traffic from residents. This has focused minds on the local nature of the issue and there is growing support for measures that encourage residents to change their behaviour, as well as re-visiting past initiatives such as a one-way system.

Maggie Rae, Corporate Director notes: "Community Air Quality Groups have made a real difference in Wiltshire-building support at a local level for interventions to tackle air pollution".[64]

64 http://www.wiltshireairquality.org.uk/reports

Engaging the media

Media reporting on air pollution can influence public understanding and acceptance of measures. Local media can be helpful in building understanding and support.

However, there is a significant risk that air pollution issues are misreported because the general level of understanding is poor, the science is complex and the measures to address air pollution can be contentious.

To effectively engage the media, you need to provide short, simple, credible briefings to journalists on:

- the nature of local air pollution issues and their effects
- the things that people can do individually to help themselves
- the steps the local authority has taken and is taking to address the issues and how people can get involved
- stories of local people taking action
- stories of success (including vox pops from local people)
- how other organisations are contributing

Editors like statistics, hard facts, comparisons and images to bring a story to life. Provide the statistics in a simple but credible form, and create images that help visualize what is often seen as an invisible problem.

Your media team will be able to advise on making stories newsworthy – for example, the importance of timeliness and human interest.

Working with your in-house communications team

The communications team of your local authority will be expected to support the agreed priorities of the council and to protect the reputation of the council. They are likely to be stretched and might not have gained additional resources to support the public health agenda when it transferred. The support they will be able to offer will depend on whether air pollution has been identified as a priority and whether air pollution is likely to impact on the reputation of the council.

You can work most effectively with the communications team by:

- Informing them about the issues (in simple terms), your activities and getting their advice
- Highlighting potential reputation risks as early as possible and discussing how these can be mitigated (e.g. being ready with potential solutions and action to address problems)
- Developing clear messages to help them explain the local air pollution problems and solutions to the media and other interested stakeholders (e.g. using headlines with supporting proof points)
- Involving them in agreeing objectives for communications activities at an early stage
- Being available to act as a champion and spokesperson
- Working together to make the case for additional resources to support proactive communications e.g. internal business cases or incorporating communications support in applications for external grants

Where can I get more information?

This guide is part of a resource pack for Public Health teams. The resource comprises two briefings for elected members and Directors of Public Health as well as three further short guides to help Directors of Public Health and their teams to take action.

Briefings:

- Getting to grips with air pollution – a Briefing for Directors of Public Health
- Air Pollution: a public health issue – a Briefing for Elected Members

Guides:

- Engaging local decision makers on air pollution
- Understanding air pollution in your area
- Communicating with the public during air pollution episodes

6. Air Pollution: an emerging public health issue.
Briefing for elected members

Introduction

New evidence of the serious public health impacts of everyday air pollution is driving increased political, public and media interest in the issue. The good news is that there are cost-effective actions local authorities can take to tackle the health impacts of air pollution. This briefing is designed to get you up to speed, and help you ask the right questions of the right people. It is published alongside more detailed resources for local public health teams.

What are the main pollutants?

Air pollution is a mixture of particles and gases that can have adverse effects on human health. The most important pollutant is **particulate matter (PM)**. PM has three size fractions **PM_{10}**, **$PM_{2.5}$** and **$PM_{0.1}$**. **PM_{10}** includes all particles smaller than 10 microns[65] (including $PM_{2.5}$ and $PM_{0.1}$) and $PM_{2.5}$ comprises all particles smaller than 2.5 microns (including $PM_{0.1}$).

$PM_{2.5}$ has the strongest epidemiological link to health outcomes[66] and is used for the Public Health Outcomes Framework indicator 3.01[67]. At this size **the particles can be inhaled deep into the lungs.**

The very smallest particles, ultrafine $PM_{0.1}$, (the smallest fraction of $PM_{2.5}$) are nano-particles smaller than 0.1 microns and are thought, once inhaled, to be able to **pass directly into the bloodstream**.[68]

65 A micron is 1 millionth of a metre, or 1000th of a millimetre.

66 The mortality effects of long-term exposure to particulate air pollution in the UK, A report by the Committee on the Medical Effects of Air Pollutants, 2010 https://www.gov.uk/government/publications/comeap-mortality-effects-of-long-term-exposure-to-particulate-air-pollution-in-the-uk

67 http://www.phoutcomes.info/

68 Particulate Matter Air Pollution and Cardiovascular Disease: An Update to the Scientific Statement from the American Heart Association, Circulation, 121, p.2331-2378, 2010. http://circ.ahajournals.org/content/121/21/2331.full

PM can be composed of particles from combustion products, products from abrasion of engine components, brakes and tyres on road surfaces, generated during construction and agricultural processes, as well as components generated by chemical reactions in the air. Much of the PM in urban environments, particularly that close to roads, can come from traffic sources and comprises soot, part burnt diesel and petrol compounds that form benzene-based carcinogens, heavy metals, silica, bitumen, rubber and organic and other waste matter from road surfaces. Domestic burning of wood and coal is a significant source (38% of primary emissions of $PM_{2.5}$ in the UK), producing smoke and soot. The proportions of each component vary strongly depending on location. In cities and along roads where most exposure tends to occur, traffic generated compounds make up a large or dominant portion of the overall composition. In the countryside, agriculture and upwind industry make a bigger contribution.

The gaseous pollutant **nitrogen dioxide** (NO_2) is a gas produced along with nitric oxide (NO) by combustion processes and together they are often referred to as oxides of nitrogen (NO_x). Evidence associating NO_2 with health effects however, has strengthened substantially in recent years and it is now thought that, on the balance of probability, NO_2 itself is responsible for some of the health impact found to be associated with it in epidemiological studies[69].

On average around 80% of oxides of nitrogen (NO_x) emissions in areas where the UK is exceeding NO_2 limit values is due to transport, although urban and regional background non-transport sources are still considerable[70]. The largest source is emissions from diesel light duty vehicles (cars and vans) and there has been significant growth in these vehicle numbers over the last ten years in the UK.

Ozone (O_3) comes from a combination of natural and human processes; unlike the pollutants above, it cannot be managed locally but forecasting services can help alert vulnerable individuals.

During some weather conditions that lead to acute **air pollution episodes** NO_2, O_3 and other pollutants react and condense into PM, adding to that which has been emitted.

69 COMEAP (2015). Statement on the evidence for the effects of nitrogen dioxide on health, 2015. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411756/COMEAP_The_evidence_for_the_effects_of_nitrogen_dioxide.pdf

70 Defra (2015). Improving air quality in the UK: Tackling nitrogen dioxide in our towns and cities. UK, Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486636/aq-plan-2015-overview-document.pdf

Did you know

1. Air pollution is a serious public health issue. In 2010 the Department of Health's (DH) Committee on the Medical Effects of Air Pollutants (COMEAP) estimated the burden of particulate air pollution in the UK in 2008 to be equivalent to nearly **29,000 deaths** and an associated loss of population life of **340,000 life years lost**. Reducing PM by 10 µg/m^3 would extend lifespan in the UK by five times more than eliminating casualties on the roads, or three times more than eliminating passive smoking.

2. The scientific understanding of the health effects of everyday air pollution has changed dramatically in recent years. Population effects of air pollution that were largely unknown in 1998 and uncertain in 2005 when air quality limits were set - such as all-cause mortality - are now quantifiable.

3. EU and UK limit values are in place to protect human health. However, it is recognised that there are no absolutely safe levels of the main pollutant of concern, PM, and impacts are observed below levels permitted by EU and UK limits. Any improvement in air quality will have positive health consequences[71] and the UK has a target to reduce average concentrations of $PM_{2.5}$ at urban background locations by 2 µg/m^3 by 2020.[72]

4. Vehicle exhaust pollution was classified as carcinogenic in 2013.[73]

5. The absence of an Air Quality Management Area does not mean there is no public health problem from air pollution.

There is now clear evidence that long-term exposure to everyday air pollutants contributes to cardiovascular disease (CVD, including heart diseases and stroke), lung cancer, and respiratory disease (which includes asthma and chronic bronchitis).

The heaviest burden is borne by those with greatest vulnerability and/or exposure. The elderly, children and those with cardiovascular disease and/or respiratory disease are more susceptible to air pollution than others. Those who spend more time in highly polluted locations will be affected more. Since air pollution levels are typically as high within vehicles as just outside, this is likely to include not only those who live and work near busy roads, but also those who drive for a living.

Road vehicles are the main pollution sources that people are exposed to in most populated environments and the pollution they generate (PM) is the most harmful. Combustion for heating, agriculture and industry also contributes,

71 Review of evidence on Health Aspects of Air Pollution – REVIHAAP project: final technical Report, World Health Organization Office for Europe, 2013. http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report

72 This is called the National Exposure Reduction Target (NERT), and is determined on the basis of the population's average exposure to $PM_{2.5}$ at urban background sites, the Average Exposure Indicator (AEI). Urban background sites are measurement sites in town and cities that are not significantly influenced by emissions from specific local major roads, industry or other pollution sources. For more information on site types see: http://uk-air.defra.gov.uk/networks/site-types

73 http://www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf

but tends to be more dilute. The contribution of each source category varies enormously by location. Near busy roads local traffic pollution dominates, while further from roads regional transport, commercial and industrial emissions are the major contributors.

There is a vast difference in emissions of different vehicles and fuels. In general diesel exhaust contains up to 30 times more PM than petrol or Liquid Petroleum Gas (LPG) or Compressed Natural Gas (CNG), but all vehicles generate additional PM from friction of brakes and tyres.

Small changes in distance from the source, street layouts and physical barriers can make a big difference to exposure. For example, pollution levels next to a busy road can vary from the part of the pavement nearest to the traffic to the part of the pavement farthest away, and will be much lower on a parallel side street. Intense sources such as busy junctions lead to the creation of localised pollution 'hotspots' where very high levels of pollution are reached.

The proximity to an emissions source is not the only factor that affects the amount of pollution in a given locale. Tall buildings along narrow streets can lead to the 'canyon effect' where pollution is trapped along the street which can intensify hotspots. Air pollution reaches people from every source that is upwind. However, it will be heavily diluted if more than a few hundred metres away, especially in windy conditions. Nonetheless in dense or heavily polluted conurbations these many, dilute sources can add up to a significant background concentration. Sometimes weather patterns encourage this background to accumulate over hours or days to cause an air pollution 'episode.' During this time additional changes in the chemical composition and toxicity of the air can take place.

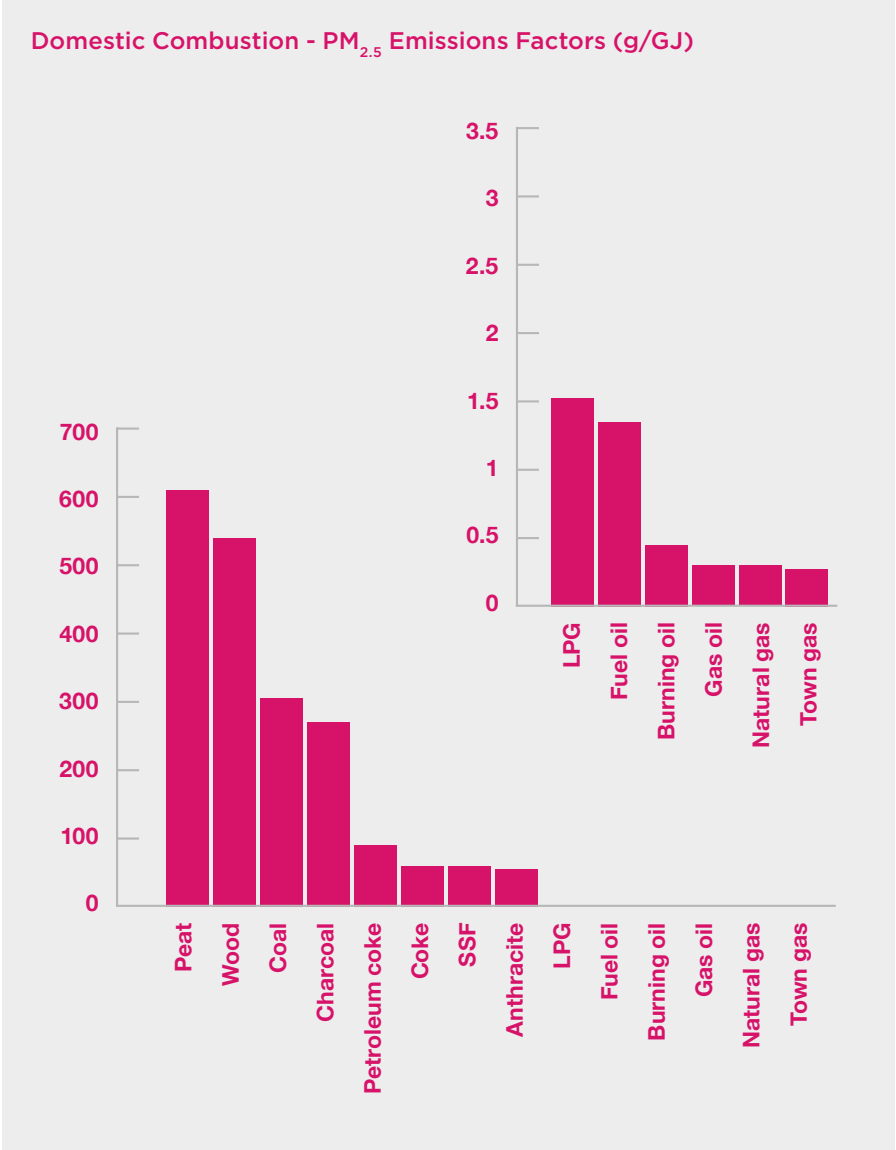
The highly localised distribution of air pollution leads to highly unequal patterns of exposure to different individuals resulting from their day-to-day behaviour. For example ambulance drivers, taxi drivers and other professional road users will inhale significantly higher amounts of pollution compared to those working outside but away from a busy road. Building design can also influence the amount of exposure to pollution individuals receive. School children in a passively ventilated school will receive much higher levels of pollution compared to office workers in a well air-conditioned office block, even if both groups are the same distance downwind of the same emission source.

The local nature of pollution hotspots creates scope for local action to reduce local concentrations and reduce people's exposure to emissions.

Recent data from BEIS, based on a domestic wood burning survey, has shown a significant increase (2.5 times) in domestic wood burning which in turn has increased PM emissions projections. Domestic combustion accounted for 38% of total $PM_{2.5}$ emissions in 2014 and is forecast to account for 41% by 2020. Of this 84% are attributed to domestic wood burning in 2014 and 88% by 2020.

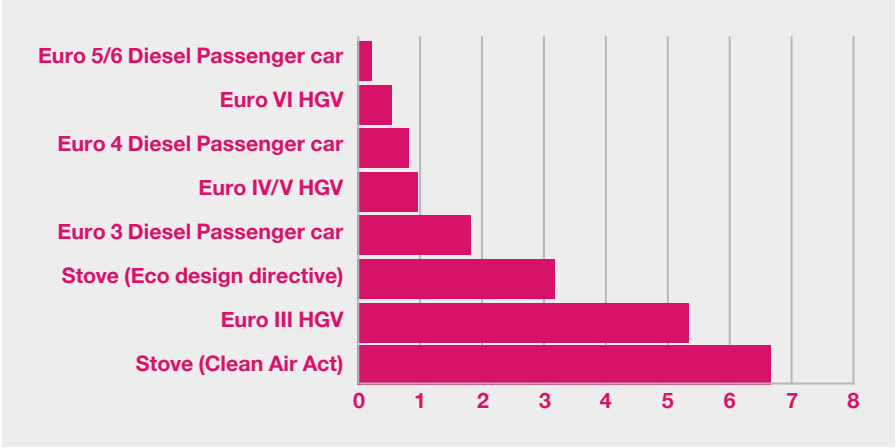
The table below shows the variability in emissions based on fuel type.

2014 $PM_{2.5}$ emission factors for residential heating by fuel type



An Ecodesign domestic stove is likely to emit a higher mass of PM on an equivalent hourly operational basis, than diesel cars & all but the most polluting Euro III HGVs. This is illustrated in the following table.

Comparison of estimated PM emission rates from a 5 kW stove (g/h) compared to typical exhaust PM emissions (g/h) from vehicles



Recent research findings

In 2010 COMEAP estimated the burden of particular air pollution in the UK in 2008 to be equivalent to nearly 29,000 deaths and an associated loss of population life of 340,000 life years lost[74].

In 2011, DH included an indicator based on annual average $PM_{2.5}$ concentrations in the new Public Health Outcomes Framework[75]. The indicator estimates the percentage of deaths attributable to long term exposure to man-made particulate air pollution in upper and lower tier local authorities in England.

In 2012, the International Agency for Research on Cancer listed diesel exhaust pollution as a Class 1 carcinogen and extended this to all ambient air pollution in 2013[76].

In 2013 the World Health Organization (WHO) published a major review of 2,200 studies[69] concluding that:

- Annual $PM_{2.5}$ concentrations are associated with all-cause mortality to a high level of confidence, and with much greater certainty than in 2005
- "There is no evidence of a safe level of exposure to PM or a threshold below which no adverse health effects occur". Negative health impacts have been found well below current EU & UK limits
- NO_2 was associated with "adverse health effects at concentrations that were at or below the current EU limit values"

In 2015, the Royal College of Physicians and the Royal College of Paediatrics and Child Health published a report on the lifelong impact on air pollution[77]. It considered the effects of chronic and persistent pollution exposure from conception to old age, taking into account both outdoor and indoor pollution exposure sources. It also viewed air pollution as a stressor that interacts with many other stressors such as diet, socio-economic deprivation and climatic conditions to create reduced health and increased susceptibility to disease[78].

74 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/304641/COMEAP_mortality_effects_of_long_term_exposure.pdf
75 http://www.phoutcomes.info/search/air
76 https://www.iarc.fr/en/media-centre/iarcnews/pdf/pr221_E.pdf
77 https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution
78 Royal College of Physicians. Every breath we take: the lifelong impact of air pollution. Report of a working party. London: RCP, 2016.

What can local authorities do?

There are many things local authorities can do to tackle the health impacts of local air pollution – and to do so cost-effectively. (See the examples of good practice at the end of this briefing.)

While overarching regulations like vehicle emissions standards are controlled by governments and the EU and new vehicle and appliance designs by industry, local authorities have many powers in:

- traffic and parking management
- street design and road layouts
- planning
- using idling powers
- public and school transport policies
- forbidding the dirtiest vehicles or favouring clean vehicle fuels like petrol, LPG or CNG over diesel and bio-diesel
- installing electric vehicle charging points
- reviewing and enforcing Smoke Control Areas
- low or zero emission last mile services
- fleet management and car clubs
- vehicle and building air conditioning
- building energy efficiency and cleaner heat sources

All these actions are potential ways to reducing emissions, concentrations or exposure to pollution.

Any improvement in air quality will have positive health consequences. Improvements to air quality are also an important co-benefit of interventions targeting other health outcomes, such as active travel and increased physical activity.

Actions to address the health impacts of air pollution can also play a critical role in supporting other local priorities such as health inequalities, care integration and supported self-management, sustainability, growth and regeneration and localism and community engagement.

The business case for public health action on air pollution

The King's Fund (2013) report on *Improving the Public's Health*[79] 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 spillover benefits including noise reduction. The overall benefit-to-cost return was £620 in benefits for every £100 spent."

Cost-beneficial options for reducing air pollution include measures to encourage people to make more journeys by bike or on foot.

79 http://www.kingsfund.org.uk/publications/improving-publics-health

What can elected members do?

- Raise concerns amongst your residents and businesses
- Find out if you have local pollution hot spots (remembering that there may be a public health problem even where there isn't an Air Quality Management Area)
- Find out if your local authority has any Smoke Control Areas (SCAs), and ensure they are clearly communicated to support enforcement
- Raise the issue with your health and well-being board
- Encourage Cabinet understanding and overview and scrutiny across a range of council strategies which will have an impact, direct or indirect, on air pollution
- Engage your Local Enterprise Partnership (LEP) about considering mitigation of air pollution along economic development
- Consider air pollution issues from construction, transport and building heating as part of planning decisions
- Consider using your powers to implement a Clean Air Zone
- Celebrate successes in reducing air pollution
- Ensure your council is encouraging others in the community to act
- Ensure your council is informing and engaging the public.

What questions should elected members ask?

- Do we have a problem of air pollution in our area? Are we considering levels of pollution below the EU limit? Where are our local hot spots?
- Does the council have a robust way of understanding local levels of air pollution and its effects on the health of local people?
- What does the Joint Strategic Needs Assessment (JSNA) say about air pollution? Should it say more?
- Does the council have a strategy and action plan for improving air quality or reducing exposure to pollution?
- Is the council considering air pollution when it decides its health and well-being priorities? What does the Health and Well-being Strategy say about air pollution?
- Is the council considering how action on air pollution might support its work on active travel, health inequalities, self-management and integrated care, sustainability, growth and regeneration, and localism and community engagement?
- Is the council working with local businesses, the NHS and the voluntary sector to ensure they are playing their role in improving air quality?
- Are members of the public aware of air pollution and do they know what to do if they have concerns about it? Could the council do more to get people engaged, for instance with community measurement schemes?

What are other local authorities doing in this area?

- Some local authorities have set up SMS messaging services that warn vulnerable individuals that air pollution levels are high so that they can take steps to reduce their exposure or ensure they have medication. Examples include airAlert[80] which is run by a partnership of councils in Sussex and airTEXT[81] which covers Greater London. Defra publishes a daily air quality forecast[82] based on the Daily Air Quality Index (DAQI)[83] to inform the public when air pollution is expected to be elevated as well as providing associated health advice.

- A number of councils have **retrofitted some or all of their vehicles to run on gas fuels** (LPG, CNG or biogas). These emit as little as 1/30th of the PM caused by diesel. It is also cheaper to run as the fuel costs are less.

- Plymouth Hospital **Travel Plan** resulted in a reduction in staff arriving by car (from 90% to 54%). The plan included restricted and charged parking permit allocation, supplemented with improved Public Transport services, discounted Public Transport tickets and promotion of car sharing (from the lowemissionhub.org).

- City of York Council is **retrofitting all the sightseeing buses from diesel to electric**. This will not only provide significant improvements in air quality but also reduce fuel costs by £15k a year. The council have also paid for the retrofit of some passenger service buses, as part of the council's Low Emissions Strategy.

- In the US, California has introduced restrictions on where new schools can be sited in relation to the major sources of air pollution. Since 2003 **California state law prohibits new schools being sited within 500 feet of a highway.** Guidance suggests how the siting of new schools, day care centres, and other public buildings needs to be considered to reduce the exposure of vulnerable young people to high levels of air pollution.

80 http://www.airalert.info/
81 http://www.airtext.info/
82 http://uk-air.defra.gov.uk/forecasting/
83 http://uk-air.defra.gov.uk/air-pollution/daqi

- **Camden Council has installed a series of cycle-friendly measures on a key route in the borough.** Two metre-wide lanes along Royal College Street are separated from the rest of the highway by round rubber blocks or 'light segregation,' making the cycle lane safer for cyclists and reducing air pollution by encouraging more cycling. Light segregation methods are used more extensively in many European cities, such as Barcelona, and are considerably cheaper to install than many of the types of cycle lanes you typically see in the UK.

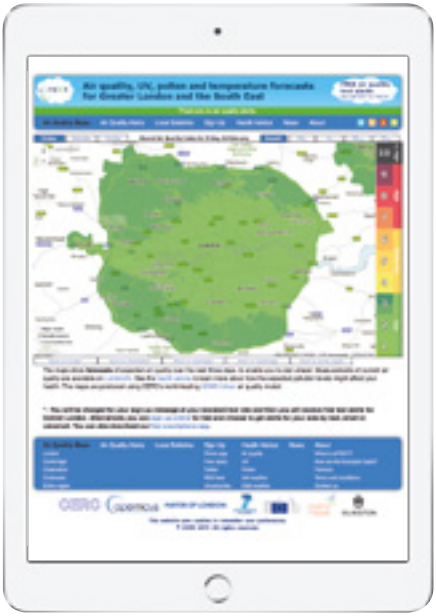
- **In several areas local communities are taking control of the measurement of local air pollution.** The East End Quality of Life Initiative community group works with Sheffield City Council to run local monitoring using low cost diffusion tubes. This has built local understanding of air pollution and engaged local communities in assessing and taking action on local issues. Similar programmes are underway in the City of London, Kings Lynn and elsewhere.

- Many local authorities have undertaken studies to understand the nature and sources of local air pollution and some are undertaking feasibility studies to understand whether the introduction of a Clean Air Zone could make a positive difference to local air quality.

- Local authorities can encourage local businesses to reduce their emissions. A **Zero Emissions Network (ZEN) has been established by local businesses in Shoreditch with the help of Hackney Council.** The network offers advice to businesses who wish to reduce their emissions, free trials of electric vehicles and cargo bikes, consultation on reducing energy demand and on reducing emissions resulting from supply chains.

- Oxford City Council and Oxfordshire County Council have implemented a **Low Emission Zone (LEZ) for buses in Oxford city centre.** An LEZ encourages the uptake of less polluting vehicles by banning highly polluting vehicles from highly polluted areas, usually a city centre. In Oxford this has targeted the highly polluting local buses.

- Wandsworth council reviewed its old **Smoke Control Areas**, merged them into a single borough-wide SCA, and put in place a communication campaign to support enforcement.



Where can I get more information?

This Briefing is part of a resource pack for Public Health teams. The resource comprises an additional briefing for Directors of Public Health – Getting to Grips with Air Pollution as well as three short guides to help Directors of Public Health and their teams to take action.

Briefing:

- Getting to Grips with Air Pollution – A briefing for Directors of Public Health

Guides:

- Understanding air pollution in your area
- Engaging local decision-makers about air pollution
- Communicating with the public during air pollution episodes
- Communicating with the public on the long-term impacts of air pollution

Estimates of the number of deaths in UK local authorities that can be attributed to long-term exposure to particle air pollution have been published by PHE.

- Public Health England – Estimating Local Mortality Burdens associated with Particulate Air Pollution https://www.gov.uk/government/publications/estimating-local-mortality-burdens-associated-with-particulate-air-pollution

Information on the Public Health Outcomes Framework Indicator 3.01 can be found here:

- http://www.phoutcomes.info/
- http://www.phoutcomes.info/public-health-outcomes-framework#gid/1000043/pat/6/ati/102/page/6/par/E12000004/are/E06000015

The Office for National Statistics has published a bulletin on air pollution in the UK over the last three decades

- Air quality statistics in the UK
- Has been published 1987 - 2015 to date
- http://www.gov.uk/government/publications/air-quality-statistics

The Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) has published a series of reviews of the effects of air pollution on health:

- http://www.comeap.org.uk

Defra has produced a series of resources for Local Authorities on air pollution, which are available from its website:

- http://laqm.defra.gov.uk/public-health/roleforlas.html

Air quality forecasts, near real time measurement data, national modelling data as well as general information on air pollution, published research reports and reports on national compliance can be found on Defra's Air Information Resource website - UK Air.

- http://uk-air.defra.gov.uk/
- Additional information on local air pollution campaigns is provided by the Healthy Air Campaign
- http://healthyair.org.uk

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