Teaching toolkit

Air quality and health

Financial support for the sustainability clinical fellowship was provided as an independent medical education grant from Pfizer Limited. Pfizer Limited had no involvement in candidate selection and no influence on the work of the clinical fellowship.

Royal College of Physicians

Instructions and teaching notes for facilitators

This toolkit has been designed to support physicians to deliver introductory teaching for peers and colleagues on air quality, and the links between air pollution and human health. The teaching notes supplied provide background information, discussion points and questions to help deliver an interactive and thought-provoking session even when the facilitator may have limited expertise and knowledge in this area.

It is anticipated that an average session would last 60–90 minutes without a break. This is based on teaching a small group (five to ten participants) in a face-to-face setting. Recommended time spent on each section is given in the teaching notes. A short break may be incorporated depending on the facilitator's preference and time available. Timings can be adapted by the facilitator as required, eg promoting longer periods of discussion, reducing small group discussion time or reviewing the additional resources highlighted in the slides and teaching notes. The teaching may also be delivered across two separate sessions if required. It is recommended that additional time is allowed if the session is delivered online.

References are provided for further reading and the facilitator may choose to review these in advance of the teaching session.

The teaching can be adapted for both small and larger group (eg 20–30 participants) teaching. For smaller groups, the discussion activities may be more appropriately undertaken in pairs, or simply by sharing ideas across the whole group. For larger audiences, 'breakout' groups of four to six may be more appropriate for discussion activities.

The teaching can be delivered either online or in-person, but if online, would require a platform that allows audience interaction and the ability to create 'breakout rooms' to facilitate small group discussions.

Hybrid delivery (online and in person) is possible but not recommended, to ensure smooth running of the session and activities, and permit all participants an opportunity to contribute.

Learning objectives

- Define air pollution and identify the pollutants with the greatest effect on human health.
- List key contributors to air pollution, recognising both indoor and outdoor sources.
- Describe the impact of air pollution on health across the life course.
- Discuss the impact of air pollution across organ systems.
- Discuss the links between air pollution, health inequalities, climate change and economic cost.
- Identify actions that can be taken by physicians.
- Consider barriers and enablers when talking to patients about air quality.

Resources required

For in-person delivery

- At least one facilitator.
- Private teaching space appropriate for size of intended teaching group.
- Slide deck.
- Teaching notes for reference.
- Access to AV system able to display PowerPoint slides.
- Consider access to a whiteboard or flipchart to write down key points / ideas from group feedback (not essential).

For online delivery

- At least one facilitator.
- Facilitator may wish to access two screens to ensure teaching notes and presentation are visible simultaneously.
- Online platform permitting audience participation, sharing of PowerPoint slides, and creation of 'breakout rooms' for small group discussions.
- Consider use of an online 'whiteboard' or notes page to write down key ideas from group feedback (not essential).

Target audience

This teaching toolkit is intended for delivery to physicians across specialties and of any career grade, particularly those with limited understanding of the impacts of air quality on health. The session is also of interest and relevance to a multidisciplinary audience given the impact of air pollution across organ systems and throughout the life course.

Supporting notes

Background information supports delivery of the slide content and is best reviewed ahead of delivering the session. This information is not intended to be read out verbatim but provides additional explanations to support the information provided on the slides. References for each slide are provided in the teaching notes for further reading and preparation.

Guidance on delivery contains suggested discussion points, recommendations on how to deliver the session and possible questions to pose to participants.

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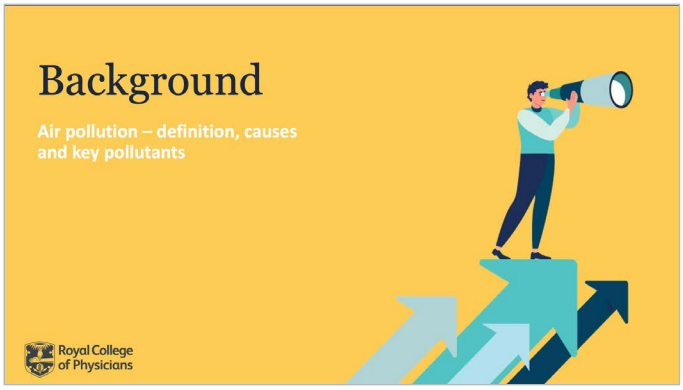
Teaching notes

Introduction and learning objectives

Slides: 1–2 | Estimated time allocation: 1 minute

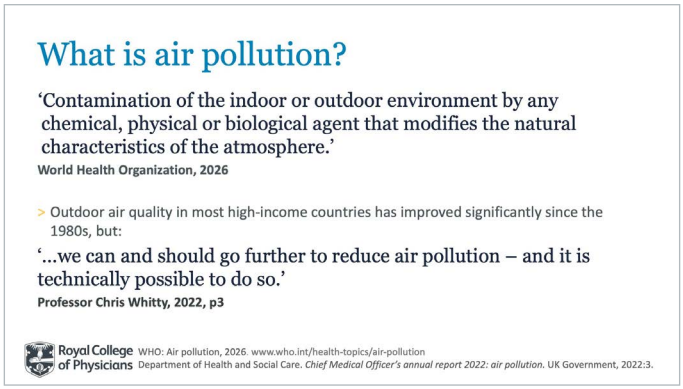
This teaching session is designed to support participants in achieving a greater understanding of the links between air quality and human health. The material is based on a range of references, including the RCP's 2025 report, 'A breath of fresh air: responding to the health challenges of modern air pollution' which sets out recommendations on how to tackle this important issue. The report specifically calls for education for health professionals to ensure that air pollution is considered when approaching the prevention, diagnosis and management of diseases and conditions.

References are given throughout the session to provide guidance and further reading. There are also QR code links to alternative resources including podcasts and case studies.



Background

Slide: 3 | Estimated time allocation: <1 minute



What is air pollution?

Slide: 4 | Estimated time allocation: 1 minute

The World Health Organization (WHO) defines air pollution as 'contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.'

The WHO global air quality guidelines consider 'classical' pollutants as particulates, ozone, nitrogen dioxide, sulphur dioxide and carbon monoxide. There are other substances which contribute to air pollution, but a smaller or insufficient body of evidence exists around the impact on health.

Poor air quality is a global environmental health risk associated with increased morbidity and mortality. Air pollution affects everybody, and yet individuals can have very little, if any, control over their exposure, which can be generated from transport, industrial practices and agriculture, among many other sources.

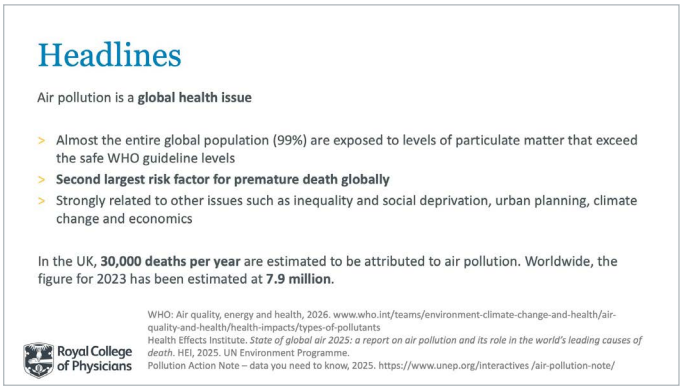
Types of exposures may vary day-to-day, by country, occupation or level of socioeconomic deprivation – deepening health inequalities.

Although progress on air quality has been made over the past few decades, improvements must continue. This was highlighted in the chief medical officer's 2022 Annual Report.

References for this section

- WHO. Air quality, energy and health, 2026. www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants
- WHO. Air pollution, 2026. www.who.int/health-topics/air-pollution

- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/
- Department of Health and Social Care. Chief Medical Officer's annual report 2022: air pollution. UK Government, 2022. www.gov.uk/government/publications/chief-medical-officers-annual-report-2022-air-pollution



Headlines

Slide: 5 | Estimated time allocation: 1 minute

This slide highlights the key 'headlines' in relation to air quality and health. Although the teaching session is predominantly UK-focused, it is vital to acknowledge that air pollution is a global health issue and part of a complex interplay with inequality, social deprivation, climate change, urban planning and economics. Those living in low- or middle-income countries are the most exposed to air pollution and air quality monitoring is often less robust.

Air pollution is implicated in 30,000 deaths per year in the UK and millions worldwide.

It is the second largest risk factor for premature death globally, behind only hypertension, and the greatest environmental risk factor for premature death.

References for this section

- WHO. Air quality, energy and health, 2026. www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/health-impacts/types-of-pollutants
- Health Effects Institute. State of global air 2025: a report on air pollution and its role in the world's leading causes of death. HEI, 2025. www.stateofglobalair.org/resources/report/state-global-air-report-2025
- UN Environment Programme. Pollution Action Note – Data you need to know, 2025. https://www.unep.org/interactives/air-pollution-note/

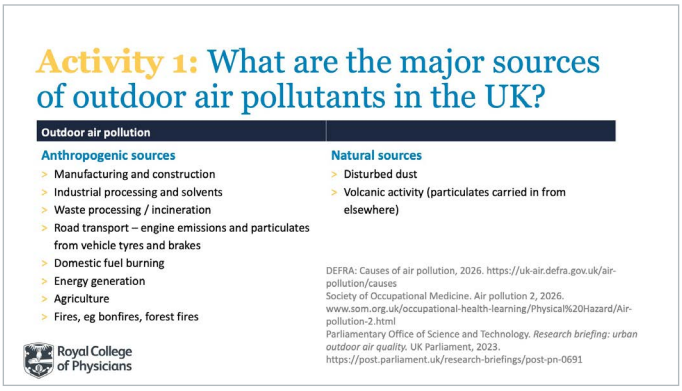
What are the major sources of outdoor air pollutants in the UK? (Activity slide)

Slide: 6 | Estimated time allocation: 5 minutes for discussion

Activity 1: What are the major sources of outdoor air pollutants in the UK?

Guidance on delivery

Depending on the number of participants, consider splitting into smaller groups of 3–5 to discuss this issue. Ensure groups nominate someone to feedback ideas. Collect these before moving on to the next slide.
If teaching in person, you may wish to write down each group's contributions on a flipchart / whiteboard.



What are the major sources of outdoor air pollutants in the UK? (Feedback slide)

Slide: 7 | Estimated time allocation: 5 minutes

Most air pollution is from human-made sources, although natural events also contribute. Road transport is likely to be the major contributor identified by participants. This includes not just emissions at the tailpipe, but also

particles generated from friction on tyres, brake wear, and other non-exhaust emissions.

Combustion of coal and heavy oils by power stations and refineries contributes a range of pollutants. The last coal-fired power station in the UK was closed in 2024, and, in England, the sale of traditional house coal was banned completely from 2023.

Domestic coal and wood burning continues to contribute to air pollution. While pollutant release from engines has declined owing to strict controls on new vehicles, emissions from domestic wood burning have increased as households perceive this is a 'low-cost' or 'carbon-neutral' heat source, as well as seeking a 'cosy' aesthetic.

Industries such as metal manufacture, cement production, textile dyeing and finishing, and chemical production release a range of pollutants into the atmosphere, including gases and particulates. Natural events can also contribute to air pollution, including dust and sandstorms, volcanic eruptions and wildfires.

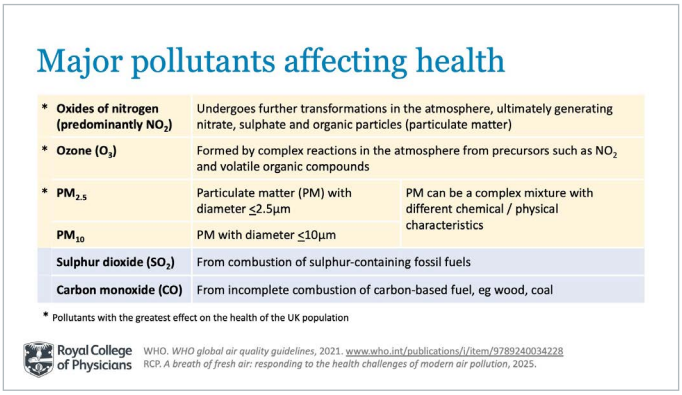
Guidance on delivery

Topical events linked to these headings may emerge during feedback. It may be necessary to limit the discussion depending on time constraints. However, encourage participants to continue their discussion and further reading after the session.

The case of Ella Adoo-Kissi-Debrah is discussed further on slide 11.

References for this section

- DEFRA. Causes of air pollution, 2026. https://uk-air.defra.gov.uk/air-pollution/causes
- Society of Occupational Medicine. Air pollution 2, 2026. www.som.org.uk/occupational-health-learning/Physical%20Hazard/Air-pollution-2.html
- Parliamentary Office of Science and Technology. Research briefing: urban outdoor air quality. UK Parliament, 2023. https://post.parliament.uk/research-briefings/post-pn-0691



Major pollutants affecting health

Slide: 8 | Estimated time allocation: 3 minutes

Air pollution is not a new problem. However, changes in lifestyle, transport, manufacture and other activities have changed the type of pollutants we are exposed to over time.

For example, in the UK in the 1940–50s, people would have been exposed to soot and sulphur dioxide from burning coal. In the following decades, emissions from leaded petrol were prevalent. Now, people may breathe nitrogen dioxide or particulate molecules from diesel engines, although exposure types can vary across the UK. In urban areas, traffic-related pollution is more likely, while in rural regions, air pollution may be linked to activities such as agriculture, burning of solid fuels, or forest and heathland fires.

Primary pollutants are released directly to the atmosphere from a given source. Secondary pollutants form from a series of physical and/or chemical reactions in the atmosphere.

Pollutants with the strongest evidence for their adverse effects on human health include particulate matter, ozone, oxides of nitrogen, sulphur dioxide and carbon monoxide.

The WHO Air quality guidelines provide recommendations for long- and short-term concentrations for different key air pollutants. The guidelines highlight that the key air pollutants (mentioned above) form the basis of the recommendations because of their worldwide importance and threat to human health, but this should not imply that other air pollutants are irrelevant.

Oxides of nitrogen (predominantly nitrogen dioxide, NO_2)

Oxides of nitrogen result from combustion in air. The main sources are vehicle engines.

Nitrogen dioxide has direct health effects but its ability to absorb visible solar radiation and impair atmospheric visibility, as well as potentially contributing to climate change, is also important. Oxides of nitrogen contribute to the formation (through photochemical reactions) of secondary pollutants, such as ozone and particulate matter.

Ozone

Ozone is a secondary pollutant; it is formed from primary pollutants, such as nitrogen dioxide and volatile organic compounds, through a series of complex reactions in the atmosphere. Formation can take place over a prolonged period and may arise from distant emissions.

Particulate matter (PM)

PM is a complex mix which can include carbon, ammonium compounds, metal oxides and salts, and organic materials. Its components can have diverse chemical and physical characteristics. This heterogeneity complicates research and interpretation of data on the health impacts.

PM is classified by diameter rather than constitution; the size that determines particles' ability to enter, be deposited in or cleared from the respiratory tract.

- PM2.5 fine particles, <2.5µm diameter. Ultrafine particles are <0.1µm diameter.
- PM10 coarse particles between 2.5 and 10µm diameter.

Some PM may be secondary, formed by reactions within the atmosphere. Others are derived from natural sources, such as sea spray and desert sand.

Sulphur dioxide (SO_2)

SO2 is generated through combustion of sulphur-containing fuels, such as coal and oil.

In the UK, emissions have fallen dramatically with the closure of coal-fired power stations and tighter controls on the sulphur content of liquid fuels. However, sulphur dioxide remains a major air pollution component in many parts of the world.

Carbon monoxide (CO)

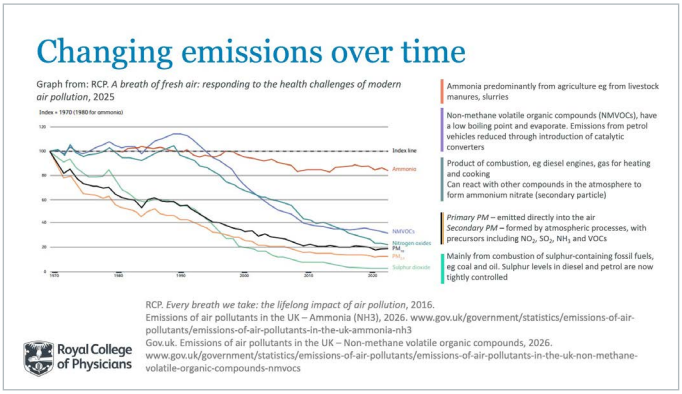
CO results from incomplete combustion of carbon-containing fuels such as wood, petrol, coal and natural gas.

Guidance on delivery

The aim of this section is to provide a broad understanding of the key air pollutants, rather than complex exploration of biological and chemical processes. Direct participants towards reputable sources of information, such as guidance and reports from the WHO and the RCP, should they wish to undertake further reading about air quality recommendations, legislation and policies, and changing patterns of air pollution.

References section

- WHO. WHO global air quality guidelines, 2021. www.who.int/publications/i/item/9789240034228
- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/



Changing emissions over time

Slide: 9 | Estimated time allocation: 2 minutes

Progress has undoubtedly been made on reducing emissions in the UK. The graph demonstrates how all pollutants other than ammonia have shown a steady decline since the 1970s.

The index line shows the level of annual emissions, had they remained constant at 1970s levels. The y-axis represents percentage of 1970s emission levels. Further details about particulate matter, sulphur dioxide and oxides of nitrogen are in the previous slide's teaching notes.

Non-methane volatile organic compounds (NMVOCs)

NMVOCs are a broad group of organic compounds, emitted from a range of sources, including petrol vapour, solvents, cleaning products and combustion.

NMVOCs can react with other air pollutants in the presence of UV light to produce ground-level ozone, which can have adverse effects on health. Indoors, reactions between compounds and other chemicals can produce dangerous compounds, such as formaldehyde.

Ammonia

Emissions of ammonia have demonstrated a much slower decline than other pollutants. In the UK, ammonia emissions come largely from agricultural sources; breakdown of livestock manure and urine, and spreading of inorganic fertilisers. In 2024, agriculture was responsible for 89 % of total ammonia emissions.

Ammonia contributes to the formation of secondary particulates, reacting in the atmosphere with other compounds, such as sulphur dioxide and oxides of nitrogen to create ammonium sulphate and ammonium nitrate.

Guidance on delivery

Key information about each pollutant is given, including any changes to legislation which supported the reduction in emissions. A detailed discussion of each pollutant's characteristics of each pollutant is outside the scope of the session; additional information is provided in the teaching notes if required.

Although the overall trends appear reassuring, emphasise the need for ongoing action. Slide 10 highlights that air pollution continues to have a significant and concerning impact on health, despite the progress made.

References for section

- RCP. Every breath we take: the lifelong impact of air pollution, 2016. https://www.rcp.ac.uk/resources/every-breath-we-take-the-lifelong-impact-of-air-pollution/
- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/
- Gov.uk. Emissions of air pollutants in the UK – Ammonia (NH3), 2026. www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-ammonia-nh3
- Gov.uk. Emissions of air pollutants in the UK – Non-methane volatile organic compounds (NMVOCs), 2026. www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-non-methane-volatile-organic-compounds-nmvocs

But...

Slide: 10 | Estimated time allocation: 1 minute

Despite significant improvements made in reducing air pollution over the past few decades, 790,000 excess deaths in Europe each year are attributed to ambient air pollution. Many of these are the result of non-respiratory illnesses.

Based on increasing epidemiological and toxicological evidence, in 2021 WHO substantially adjusted its health-related air quality guideline limits for fine particulates and nitrogen dioxide. Consequently, it is recognised that up to 99 % of the global population are exposed to potentially toxic levels of air pollution.

Studies of several million participants indicate that exposure to low-mean air pollutant concentrations can affect health, even at levels below the WHO guidelines.

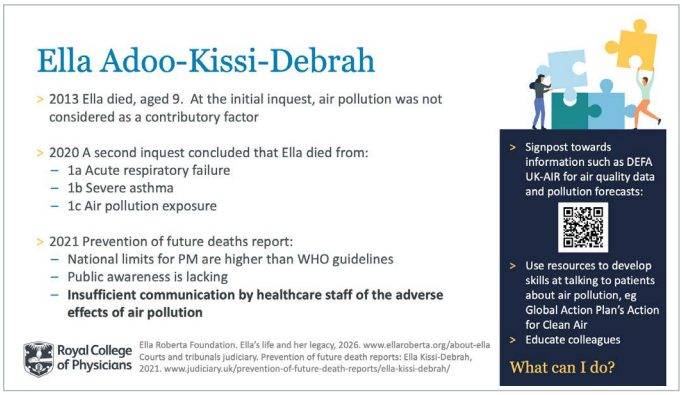
The 2025 RCP report, 'A breath of fresh air', concludes that there are no safe levels of air pollutants and that the more we can do to improve air quality, the better.

Guidance on delivery

The health impacts of air pollution across organ systems and across the life course will be discussed in further detail later in the session.

References for section

- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/
- Lelieveld J, Klingmüller K, Pozzer A et al. Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions. *Eur Heart J* 2019;40:1590-6. https://pmc.ncbi.nlm.nih.gov/articles/PMC6528157/



Ella Adoo-Kissi-Debrah

Slide: 11 | Estimated time allocation: 3 minutes

The story of Ella Adoo-Kissi-Debrah highlights why it is so vitally important that healthcare professionals are aware of the harms of air pollution.

Ella developed asthma aged 7 and died in February 2013, aged 9. She had had multiple hospital admissions with asthma exacerbations. On her last admission, she had a cardiac arrest and could not be resuscitated.

Ella's mother, Rosamund, was not told by any healthcare professionals during her many hospital admissions that Ella's condition may be worsened by air pollution. At the initial inquest into her death, the possibility that air pollution may have contributed was not considered. A second inquest in 2020 concluded that Ella died from acute respiratory failure, secondary to asthma exacerbation caused by air pollution exposure.

Subsequently, the coroner issued a 'Prevention of future deaths' report in April 2021, highlighting several concerns. The first was that UK national limits for particulate matter (PM) are far higher than WHO air quality recommendations. The report stated that evidence at the inquest showed that there are no 'safe' PM levels and that adherence to the WHO guidelines should be the minimum requirement. Legally binding targets, based on WHO guidelines, were identified as a way to reduce the number of air pollution-related deaths in the UK.

Secondly, the report emphasised low public awareness of sources of information about air pollution levels, both local and national. It proposed that greater awareness would help individuals reduce their personal exposure, and that local and national government should address publicising the data. The report recognised the need for greater air quality monitoring capacity.

Thirdly, insufficient communication by medical and nursing staff to patients and carers about the adverse health effects of air pollution should be addressed.

The report identified action would be required at undergraduate and postgraduate level, as well as within professional guidance.

Healthcare professionals can support patients by signposting to resources such as DEFRA's UK Air Information Resource which offers an air pollution forecast as well as current air quality data for UK regions. The site is accessible via the QR code on the slide.

Guidance on delivery

Participants may be aware of Ella's story and this slide may generate discussion about the events and media coverage. Participants may wish to share their own experiences of speaking to patients about air pollution (if any). There will be further opportunity to explore this later in the session.

Highlight the QR code on the slide, which links to useful resources on current air quality data and pollution forecasts.

References for section

- Ella Roberta Foundation. Ella's life and her legacy, 2026. www.ellaroberta.org/about-ella
- Courts and tribunals judiciary. Prevention of future death reports: Ella Kissi-Debrah, 2021. www.judiciary.uk/prevention-of-future-death-reports/ella-kissi-debrah/
- DEFRA. UK air information resource, 2026. https://uk-air.defra.gov.uk/
- Global Action Plan. Talking to patients about clean air [video]. Global Action Plan, 2022. www.actionforcleanair.org.uk/evidence-resources/talking-to-patients-about-clean-air

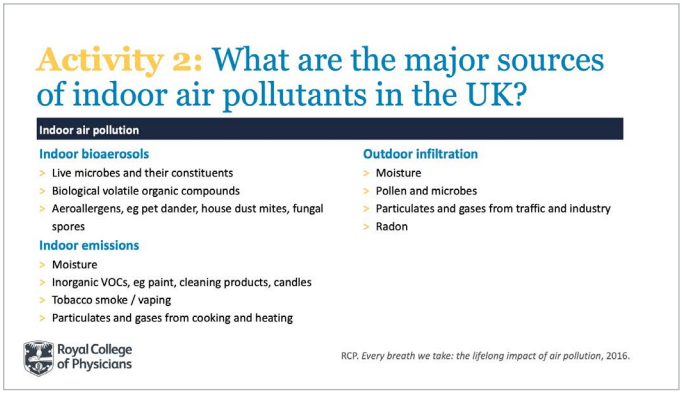
What are the major sources of indoor air pollutants in the UK? (Activity slide)

Slide: 12 | Estimated time allocation: 5 minutes for discussion

Activity 2: What are the major sources of indoor air pollutants in the UK?

Guidance on delivery

Depending on the number of participants, consider splitting into smaller groups of 3–5 to discuss this issue. Ensure groups nominate someone to feedback ideas. Collect these before moving on to the next slide.
If teaching in person, you may wish to write down each group's contributions on a flipchart / whiteboard.



What are the major sources of indoor air pollutants in the UK? (Feedback slide)

Slide: 13 | Estimated time allocation: 5 minutes

Some indoor air pollution will result from infiltration of pollutants from outdoors, including from traffic and industry. The amount of infiltration from outdoor sources will depend on ventilation levels and how airtight the building is.

Activities carried out indoors, such as cooking and heating, will generate air pollutants directly into the indoor environment.

Radon is a radioactive gas, formed through the radioactive decay of small amounts of uranium, naturally present in rock and soil. High exposure to radon can increase the risk of developing lung cancer. Although every building has some radon, levels are low in most areas. In areas where levels are higher, remedial building works can reduce levels. UK Radon, part of the UK Health Security Agency, provides information and guidance for householders, professionals and employers.

Building materials and furnishings can be major sources of volatile organic compounds (VOCs), eg from foams or flame retardants used in their manufacture. VOCs are also generated through use of paint, cleaning products, air fresheners, polish and personal care products, among other products.

References for section

- RCP. Every breath we take: the lifelong impact of air pollution, 2016. https://www.rcp.ac.uk/resources/every-breath-we-take-the-lifelong-impact-of-air-pollution/
- UK Health Security Agency. Radon: Information on radon and reports from the Centre for Radiation, Chemical and Environmental Hazards (CRCE), 2022. www.gov.uk/government/collections/radon
- UK Health Security Agency. UK radon, 2026. www.ukradon.org

Indoor air pollution

Slide: 14 | Estimated time allocation: 1 minute for slide contents | 3 minutes for activity

Most people spend the majority of their time indoors (estimates have been placed at 80–90%).

Indoor air pollution has been researched less extensively than outdoor. There may be considerable variation between individual indoor air pollution exposures depending on behaviours, lifestyle choices and infrastructure. An individual may be exposed to multiple pollutants in one location, so identifying those with the greatest health effects is made more challenging.

Different indoor environments will vary in the type of exposures generated (home, school, hospital, office building etc).

While there is widespread monitoring of outdoor air quality, there are limited standards guiding the recommended quality of indoor air. Any legislation largely applies to new buildings. Recent studies have indicated that indoor air quality can be worse than outdoor.

Outdoor air pollution contributes to indoor air quality. Pollutants generated indoors, for example from wood burning or cooking, also accumulate in buildings, with the resultant pollutants taking longer to disperse.

Whilst NICE provides guidance on indoor air pollution including for the general public, professional responsibility lies with those planning, designing, renovating and maintaining homes. Therefore, privately owned housing may not be subject to the same standards; it relies on individuals having knowledge and understanding of air pollution impacts and ways to mitigate this.

Further research and data are required to understand the long-term health impacts of indoor air pollution.

Activity 3: In small groups or pairs, ask participants to discuss ways in which individuals could reduce their exposure to indoor air pollutants.

Guidance on delivery

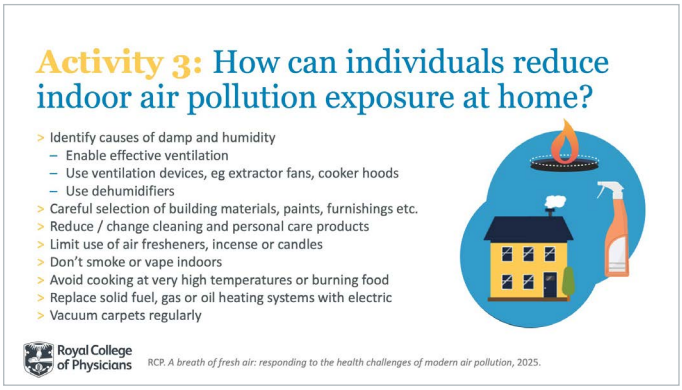
When discussing how individuals could reduce exposure to indoor air pollution (activity 3), consider referring back to slide 13 as a reminder of key sources of indoor air pollution.

Depending on the number of participants, consider splitting into smaller groups of 3–5 to discuss this issue.

Suggested ways of reducing exposure are summarised on slide 15.

References for this section

- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/
- NICE. Indoor air quality at home, 2020. www.nice.org.uk/guidance/ng149
- Global Action Plan. Revealed - Indoor air pollution 3.5 times worse than outdoor air pollution. Global Action Plan, 2019. www.globalactionplan.org.uk/insights/news/revealed-indoor-air-pollution-3-5-times-worse-than-outdoor-air-pollution



How can individuals reduce indoor air pollution exposure at home? (Feedback slide)

Slides: 15 | Estimated time allocation: 2 minutes

This slide summarises some ways in which individuals can reduce their indoor air pollution exposure at home.

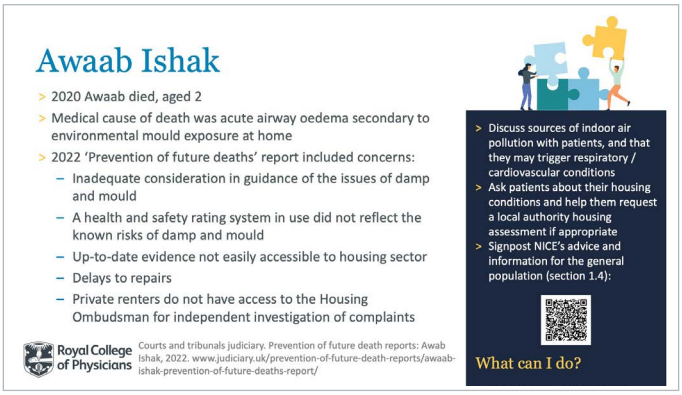
Guidance on delivery

This may generate discussion around the inherent challenges in making these changes – particularly for people living in rented accommodation, people with pre-existing health problems, or those who do not have financial means to make significant changes to their property or buy new / updated equipment.

It is vitally important to recognise the link between air quality and health inequalities. This will be discussed further later in the session.

References for this section

- RCP. A breath of fresh air: responding to the health challenges of modern air pollution, 2025. https://www.rcp.ac.uk/policy-and-campaigns/policy-documents/a-breath-of-fresh-air-responding-to-the-health-challenges-of-modern-air-pollution/



Awaab Ishak

Slide: 16 | Estimated time allocation: 3 minutes

Awaab Ishak died aged 2, in 2020. His death resulted from prolonged exposure to spore-forming moulds in his home. Awaab's flat was owned by a housing association, who were notified of the presence of mould in 2017. Awaab's father was advised to paint over the mould but not about using specialist paint. No action to treat or prevent the mould was taken.

Mould remained an issue in the home. Awaab was born in 2018. In 2019, the family made an application for rehousing. A health visitor contacted the housing association in 2020, outlining concerns about the mould's impact on Awaab's health. Also in 2020,

Awaab's family instructed solicitors to make a claim regarding the disrepair. The property was inspected by the housing association who confirmed the presence of mould. However, their policy was not to repair and treat until this had been agreed with solicitors. When Awaab died, no action had been taken and mould was present in all rooms in the flat.

In a broader review of complaints to the Housing Ombudsman, key themes emerged, including an over-emphasis by professionals on the cause of mould being inhabitants' lifestyle; whereas mould was often related to normal – not excessive – activities, such as cooking, washing and drying clothes. In addition, the review identified a failure to act proactively in considering wider sources of damp, such as structural issues and ventilation.

Individual healthcare professionals and teams can ensure that sources of indoor air pollution and their impact are discussed with patients; eg that pollutants can trigger or exacerbate asthma, or other respiratory and cardiovascular conditions.

If patients do present with frequent exacerbations or worsening respiratory symptoms, ask about their housing conditions and support the patient to request a local authority housing assessment, if appropriate.

NICE guidance on indoor air pollution includes advice and information for the general population. Healthcare professionals can signpost to this information or create written resources for their own organisation.

Guidance on delivery

Participants may be aware of Awaab's story, and this slide may generate discussion about the events and media coverage. Participants may wish to share their own experiences of speaking to patients about air pollution (if any). There will be further opportunity to explore this later in the session.

Highlight the QR code on the slide, which links to useful resources that may be signposted or adapted for patients and the public.

References for this section

- Courts and tribunals judiciary. Prevention of future death reports: Awaab Ishak, 2022. www.judiciary.uk/prevention-of-future-death-reports/awaab-ishak-prevention-of-future-deaths-report/
- NICE. Indoor air quality at home, 2020. www.nice.org.uk/guidance/ng149

Air pollution and the NHS

Slide: 17 | Estimated time allocation: 1 minute

The NHS has a large workforce and estate, which all contribute to air pollution. The NHS fleet is the second largest in the country (after Royal Mail), consisting of more than 20,000 vehicles, travelling over 460 million miles annually. This, along with the impacts of staff travel and commissioned services, contributes to deaths from air pollution.

Therefore, the health service contributes to ill health for the patients that it serves. As a large and influential organisation, the NHS can make meaningful and impactful changes; reducing air pollution and improving the health of the population. There are also significant potential cost savings, which can be reinvested in patient care.

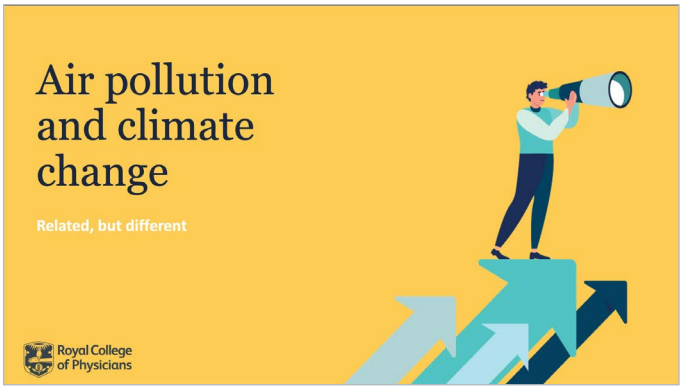
The NHS England Net Zero travel and transport strategy outlines ambitious targets to decarbonise the NHS fleet (including ambulances) by 2040. This not only impacts air pollution, but also climate change.

Local action that could be taken by healthcare professionals includes using telephone follow up where clinically appropriate, or coordinating appointments to reduce journey frequencies. Individual healthcare workers can choose to carpool with colleagues, as well as selecting clean or active transport options. The latter is also beneficial for physical and mental health.

Engine idling (leaving a vehicle's engine running while the vehicle is stationary) increases the amount of exhaust emissions. An idling engine burns fuel less efficiently and can produce more emissions than a moving vehicle. Local initiatives to raise awareness of this within car parks or drop-off points of institutions can encourage staff, patients, visitors and other vehicles to turn off engines when stationary.

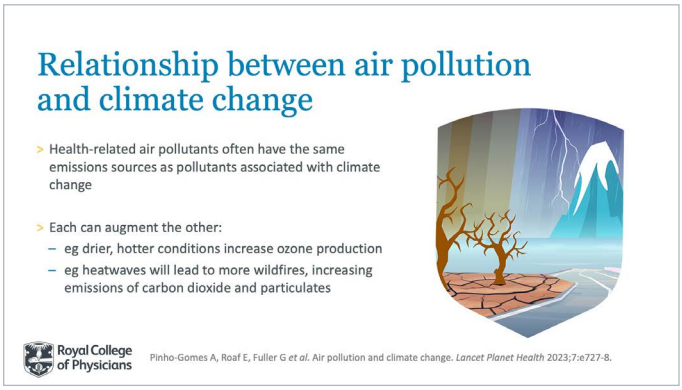
References for this section

- Transformation Partners in Health and Care. Toolkit for NHS trusts: supporting the NHS to reduce its impact on air pollution. Transformation Partners in Health and Care, 2020. www.transformationpartners.nhs.uk/resource/toolkit-nhs-trusts-supporting-nhs-reduce-impact-air-pollution
- Net zero travel and transport strategy, 2023. www.england.nhs.uk/long-read/net-zero-travel-and-transport-strategy



Air pollution and climate change: Related, but different (Cover slide)

Slide: 18



Relationship between air pollution and climate change

Slide: 19 | Estimated time allocation: 1 minute

Many air pollutants that affect health arise from the same sources as pollutants associated with climate change. Therefore, there can be co-benefits of climate action on air pollution.

Each phenomenon can augment the other. For example, with climate change there will be longer periods of drier and hotter conditions which increase ozone production. Heatwaves can lead to wildfires, which increase emissions of carbon dioxide and particulates, adding both to air pollution and the greenhouse effect.

Guidance on delivery

There are extensive resources concerning climate change and healthcare. A full discussion of the complex links between air pollution and climate change is outside of the scope of the session.

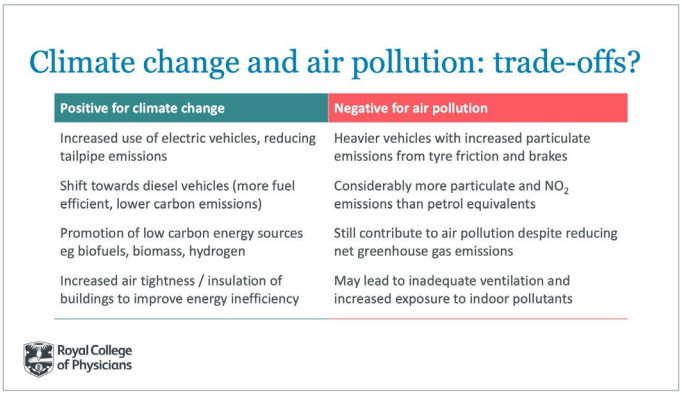
If participants are interested in the broader impacts of climate change on health, the RCP has published the 'Green Physician Toolkit' and an 'Introduction to healthcare sustainability teaching toolkit' to provide information and recommendations, tailored to physicians.

References for this section

- Pinho-Gomes A, Roaf E, Fuller G et al. Air pollution and climate change. *Lancet Planet Health* 2023;7:e727-8.

Further resources on healthcare sustainability and climate change

- RCP. Green physician toolkit, 2025. https://www.rcp.ac.uk/policy-and-campaigns/our-policy-priorities/climate-and-sustainability/green-physician-toolkit/
- RCP. Teaching toolkit: an introduction to healthcare sustainability, 2026. https://www.rcp.ac.uk/resources/teaching-toolkit-an-introduction-to-healthcare-sustainability/



Climate change and air pollution: trade-offs?

Slide: 20 | Estimated time allocation: 1 minute

The co-benefits of climate action on air pollution are not universal, and this table highlights the potential 'downsides' for some activities intended to mitigate climate change.

There remains uncertainty about the future impacts of net zero interventions. Ongoing monitoring, data collection and research is required to assess the effects on air quality.

Guidance on delivery

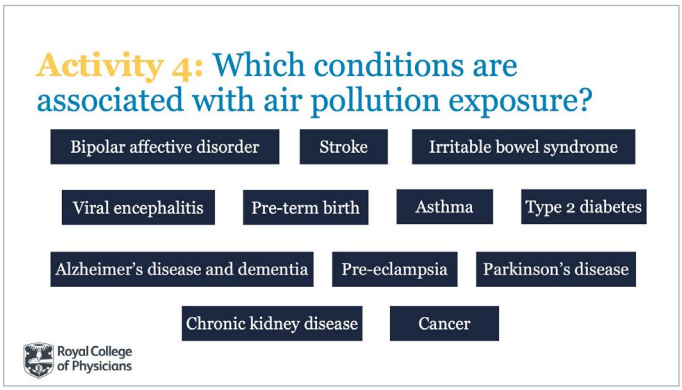
These will not be discussed in depth during the session but serve to highlight that the broad range of consequences of any action must be considered and monitored.

References for this section

- Pinho-Gomes A, Roaf E, Fuller G et al. Air pollution and climate change. *Lancet Planet Health* 2023;7:e727-8.
- Williams M. Tackling climate change: what is the impact on air pollution? *Carbon Management* 2012;3:511-9.

Air quality and health: The impact of air pollution across the life course and across organ systems (Cover slide)

Slide: 21



Which conditions are associated with air pollution exposure? (Activity Slide)

Slide: 22 | Estimated time allocation: 3 minutes

Activity 4: Which conditions are associated with air pollution exposure?

Ask participants to consider which of the conditions or outcomes listed on the slide have been associated with air pollution exposure.

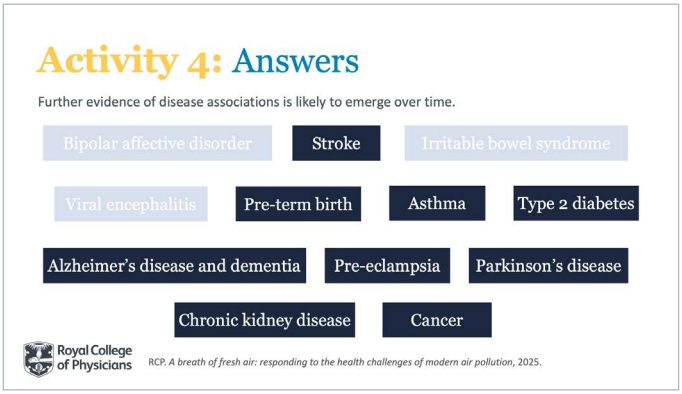
Guidance on delivery

This activity is intended to highlight the multi-organ impacts of air pollution exposure.

Depending on the number of participants, consider splitting into smaller groups of 3–5 to discuss the activity.

To save time, this activity may also be run as a vote, asking participants to raise their hands as to whether they think each condition has been associated with air pollution exposure.

Answers are provided on the next slide.



Activity 4: Answers

Slide: 23 | Estimated time allocation: 1 minute

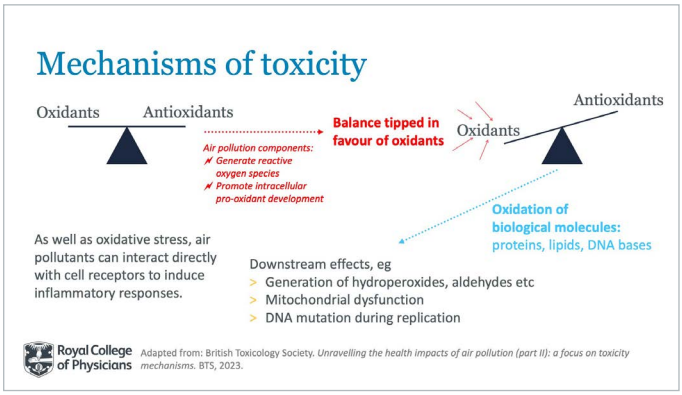
Associated with air pollution exposure:

- Stroke: air pollution is estimated to account for approximately 3,100 premature deaths from stroke in the UK
- Pre-term birth: it has been estimated that around 5.8 million pre-term births globally have been attributed to PM2.5 exposure
- Pre-eclampsia
- Asthma
- Alzheimer's disease and dementia
- Type 2 diabetes
- Chronic kidney disease
- Cancer: chronic air pollution exposure has been associated with a range of different cancers; including of the lung, liver, stomach, bowel, bladder, breast, prostate, kidney, and haematological malignancies like leukaemia
- Parkinson's disease

Not currently associated:

- Irritable bowel syndrome (rather, inflammatory bowel disease has been associated)
- Viral encephalitis
- Bipolar affective disorder

Numerous studies have provided evidence for the effects of air pollution on almost all organs of the body. It is likely that there will be continued improvements in understanding the mechanisms by which this occurs.



Mechanisms of toxicity

Slide: 24 | Estimated time allocation: 2 minutes

The mechanisms by which air pollutants lead to the development of disease are complex, and our understanding is likely to continue to develop.

The predominant mechanism is oxidative stress. This is an imbalance between oxidants and antioxidants, which overwhelms usual cellular defences. Components of air pollution can lead to the generation of reactive oxygen species, or indirectly promote intracellular pro-oxidant development, tipping the balance in favour of oxidants.

Oxidation of biological molecules such as proteins, lipids and DNA bases leads to the creation of secondary damaging products, mitochondrial dysfunction, DNA mutation and oncogenic processes.

Air pollutants can also interact with cell receptors and induce downstream immune responses, eg cytokine release, leading to inflammation.

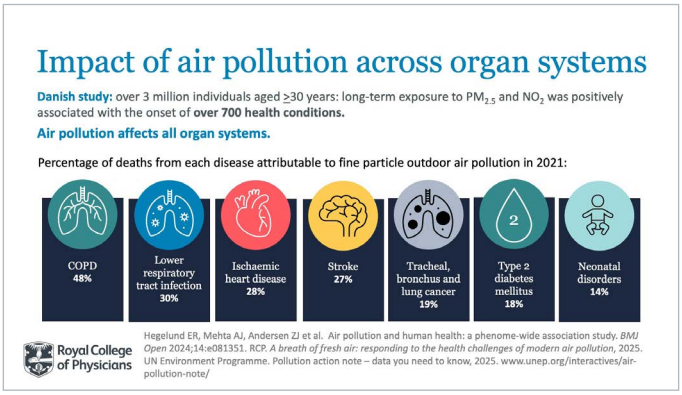
Guidance on delivery

This is a basic summary of mechanisms by which air pollution leads to disease.

A detailed discussion of chemical and biological processes is beyond the scope of the session. Participants can be encouraged to explore existing literature and research if they wish to find out more.

References for this section

- British Toxicology Society. Unravelling the health impacts of air pollution (part II): a focus on toxicity mechanisms, 2023. https://www.thebts.org/publicstatements/unravelling-the-health-impacts-of-air-pollution-part-ii-a-focus-on-toxicity-mechanisms/



Impact of air pollution across organ systems

Slide: 25 | Estimated time allocation: 2 minutes

Published estimates place the mortality burden of air pollution in the UK between 29,000 and 43,000 deaths per year.

Exposure to air pollution has impacts on health far beyond the respiratory system. Wide systemic effects are now recognised, with air pollution having the potential to affect almost all organ systems and tissues.

A Danish study, published in 2024, followed up 3,111,988 individuals, aged 30 or over on 1 January 2000, who had lived in Denmark for at least 1 year. Residential addresses were geocoded and individuals linked to the air pollution level in their specific residential location. Health outcomes were gathered, using data from national registers (patient register and cause of death register). Individuals were followed from 1 January 2000 to the date of first occurrence of an outcome, emigration or death from other causes, or 31 December 2017. Only health conditions considered 'non-rare' were included as outcomes of interest.

Long-term exposure to fine particle outdoor air pollution (PM2.5) was associated with 745 health conditions, of which 340 were statistically significant. Long-term exposure to nitrogen dioxide was positively associated with 813 health conditions, of which 589 were statistically significant.

The United Nations Environment Programme has highlighted key data in relation to global impact of air pollution on health. In 2021, PM2.5 was attributed to

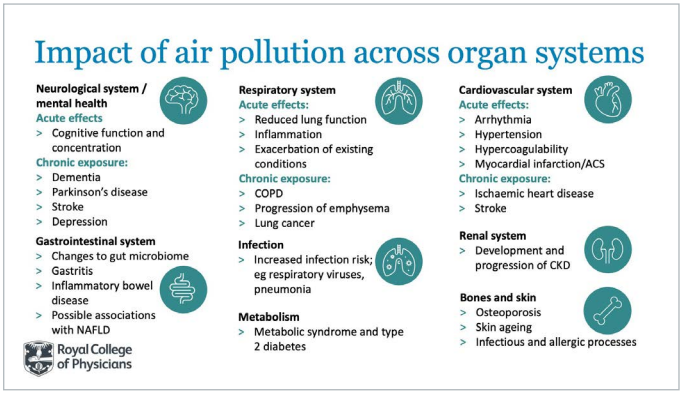
48% of deaths from chronic obstructive pulmonary disease, 30% from lower respiratory tract infections, 28% from ischaemic heart disease, 27% from stroke, 19% from cancers of the respiratory system, 18% from type 2 diabetes and 14% of deaths from neonatal disorders.

Guidance on delivery

This slide emphasises the importance of understanding the impact of air pollution for all healthcare professionals, regardless of specialty. Evidence demonstrates the adverse impact of air pollution across organ systems, not just respiratory.

References for this section

- Hegelund ER, Mehta AJ, Andersen ZJ et al. Air pollution and human health: a phenome-wide association study. *BMJ Open 2024*;14:e081351.
- UN Environment Programme. Pollution Action Note – data you need to know, 2025. www.unep.org/interactives/air-pollution-note/



Impact of air pollution across organ systems

Slide: 26 | Estimated time allocation: 3 minutes

Short-term changes in air pollution levels can have immediate effects on health, such as exacerbations of existing respiratory diseases. Short-term exposure to air pollution (particularly PM2.5) has other effects on performance; eg slower times for marathon runners, a significant increase in erroneous moves taken by chess players and incorrect calls by sporting umpires. Short-term exposure can have effects on individuals who may not otherwise be considered vulnerable to air pollution.

Long-term exposure to air pollution is associated with the development of chronic health conditions including cardiovascular disease, chronic obstructive pulmonary disease and the development of cancers.

Respiratory system

- Acute exposures can cause reductions in lung function, inflammation and exacerbation of existing conditions such as asthma.
- When air pollution exposure is chronic, this is associated with development of lung cancer, chronic obstructive pulmonary disease and worsening of emphysema.

Cardiovascular system

- Air pollution, predominantly PM2.5, can have a wide range of effects on the cardiovascular system including stroke, myocardial infarction and ischaemic heart disease.
- Gases such as nitrogen dioxide, sulphur dioxide, ozone and carbon monoxide can also have adverse effects on cardiovascular health, particularly with long-term exposure.
- WHO data from 2019 estimate that PM2.5 is responsible for 1.9 million deaths from ischaemic heart disease and 900,000 deaths from stroke annually.
- Air pollutants may exacerbate atherosclerosis, as well as increasing thrombogenicity of blood, leading to occlusive clots.

Metabolic disorders

- Air pollution has been linked to metabolic syndrome and type 2 diabetes mellitus.
- Diabetes increases the risk of developing other conditions such as cardiovascular and renal disease, which are exacerbated by air pollution

Renal system

- Long-term exposure to air pollution is linked to the development and progression of chronic kidney disease.
- Further research is required to establish the full effects of air pollution on renal function.

Gastrointestinal / hepatic system

- Air pollution can alter the gut microbiome and is linked to ulcers, gastritis and inflammatory bowel disease.
- There is emerging evidence that air pollution can cause hepatic inflammation and suggested associations with non-alcoholic fatty liver disease.

Neurological system / mental health

- The impact of air pollution exposure on mental health is poorly understood and under-researched. There is a complex relationship between environmental, social, interpersonal and biological factors.
- There are studies showing associations between PM2.5 exposure and depression, and observational evidence implicating air pollutants in a range of other mental health problems; eg anxiety, personality disorder and schizophrenia. There is far less high-quality research in these areas.
- Research undertaken in indoor environments suggests that air pollution may impact on concentration and cognitive function.

Bones and skin

- Air pollution has been linked to osteoporosis.
- Skin ageing is associated with air pollution exposure, as are allergic processes such as urticaria and skin infections.

Guidance on delivery

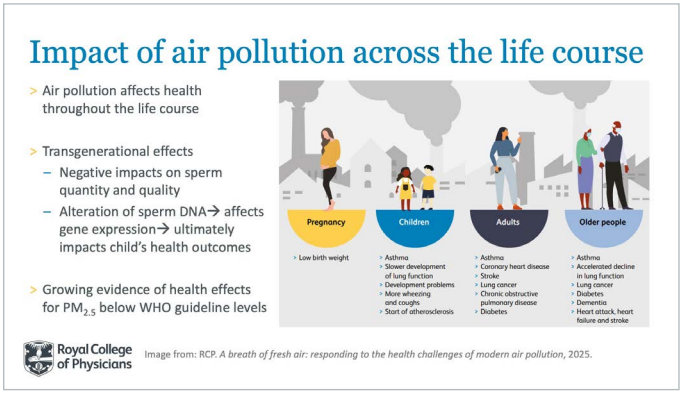
This diagram provides an overview of health conditions associated with air pollution. It does not provide comprehensive details of research. Further links are likely to emerge over time.

It may not be necessary to talk through the slide, but give the participants time to read the information.

Participants can be directed towards the RCP's 2025 report, 'A breath of fresh air: responding to the health challenges of modern air pollution', which offers a more detailed discussion and signposts the underpinning evidence.

References for this section

- RCP. A breath of fresh air: responding to the health challenges of modern air pollution. RCP, 2025.



Impact of air pollution across the life course

Slide: 27 | Estimated time allocation: 2 minutes

Air pollution has effects throughout the life course.

Damage may begin before conception and through pregnancy. Exposure in childhood can lead to ill health later in life. Exposure to fine particles is linked to infertility, although the mechanisms by which this occurs are unknown.

Transgenerational effects can result from the negative impacts on sperm quality and quantity and alteration of sperm DNA by exposure to air pollutants; subsequent changes in gene expression in the placenta and umbilical cord blood which may affect future neurodevelopment and impact health outcomes for the unborn baby.

The information below includes some examples of how air pollution exposure has been shown to affect health across the life course.

Adverse effects of air pollution in pregnancy

- Pre-term birth and low birth weight.
- Global data from 204 countries attributed 16% of low-birth-weight babies and 36% of all pre-term babies to PM2.5 annually.
- Emerging evidence of association between pollutant exposure and other adverse pregnancy outcomes, such as risk of missed abortion, incomplete miscarriage and pre-eclampsia.

Adverse effects of air pollution on fetal development

- Maternal environmental exposures affect fetal development and the function of multiple tissues and organs; brain development, immune function (increased risk of developing allergic rhinitis and asthma) and cardiometabolic health.
- Fetal exposures can ultimately lead to disease in childhood or adulthood.

Adverse effects of air pollution through childhood

Organs and tissues undergo rapid growth and development in childhood. They are therefore highly sensitive to external environmental factors, including air pollution.

- **Respiratory health:** Direct inhalation of pollutants causes inflammation and oxidative stress. There is increased risk of developing asthma and wheezing in childhood, then COPD and lung fibrosis in later life. Lung function development can be suppressed by exposure to outdoor air pollution.

- **Immune system impacts:** Possible disruption of normal immune system development, increasing the incidence of upper respiratory tract infections – as well as alteration in T-cell pathways which increases the risk of allergies, such as atopic dermatitis, eczema and asthma
- **Brain development:** The brain is rapidly developing throughout childhood, and therefore vulnerable to environmental impacts. Exposure to air pollution can lead to oxidative stress and neuroinflammation. Damage to developing neurones can increase the risk of neurodegenerative disease later in life. Studies have shown possible links between air pollution exposure and autism spectrum disorder, attention deficit hyperactivity disorder and other behavioural disorders.

Adverse effects of air pollution on adults have been discussed in more detail on previous slides.

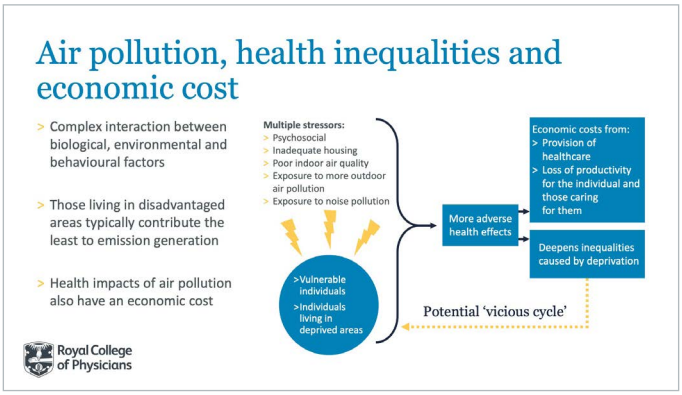
Knowledge and understanding continues to develop; there is increasing evidence that PM2.5 has adverse health effects even at exposures below the WHO guideline level.

Guidance on delivery

Participants can be directed towards the RCP's 2025 report, 'A breath of fresh air: responding to the health challenges of modern air pollution', which offers a more detailed discussion and signposts the underpinning evidence.

Air quality, health inequalities and economic cost: key cross cutting issues in the approach to air pollution (Cover slide)

Slide: 28



Air pollution, health inequalities and economic cost

Slide: 29 | Estimated time allocation: 2 minutes

Air pollution disproportionately impacts vulnerable populations; those from socially disadvantaged groups, experiencing deprivation, ethnic minority communities and those with pre-existing chronic disease and poor health.

People living in the most deprived areas are often exposed to higher concentrations of air pollution; for example, living near high volume traffic areas or industrial buildings. These groups of individuals may also be facing additional stressors, eg psychosocial stressors, inadequate housing, poor indoor air quality and noise pollution. In combination, these factors lead to worse health outcomes and deepen inequalities caused by deprivation; potentially creating a 'vicious cycle' that can be difficult to break.

Although exposure to higher air pollution concentrations is commonly related to higher indices of deprivation, some studies show that highly advantaged groups may also be exposed to higher levels of pollution, reflecting more affluent people living in city centre locations.

People living in disadvantaged areas typically contribute the least to emission generation; they are less likely to own a car and travel fewer miles per year than those in less-deprived areas.

From an economic perspective, more adverse health outcomes lead to greater reliance on healthcare services (and higher costs), as well as loss of productivity for the individual and carers.

Talking to patients about air quality: Health promotion and illness prevention (Cover slide)

Slide: 30

Talking to patients about air quality (Activity slide)

Slide: 31 | Estimated time allocation: 5 minutes

Activity 5: Talking to patients about air quality.

Ask participants to consider the question on the slide.

What do they find are the barriers or enablers to discussion? Do any of the participants have strategies that work well?

If none of the participants routinely discuss air quality and health impacts with patients, ask them to consider how they might seek to do this effectively; what interventions or approaches might help?

Guidance on delivery

Depending on the number of participants, consider splitting into smaller groups of 3–5 to discuss the activity.

Following the small group conversation, encourage participants to share their experiences before moving on to the next slide.

You may wish to document feedback on barriers / enablers on a whiteboard or flipchart.

Talking to patients about air quality (Feedback slide)

Slide: 32 | Estimated time allocation: 5 minutes

Activity 5: Talking to patients about air quality.

Ask participants to consider the question on the slide.

What do they find are the barriers or enablers to discussion? Do any of the participants have strategies that work well?

Following the small group conversation, encourage participants to share their experiences before moving on to the next slide.

You may wish to document feedback on barriers / enablers on a whiteboard or flipchart.

Guidance on delivery

If there are participants who feel confident in talking to patients about air quality, encourage them to share their experiences and provide peer-to-peer teaching.

References for this section

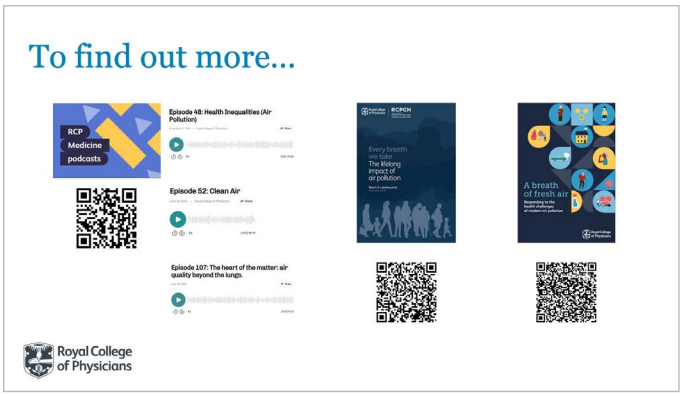
> RCP. A breath of fresh air: responding to the health challenges of modern air pollution., 2025.

Example of accessible information

Global Action Plan: Air pollution and health, 2026. www.cleanairhub.org.uk/clean-air-information/air-pollution-health

Air pollution forecasts

DEFRA. UK air information resource, 2026. https://uk-air.defra.gov.uk/



To find out more...

Slide: 33 | Estimated time allocation: 1 minute

The RCP Medicine Podcast series includes several episodes on the health impacts of air quality and how this issue can be addressed.

For further detail about the health impacts of air pollution, biological mechanisms, latest research, economic impacts, relationship to health inequalities and proposals for future action, participants can review the RCP's 2025 report, A breath of fresh air: responding to the health challenges of modern air pollution.

Guidance on delivery

The QR codes can be scanned and saved by attendees to access after the teaching session.

Summary and close

Slide: 34

References

Slide: 36–38

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