Creating a pathway towards the new WHO guidelines – what are the evidence gaps?

The updated World Health Organisation air quality guideline values are substantially lower than previous levels.

For fine particulate matter (PM$_{2.5}$), the new guideline value of 5 µg m$^{-3}$ was exceeded in 2018 all AURN monitoring sites, with the exception of Lough Navar (Northern Ireland).

The more we understand about the mechanisms from exposure to air pollution to adverse health effects, impacts are found even at levels (far) below current legal limit values.
Long-term time series – from emissions to concentrations

- Cohort studies cover long time windows, with relevance of ‘historic’ exposures prior to the 1970s.
- Consistent, long-term air pollutant concentration datasets for epidemiological studies.

Evidence gaps regarding the role of atmospheric composition change, e.g.:

- Impacts of emission control scenarios on future inorganic secondary aerosol formation.
- Changes in the role of long-range transboundary air pollution in Europe/on UK air quality.
- Hemispheric atmospheric composition change and its influence on background levels of tropospheric ozone.
- Impacts of domestic NOₓ/NMVOC emission reductions and UK tropospheric ozone formation under future climate scenarios.
- Contribution of natural/biogenic emissions to relevant AQ limit values in the view of further declining anthropogenic emissions.


AQ evidence gaps beyond WHO targets?

- Multi-pollutant multi-effect assessments of health effects from air pollutant exposures.
- Emerging health impacts, e.g. cognitive/brain health.
- Airborne transmission of microplastics and other materials (e.g. AMR, metals, POPS, pathogens, ...)
- Integrating human and ecosystem health impact assessment of atmospheric threats – considering consistently whole-environment impacts vs. siloed approaches for human health and other impacts?
- Air pollution and climate change interactions, in particular in relation to human health and well-being (incl. socio-economics, inequalities) – highly spatially and temporally variable
James Allan
University of Manchester & National Centre for Atmospheric Science
How do we measure PM$_{2.5}$ anyway?

- There are 4 MCERTS ‘equivalent’ PM$_{2.5}$ measurements:
  - FDMS TEOM
  - Beta attenuation
  - FIDAS (optical)
  - Gravimetric analysis of filters (reference method)

- The certification process is designed around getting concentrations below 25 µg m$^{-3}$ – agreement is less good at lower concentrations!

- Semivolatile material (e.g. ammonium nitrate) is sometimes difficult to measure, especially by the reference method!

- Other particle types difficult to measure (e.g. small particles in FIDAS)

- Challenge for the instrumentation and metrology communities
Secondary organic aerosols

• Major topic of research for over 20 years, still not solved
• Can form around half of PM$_{2.5}$ but formed from a mix of biogenic and anthropogenic precursors
• Predictive capability is better than it was but still not perfect

• How will yields be affected by reductions in NO$_x$? (less per oxy termination)
• What about SOA from household products?
• How will biogenic emissions be affected under climate change?
Cooking

• Known to be a significant contribution to urban PM, but poorly represented in models
• Where are the sources and how strong are they?
• How long do cooking aerosols persist in the atmosphere given components (e.g. oleic acid) are semivolatile and/or chemically reactive?
Non exhaust emissions

- Brake wear, tyre wear and road dust resuspension are becoming the major primary particulate emissions from vehicles
- Poorly constrained in terms of measurements and models

- What size are the particles ($PM_{2.5}$ vs $PM_{10}$ vs TSP)?
- How do we best measure them?
- Can we mitigate these through technical developments?
Wood stoves

• Single biggest source of primary PM$_{2.5}$ in the UK
• Emissions highly variable and uncertain
• Could be producing SOA, but again uncertain

• How much of a difference did the adoption of Ecodesign stoves and kiln dried wood make?
• How much emissions are caused by user behaviour, e.g. burning wet or waste wood, not operating the stove correctly, etc.?
• What emissions can we expect from novel manufactured fuels?
• Can technical developments continue to improve emissions?
Towards WHO guidelines

➢ Measurement challenge

➢ Mitigation challenge

➢ Equity challenge

➢ Prioritisation challenge
About EPUK: Environmental Protection UK is a national charity, with a vision for *a cleaner, healthier and more tranquil environment for all in the UK.*

Our membership is mostly drawn from environmental professionals, bringing together policy-makers, business, local authorities, third sector groups and academics, to foster partnerships for environmental action.

We provide expert policy analysis and information, including guidance, briefing notes and leaflets, on air quality, land quality and noise. We share best practice and support our members to deliver effective environmental protection.

Our current work includes a project on Air Quality & Climate Change interactions, focussing on the need for a coordinated approach and options for practical actions by local authorities and others; this project complements the recent & ongoing top-down work on air quality impacts of Net Zero.

Other work includes lobbying for effective environmental legislation and implementation, a robust Local Air Quality Management system, and supporting our Air Quality & Development Control planning guidance (produced with IAQM).
• We welcome the new WHO Guidelines for air quality. They show the urgent need for ambitious action to protect health, and should help drive this.

• We note that achieving the guidelines will be difficult. (Also that the existing limit values and objectives based on health and achievability are still exceeded)

• We need a narrative that strongly encourages action, without the guidelines seeming alienatingly impossible. This will be a fine line to tread. Air quality research will be key here.

• Looking forward to CAF/Imperial work and Defra work on pathways to achieving compliance with 2005 guidelines.

• Further query around whether the new guidelines (and any standards based on them) will change the priorities for action, and if so how? Are there measures (current or proposed) which we should or shouldn’t pursue?

• There are opportunities to capture co-benefits (and optimise) for air quality with climate change action.

Sarah Legge, Chair of the Air Quality Committee, sarah@slhenvironmental.co.uk
Creating a pathway towards the new WHO guidelines – what are the evidence gaps?

Dr Matt Loxham
BBSRC David Phillips Fellow
University of Southampton
20th January 2022
The majority of the UK population are exposed to PM2.5 > new WHO guidelines, but a significant portion of this not from UK primary sources.
Is PM mass the most appropriate metric?

Contributors to PM10 mass and PM10 oxidative potential can be quite different.
Specific source considerations

Anthropogenic PM $\rightarrow$ traffic-related PM $\rightarrow$ non-exhaust PM $\rightarrow$ brakewear PM $\rightarrow$ specific brakepad type

Beddows and Harrison (2021) Atmos Environ 244:117886


Shipping Movements
Air pollution can travel across borders (transboundary) but can also be “imported” and “exported” through differential locations of production and consumption of goods.
A local perspective

Question 1a. To what extent do you think air quality is a problem in Southampton?

- 75% Not much or not a problem
- 18% A fairly or very big problem
- 7% Not a problem at all

Southampton City Council (2018) Consultation feedback on proposals for a Clean Air Zone in Southampton

Question 10. To what extent do you agree or disagree that the following additional proposed activity will improve air quality in Southampton?

- Retrofit up to 14% buses in Southampton with accredited NOx and particulate emission reducing technology: 55%
- Maintain an effective air monitoring network to evaluate the success of these activities: 53%
- Replace Council vehicles with electric and low emission alternatives where feasible: 50%
- Continue a Low Emission Taxi Incentive Scheme to encourage replacement of older, more polluting taxis with cleaner vehicles: 40%
- New cycling infrastructure and enhancements to existing routes along three corridors in the City; also developing improved connections with Totton and the city centre: 50%
- Engagement with schools and local business to promote active and sustainable travel through the My Journey brand: 40%
- Continue promoting and sharing air quality improvement case studies and offering access to air quality resources through the Clean Air Network in Southampton and regionally: 37%
- Install a city wide network of publicly accessible electric vehicle charge points in Council owned car parks and on street for those with limited access to off street parking: 38%
- Introduce charge points specifically for taxi operators and drivers: 33%
- Produce Air Quality Supplementary Planning Document to promote best practice in reducing air pollution in new developments in the city: 34%

Question 11. What impact do you feel the preferred option for a Clean Air Zone might have on the following? Health impacts

- Positive impact: 77%
- No impact at all: 15%
- Don't know: 8%
- Negative impact: 6%

- A very positive impact: 31%
- A fairly positive impact: 24%
- A slightly positive impact: 23%
- No impact at all: 17%
- Don't know: 10%
- A slightly negative impact: 5%
- A fairly negative impact: 5%
- A very negative impact: 31%

Base respondents: 7777

Question 6. What do you think about the proposed daily charges for non-compliant Heavy Goods Vehicles?

- Slightly or far too low: 14%
- The right amount: 39%
- Slightly or far too high or there should be no charge: 47%

Far too low: 39%
Slightly too low: 17%
The right amount: 17%
Slightly too high: 14%
Far too high: 10%
There should be no charge: 6%

Base respondents: 7624

Question 11. What impact do you feel the preferred option for a Clean Air Zone might have on the following? Economic impact on the port or city

- Positive impact: 20%
- No impact at all: 10%
- Don't know: 5%
- Negative impact: 68%

A very positive impact: 25%
A fairly positive impact: 8%
A slightly positive impact: 10%
No impact at all: 10%
Don't know: 5%
A slightly negative impact: 5%
A fairly negative impact: 5%
A very negative impact: 17%

Base respondents: 7777
InSPIRE’s vision is for everyone in the UK to be able to breathe clean air that promotes a healthy brain and cognitive life regardless of where they live.
Headline News!

Small increases in air pollution linked to rise in depression, finds study

Air pollution particles in young brains linked to Alzheimer’s damage

Support the Guardian
Available for everyone, funded by readers

The Guardian

The New York Times

Air Pollution May Damage the Brain

Tiny air pollutants may cause changes in brain structure that resemble those of Alzheimer’s disease.
The impact of air quality on brain health

Review
A critical review of the epidemiological evidence of effects of air pollution on dementia, cognitive function and cognitive decline in adult population
Juana Maria Delgado-Saborit$^{a,b,c,d}$, Valentina Guercio$^e$, Alison M. Gowers$^e$, Gavin Shaddick$^f$, Nick C. Fox$^g$, Seth Love$^h$

Reviewed 69 epidemiological studies – 2006 to 2019

Current evidence suggests:

- Air pollution is causally associated with cognitive impairment and dementia.
- A biological gradient most likely exists.
- The magnitude of exposure-response is often small but significant.
Taking a Healthy Streets Approach

Lucy Saunders

lucysaunders@healthystreets.com
The 10 Healthy Streets Indicators

- Clean air
- Easy to cross
- Everyone feels welcome
- Places to stop and rest
- Things to see and do
- People feel safe
- People choose to walk and cycle
- Not too noisy
- Simple and friendly
- People feel relaxed
All these factors influence how people feel
The big health impacts of urban transport
Everyone needs an accessible environment to be active everyday
The environment needs to be pleasant too
Welcoming & accessible for all
The 10 Indicators are interdependent

Source: Lucy Saunders
The 10 Healthy Streets Indicators

- Everyone feels welcome
- Easy to cross
- Clean air
- People feel relaxed
- Things to see and do
- People feel safe
- People choose to walk and cycle
- Not too noisy
- Places to stop and rest
- Shops and eateries
Thanks

lucysaunders@healthystreets.com
Creating a pathway towards the new WHO guidelines
What are the evidence gaps

Ruth Calderwood
Air Quality Manager, City of London Corporation

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@_CityAir
Some evidence gaps

- Detailed source apportionment - localised
- PM characterisation / speciation eg metals, black carbon, nitrates
- Who has the levers to control emissions
- Where are the gaps in the above
- Where will net zero take us and when
- Are current PM$_{2.5}$ analysers accurate enough to measure 5µg/m$^3$
- How are the biggest health benefits obtained
- How will lower NO$_2$ impact on urban O$_3$