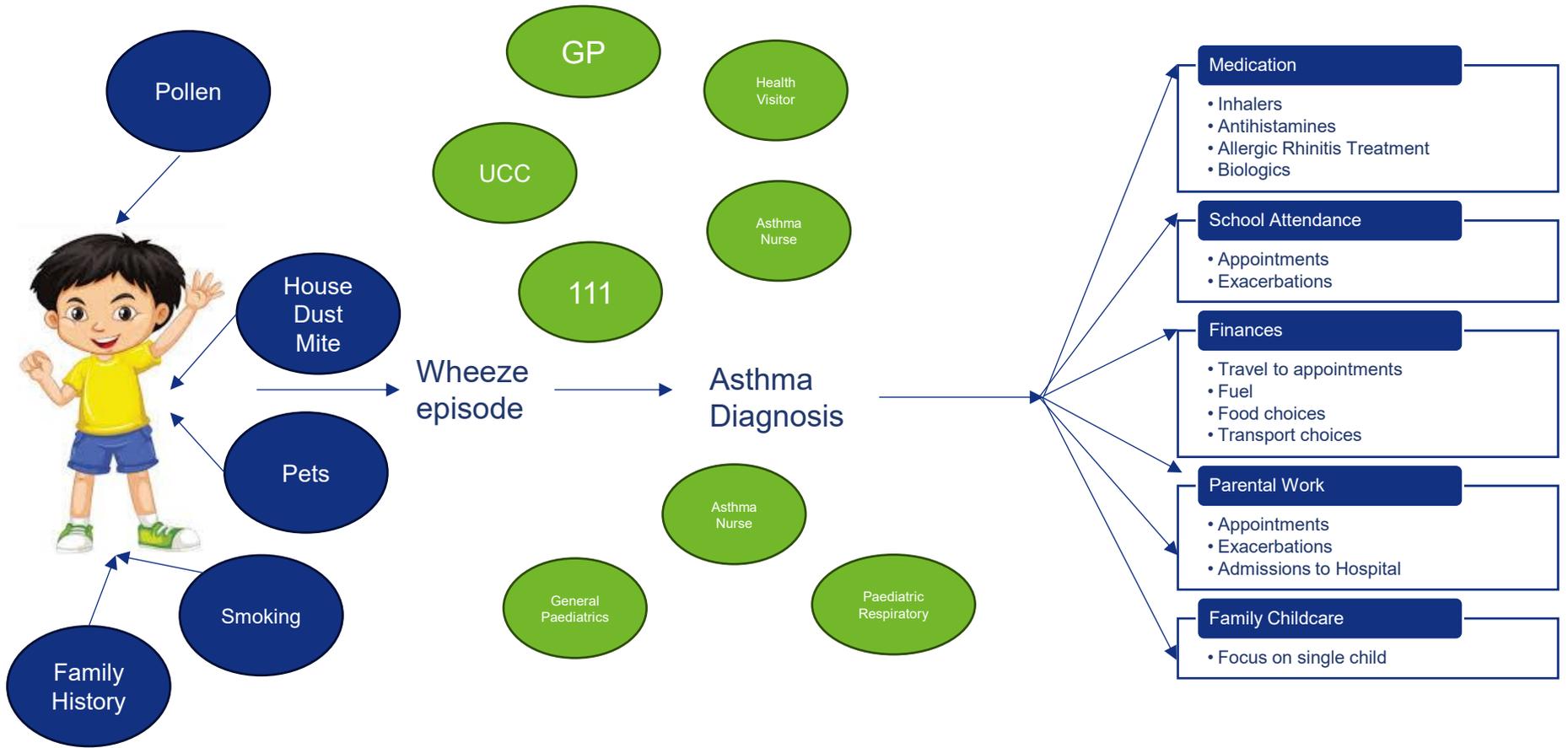


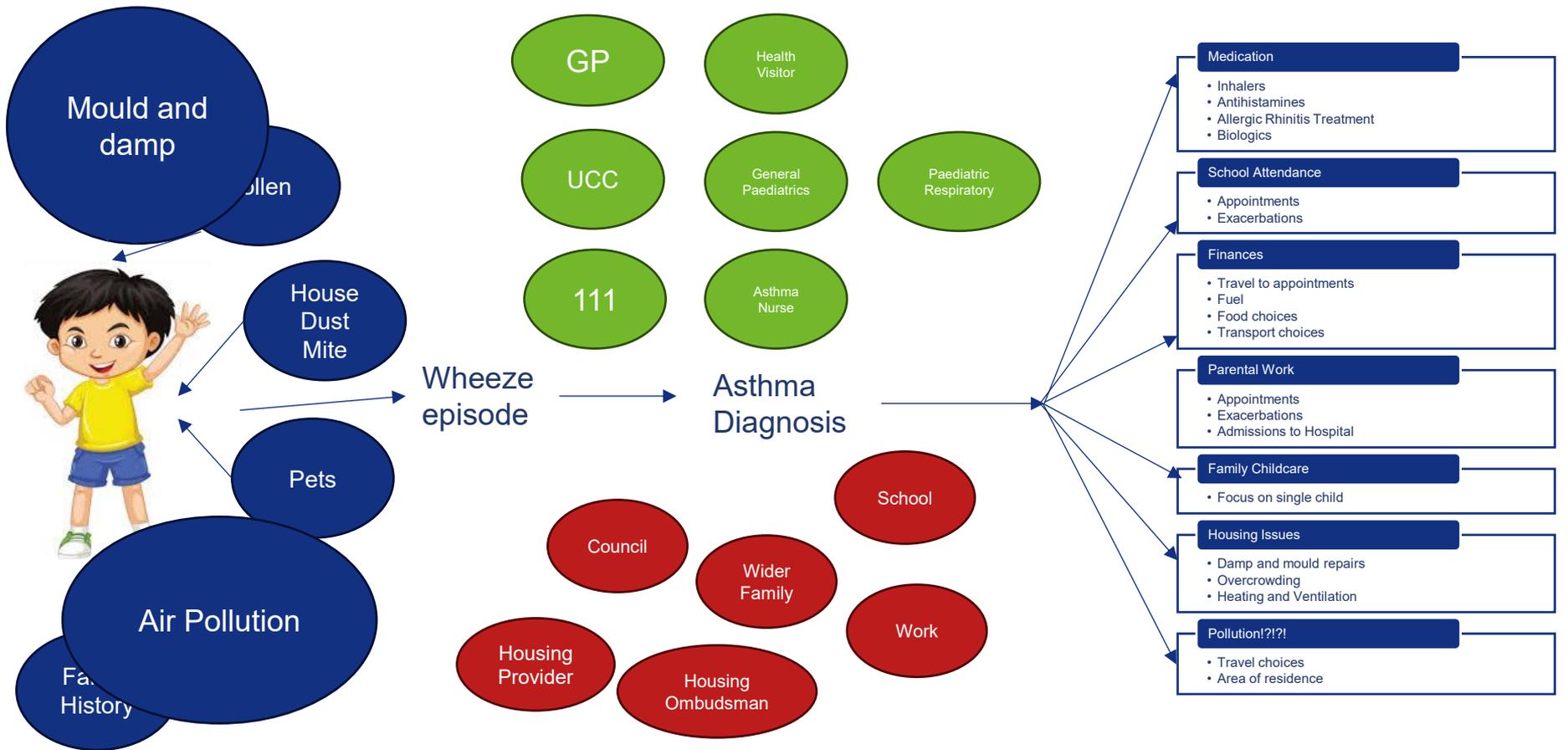
Translating Air Quality Research into Better Children's Health

Dr Abigail Whitehouse

Senior Clinical Lecturer in Childrens Environmental Health

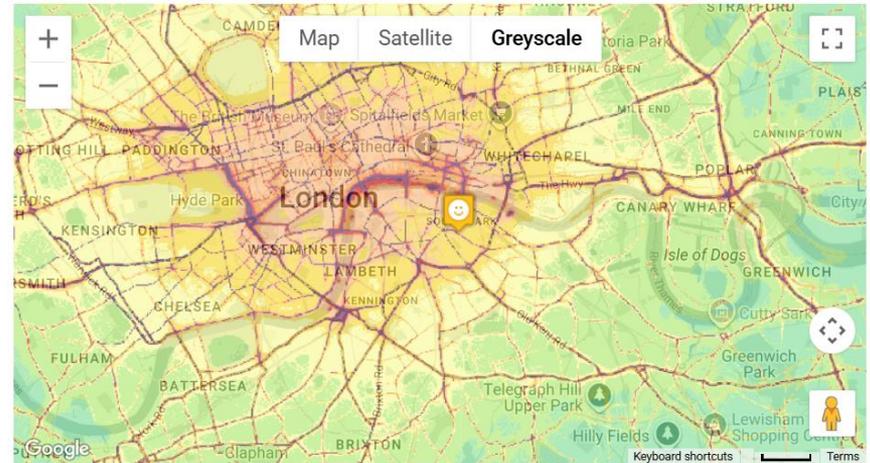
National Air Quality Conference – November 2025





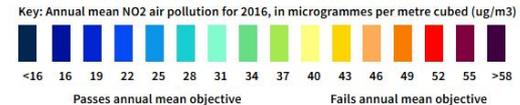
Air Quality and Children's Health

- Exposure to air pollution is the second leading risk factor for death in children aged under 5, both globally and in the UK (State of Global Air 2024 HEI)
- Deprived neighbourhoods and minoritised communities are the most affected (CMO annual report 2022)
- One in 4 UK residents live in areas with PM2.5 levels more than twice the upper limit of WHO guidelines (Expanse project)
- Children are the most vulnerable and most at risk of a lifetime of health effects.

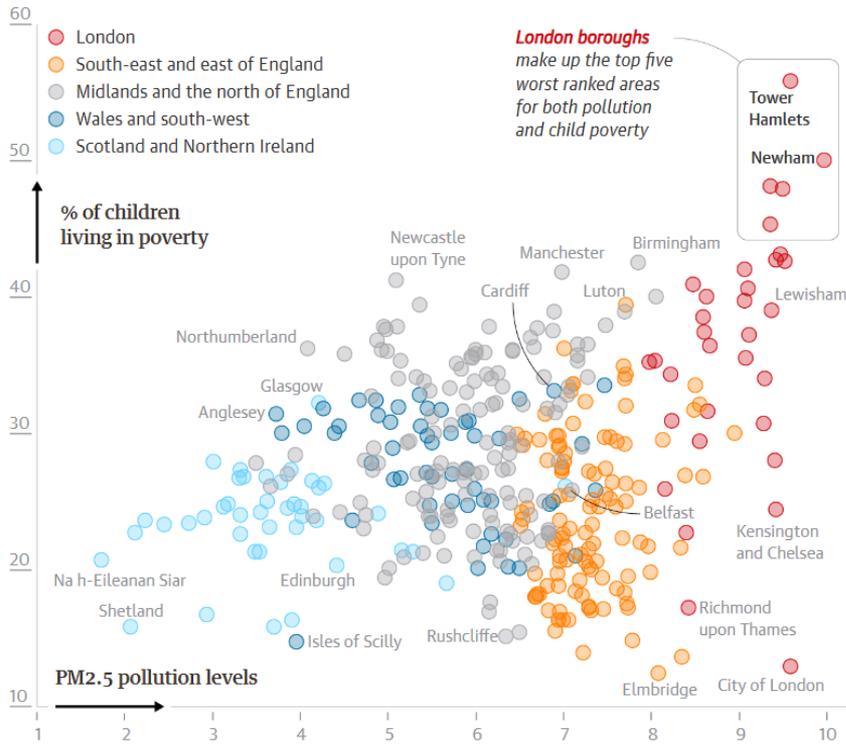


Modelled annual mean NO₂ air pollution, based on measurements made during 2016.

This map was used with permission from The Greater London Authority and Transport for London, who fund, develop and maintain the London Atmospheric Emissions Inventory. For more information please visit data.london.gov.uk

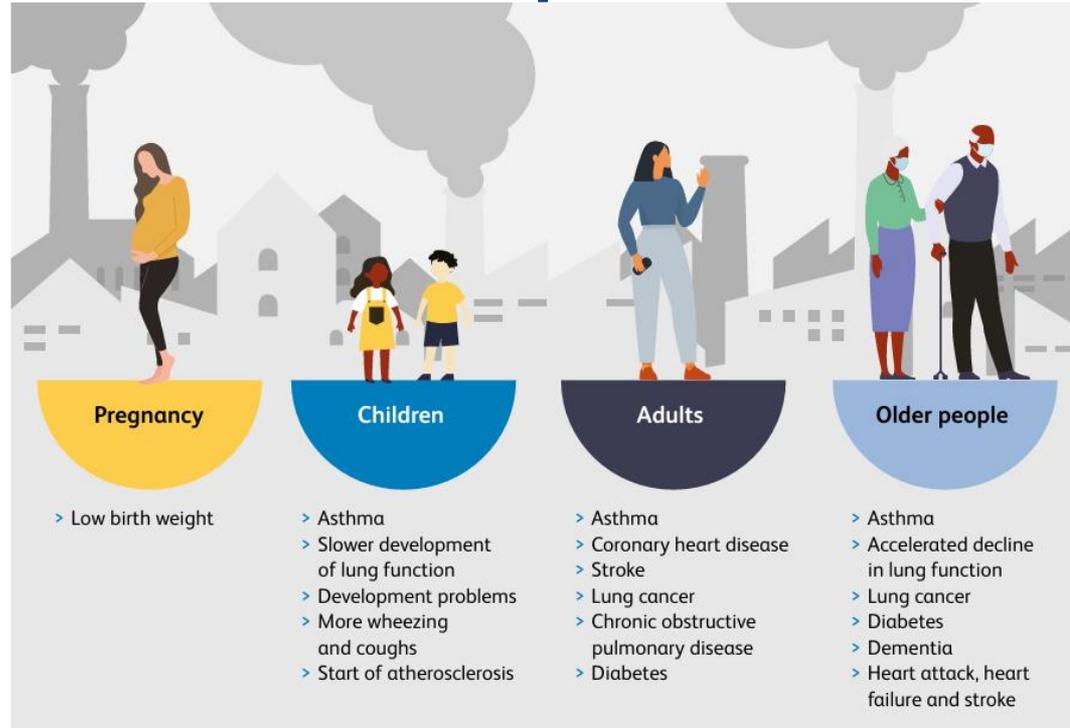


Children from low-income households are more likely to live in areas of high air pollution



Guardian graphic. Source: Labour analysis of Defra, End Child Poverty coalition data. Note: child poverty data is after housing costs. Pollution is population-weighted annual mean PM2.5 concentration for 2020 (micrograms per cubic metre)

Health Effects of Pollution Exposure



RCP A Breath of Fresh Air
2025

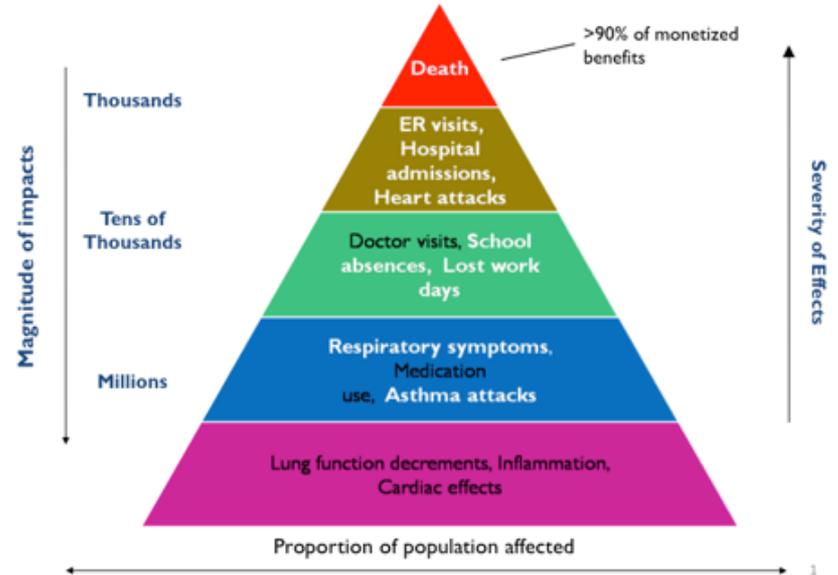
Fig 1. Health effects of air pollution throughout life (source: CMO's annual report 2022, adapted from PHE 2018).²⁸ Contains public sector information licensed under the Open Government Licence v3.0.

Cost to the NHS

- Between 2017 and 2025, the total cost to the NHS and social care of air pollution in England for where there is more robust evidence for an association, is estimated to be **£1.60 billion** for PM2.5 and NO2 combined (£1.54 billion for PM2.5 and £60.81 million for NO2)
- If we include the NHS and social care costs for other diseases for which there is currently less robust evidence for an association, then the estimate is increased to a total of **£2.81 billion** for PM2.5 and £2.75 billion for NO2 in England between 2017 and 2025.

Estimation of costs to the NHS and social care due to the health impacts of air pollution PHE 2018

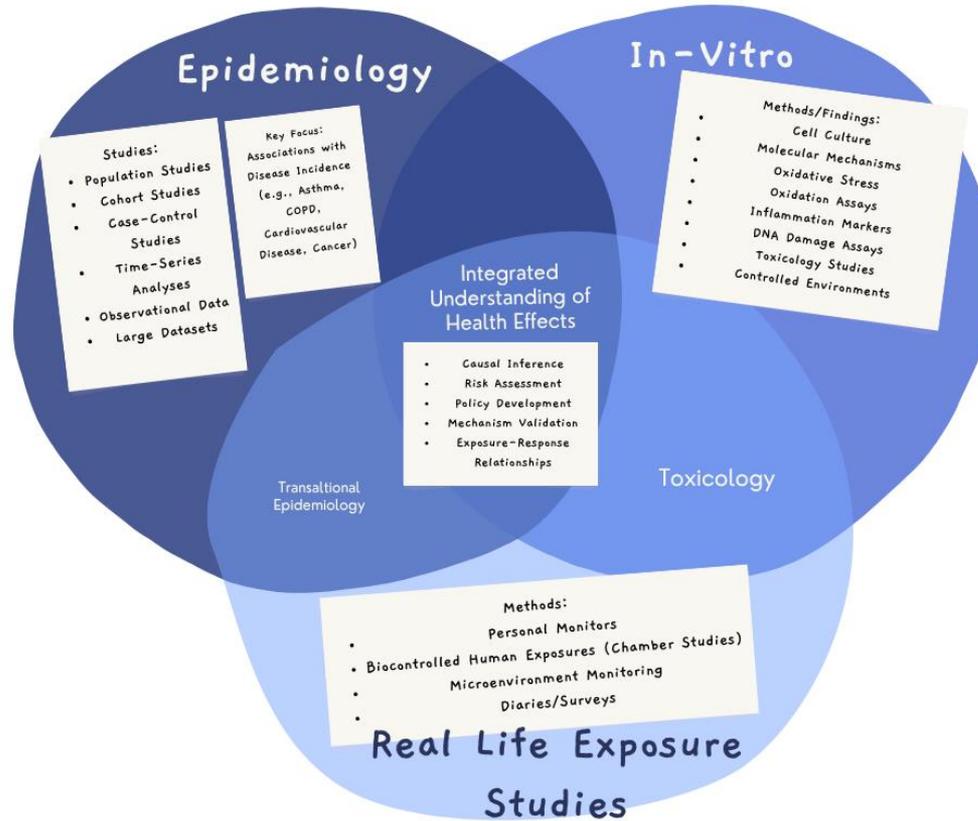
A “Pyramid of Effects” from Air Pollution



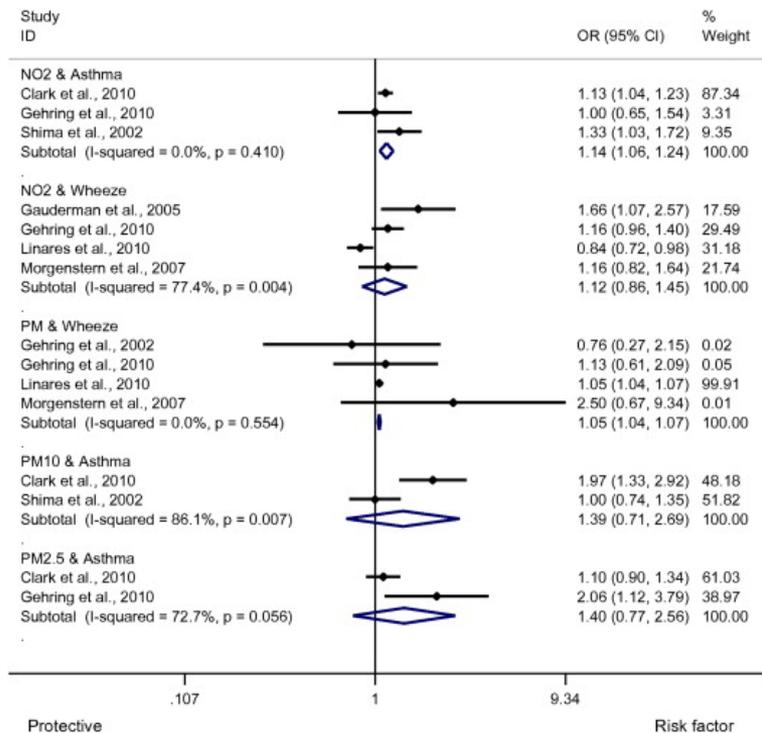
United States Environmental Protection Agency, “How BenMAP-CE Estimates the Health and Economic Effects of Air Pollution”

<https://www.epa.gov/benmap/how-benmap-ce-estimates-health-and-economic-effects-air-pollution>

So how do we know that pollution actually causes health effects?



Asthma and Wheeze



Breathing inequality: unmasking Liverpool's air pollution burden on deprived youth

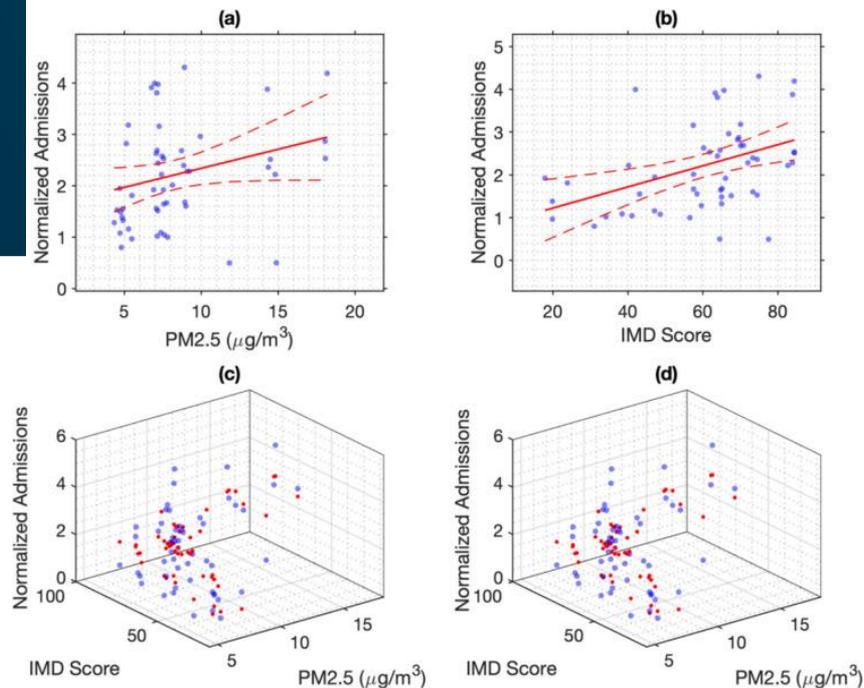
Research | [Open access](#) | Published: 20 September 2025

Volume 197, article number 1128, (2025) | [Cite this article](#)

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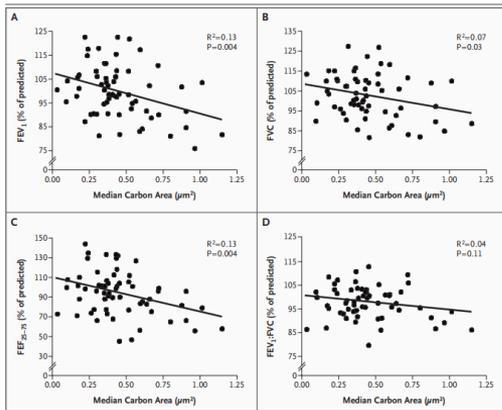
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[Jonathan E. Higham](#) ✉, [Ian Sinha](#), [Alice Lee](#), [David Taylor Robinson](#), [Olu Olajide](#) & [Sepeedeh Saleh](#)



Carbon in Airway Macrophages and Lung Function in Children

Neeta Kulkarni, M.D., Nevil Piers, M.Sc., Lesley Rushton, Ph.D., and Jonathan Grigg, M.D.



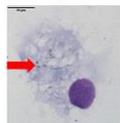
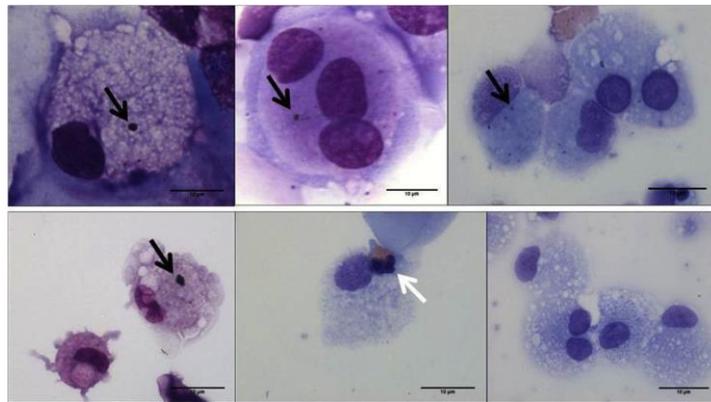
Science of The Total Environment

Volume 751, 10 January 2021, 142235

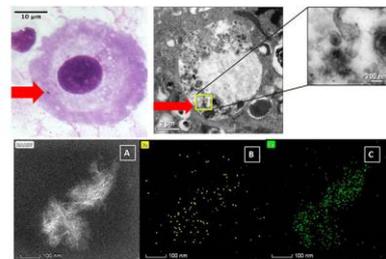


Carbon in airway macrophages from children with asthma

Rossa E Brugha,¹ Naseem Mushtaq,¹ Thomas Round,¹ Dev H Gadhvi,¹ Isobel Dundas,¹ Erol Gaillard,² Lee Koh,¹ Louise J Fleming,³ Daniel J Lewis,⁴ Marek Sanak,⁵ Helen E Wood,⁶ Benjamin Barratt,⁶ Ian S Mudway,⁶ Frank J Kelly,⁶ Christopher J Griffiths,¹ Jonathan Grigg¹



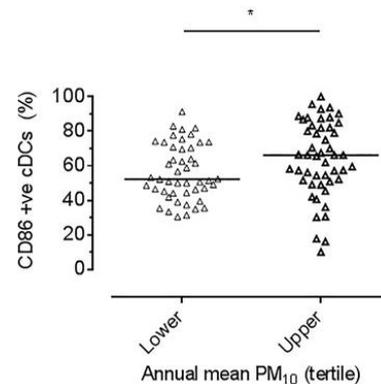
Inhaled particulate matter (PM, red arrow) encountering and phagocytosed by airway macrophage in the lower airways



TOP: Translocated PM (red arrows) interacting with tissue phagocytes in distant organs (e.g. macrophage-enriched placental cells).
 BOTTOM: Elemental mapping shows elongate nanoparticle clusters containing calcium and iron (figure B and C).

Airway dendritic cell maturation in children exposed to air pollution

Abigail L. Whitehouse^{1*}, Naseem Mushtaq¹, Lisa Miyashita¹, Benjamin Barratt², Ameerah Khan³, Harpal Kalsi¹, Lee Koh¹, Michele G. Padovan¹, Rossa Brugha¹, Frances R. Balkwill^{4*}, Andrew J. Stagg⁵, Jonathan Grigg¹



Lungs of nonsmokers (Sao Paulo)

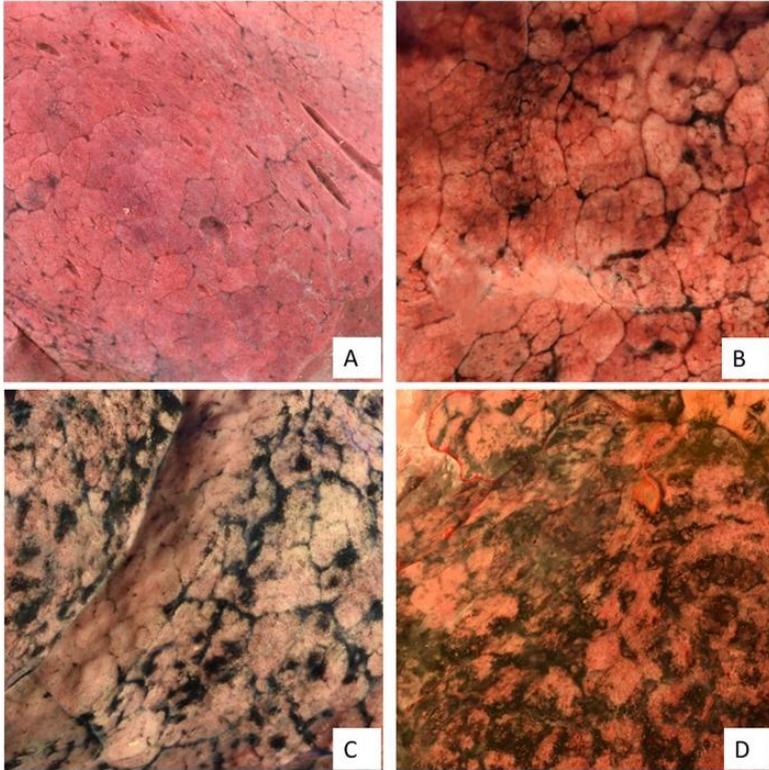
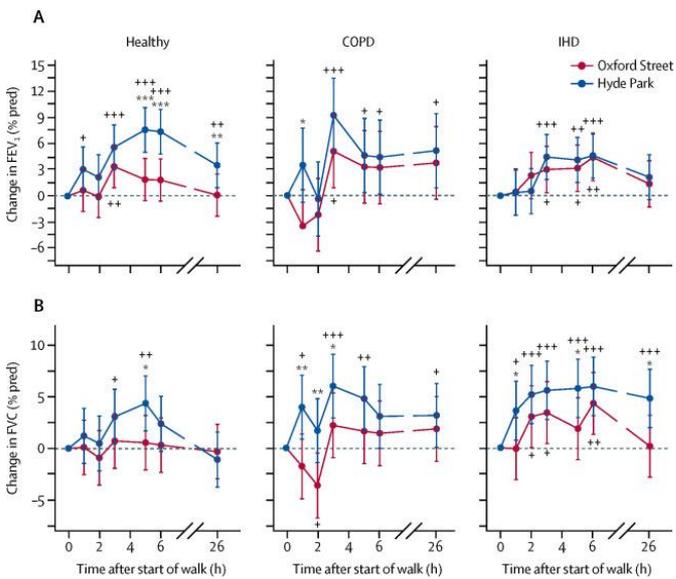


Fig 2. Image of the lung surface. Standard crops using Image J software. In clockwise order: A. Non-smoker, female, 85 yr; B. Smoker, male, 70 yr; C. Non-smoker subject, female, 76 yr; D. Smoker, female, 47 yr

Public Health and Short Term Exposures



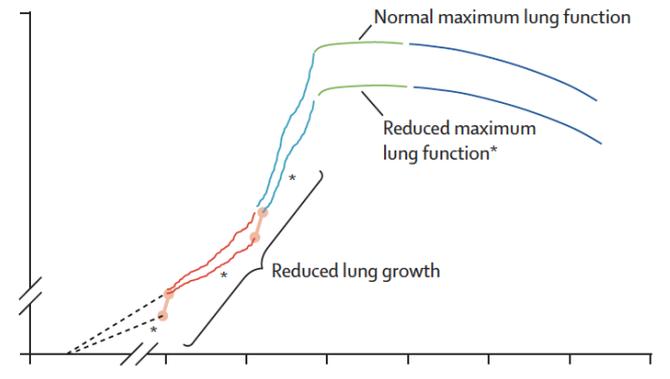
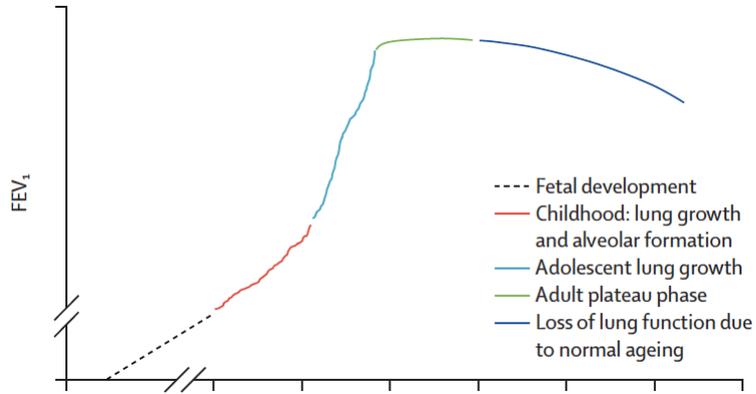
Respiratory and cardiovascular responses to walking down a traffic-polluted road compared with walking in a traffic-free area in participants aged 60 years and older with chronic lung or heart disease and age-matched healthy controls: a randomised, crossover study
 Sinharay, Rudy et al. The Lancet, Volume 391, Issue 10118, 339 - 349

Air Pollution Banding	Value	Accompanying health messages for at-risk individuals*	Accompanying health messages for the general population
<u>Low</u>	<u>1-3</u>	Enjoy your usual outdoor activities.	Enjoy your usual outdoor activities.
<u>Moderate</u>	<u>4-6</u>	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.
<u>High</u>	<u>7-9</u>	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.
<u>Very High</u>	<u>10</u>	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.



CHERISH
 Children's Health,
 Respiratory Inflammation
 and Short-term air pollution

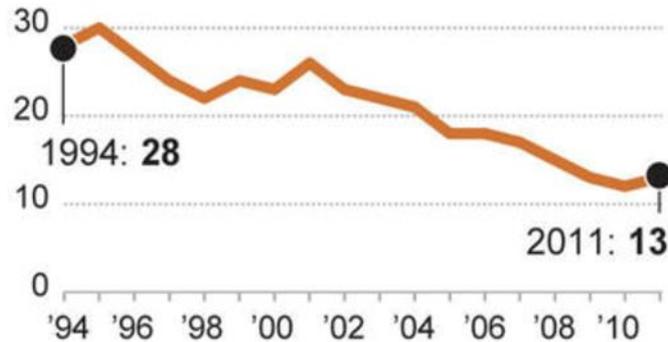
Lung Function Development



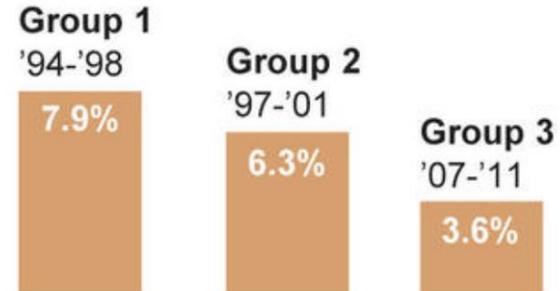
Policy Level Interventions

LUNG FUNCTION GROWTH CHILDRENS HEALTH STUDY CALIFORNIA

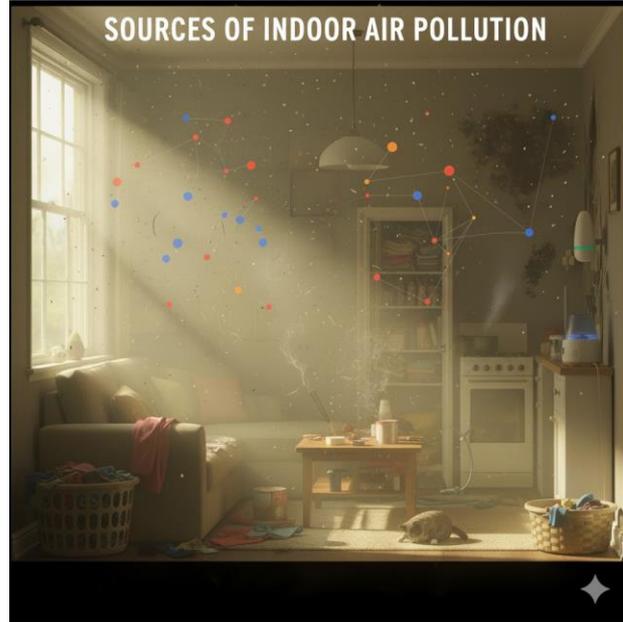
As air pollution* declined...



...the percentage of children with abnormally low lung function dropped.



Should I worry about indoor or outdoor more?



Google Gemini.....

Pollution Monitoring

Figure 2 – Comparison between average time in each microenvironment and average black carbon exposure

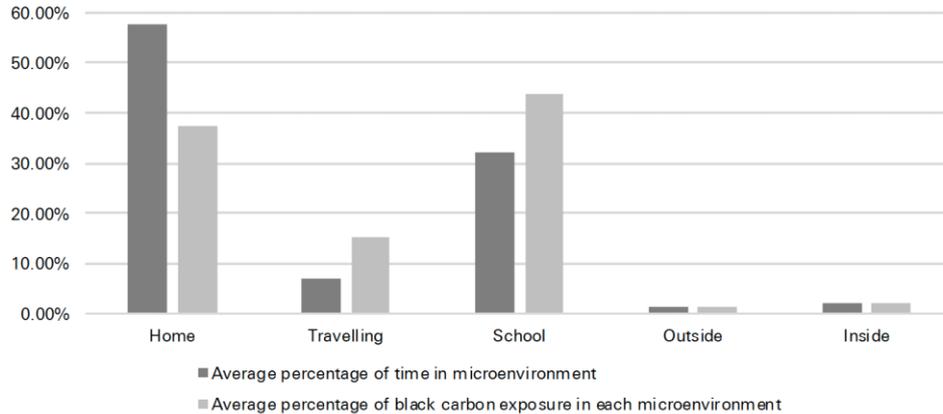
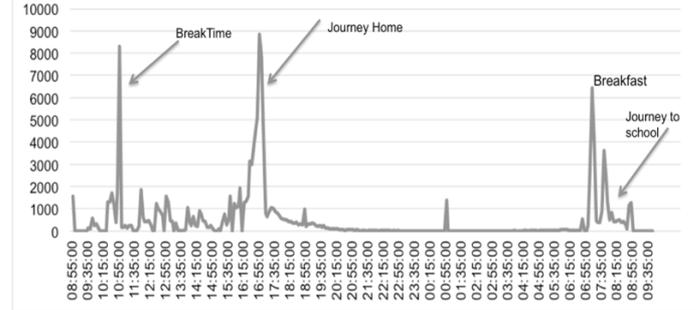
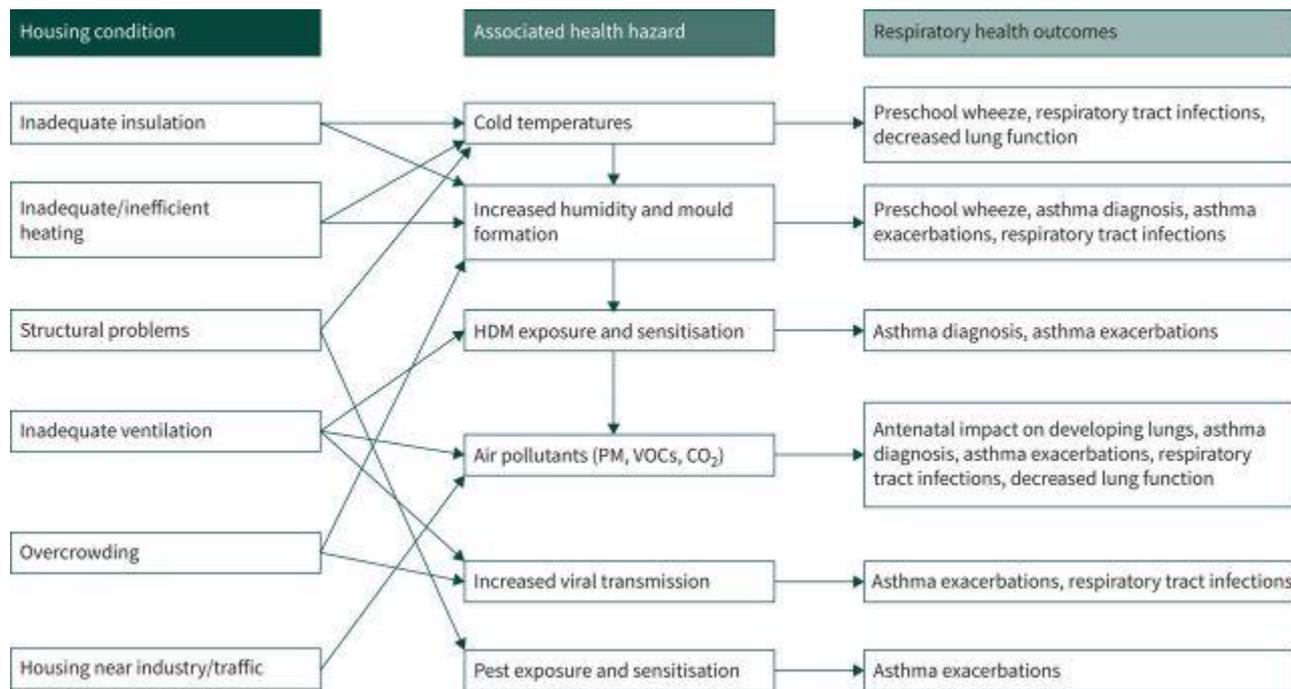


Figure 1 - An example of a child's exposure to air pollution over 24 hours





Review  Open access

The impact of poor housing and indoor air quality on respiratory health in children

Karl A. Holden | Alice R. Lee | Daniel B. Hawcutt | Ian P. Sinha [See Less](#) ^

Breathe 2023 19(2): 230058; DOI: <https://doi.org/10.1183/20734735.0058-2023>

Mould and Damp



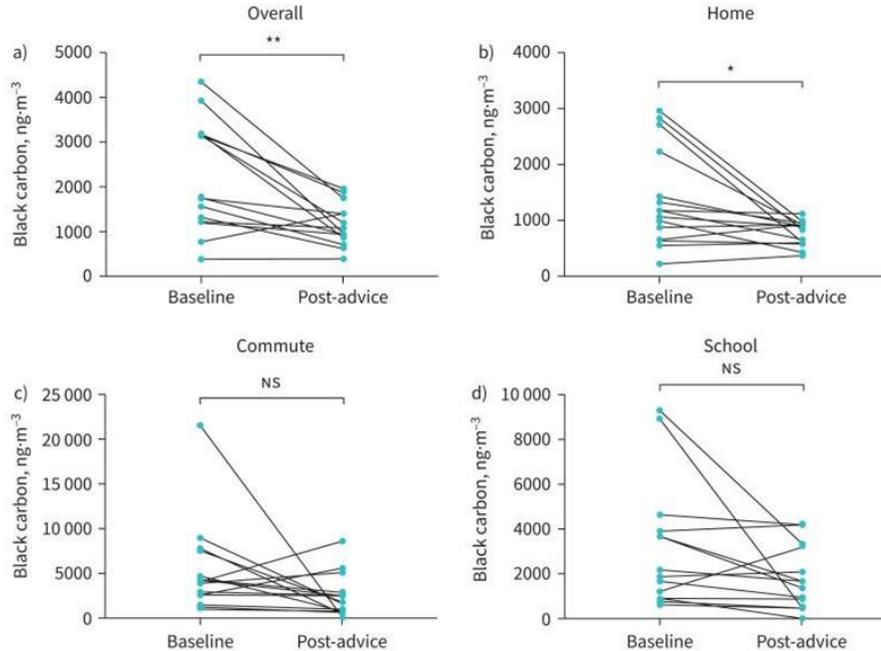
Who's Responsibility is it?

- “my home has mould and damp”
- “my home has 1 bedroom and 7 people living in it”
- “my home is next to the A13 and my daughter wheezes when she goes outside”
- “my home is too hot, its on the 12th floor”
- “the new tunnel has brought pollution to our doorstep”
- “I can't afford to heat my home”
- “we all share one room – the other room can stay cold”

- “can you help?”

Altering exposures

Personal monitoring to reduce exposure to black carbon in children with asthma: a pilot study
Lee Koh Jonathan Grigg Abigail Whitehouse
ERJ Open Research

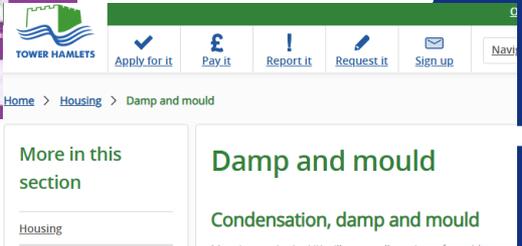


So – how can we change things?



Fill this in with your doctor, or healthcare professional.

Name and date:



- How to manage exposures
- Medical education
- How to address damp +mould / repairs

Education

- Pollution Monitoring (AtmoTube)
- Home Assessment

Environmental Assessment

- Home assessment Report
- Mitigation Report
- Referrals to relevant bodies

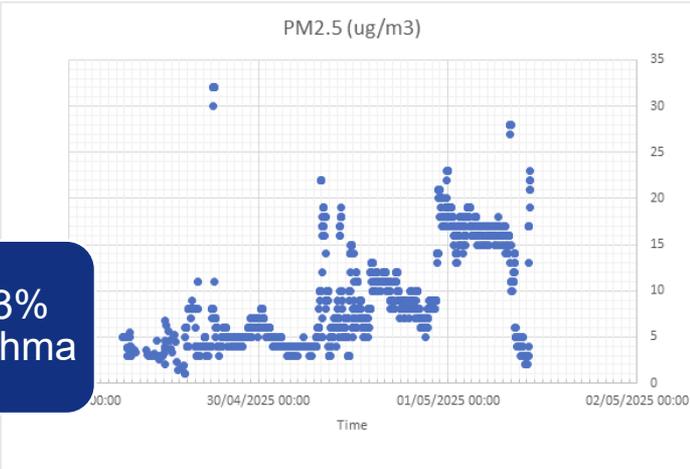
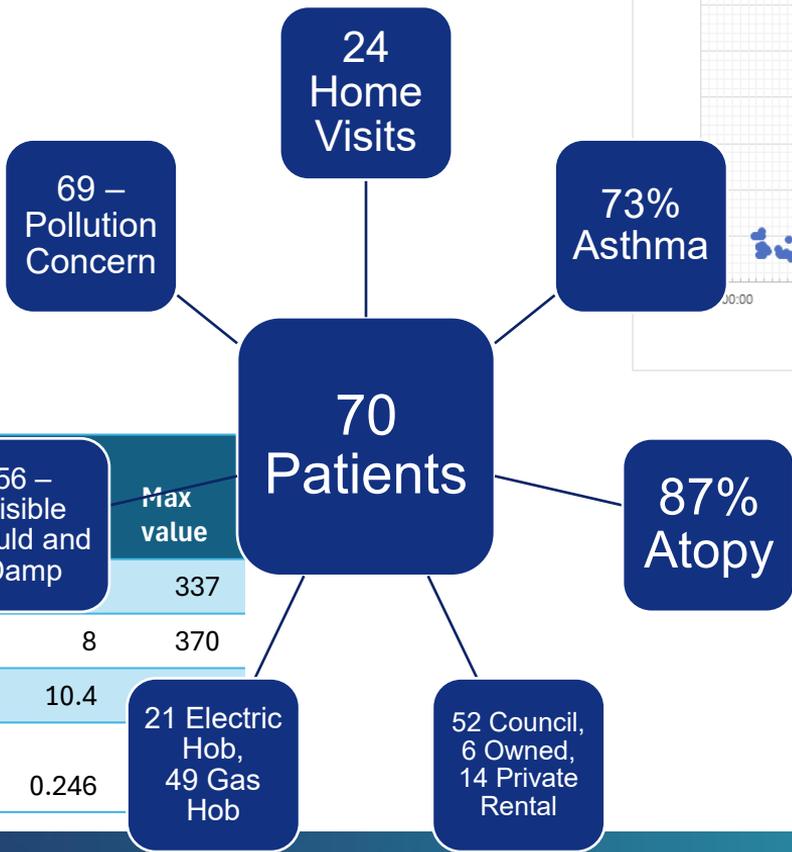
Advice and Mitigation

- C-ACT
- Allergen Assessment
- Individualised Mould assessment

Health Assessment



Results to date



Pollutant	Mean Exposure	Median Exposure	Q1	Q3	Max value
PM1	12.356	3	1	8	337
PM2.5	14.361	4	3	8	370
PM10	15.658	5	4	10.4	
VOCs	0.192	0.214	0.14	7	0.246



My air pollution plan:

Plan out the actions that you and your family can take to reduce the impact of air pollution on your health

	On all days	On high pollution days
I will use my inhaler as recommended by my GP or asthma nurse	<input type="checkbox"/>	<input type="checkbox"/>
I will treat air pollution the same way I treat other asthma triggers	<input type="checkbox"/>	<input type="checkbox"/>
We will walk, cycle or scoot to school	<input type="checkbox"/>	<input type="checkbox"/>
We will look up quieter routes to avoid roads with heavy traffic	<input type="checkbox"/>	<input type="checkbox"/>
We will turn on the extractor fan when cooking	<input type="checkbox"/>	<input type="checkbox"/>
We will swap our cleaning products to low chemical options	<input type="checkbox"/>	<input type="checkbox"/>
We will open the window when cooking	<input type="checkbox"/>	<input type="checkbox"/>
We will open the windows when cleaning	<input type="checkbox"/>	<input type="checkbox"/>
We will always turn the engine off when our car is stationary	<input type="checkbox"/>	<input type="checkbox"/>
If we paint, we will check it is labelled "low VOC"	<input type="checkbox"/>	<input type="checkbox"/>
We will leave the car at home when we can	<input type="checkbox"/>	<input type="checkbox"/>
We will ask people not to smoke in our home	<input type="checkbox"/>	<input type="checkbox"/>

This leaflet was designed in collaboration with: children with asthma, their families, GPs and clinicians. Thank you to Tower Hamlets Together and Global Action Plan as the original creators.



Air Pollution & You

Air pollution can worsen asthma symptoms including coughing, wheezing and breathlessness. The actions below can help:

- 

Discover the side streets

Use quieter roads and paths to keep away from heavy polluting traffic.
- 

Leave the car behind

Encourage your whole family to walk, cycle and scoot more - air pollution can be higher inside a car than outside.
- 

Check the pollution forecast

Sign up at AirText.info to get air pollution alerts sent to your phone.
- 

Turn the engine off

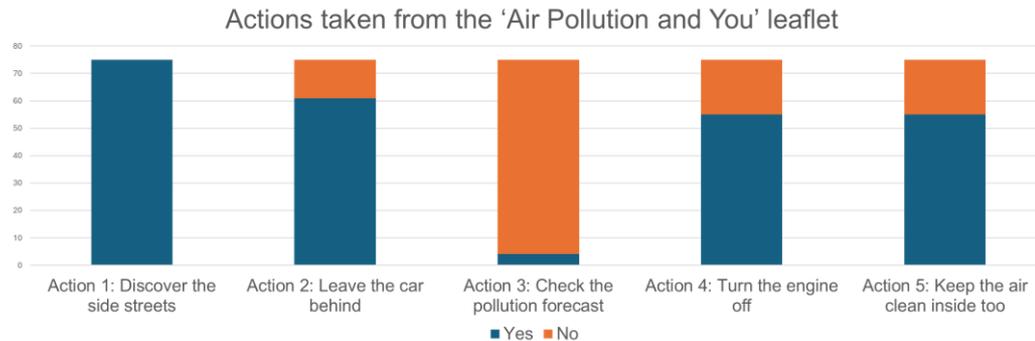
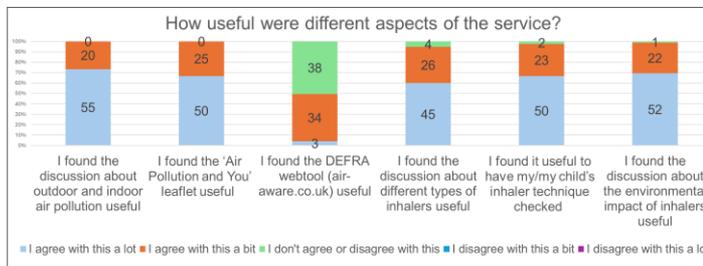
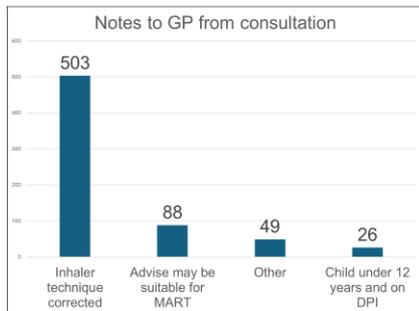
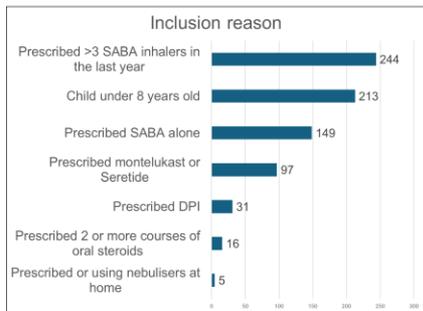
If you do need to use a car, ask the driver to turn the engine off when the car isn't moving.
- 

Keep the air clean inside too

Use fragrance free and low-chemical cleaning products. Stop air pollution collecting in your home by using extractor fans and opening windows away from busy roads.

For more information on how air pollution can affect your health, and how to reduce your exposure, visit www.cleanairhub.org.uk/tower-hamlets

Childhood Asthma and Air Quality Conversations



What can we do?

Individual

- Evidence exposures
- Correlate with symptoms
- Signpost to relevant housing support
- Give advice on individual pollution exposure reduction

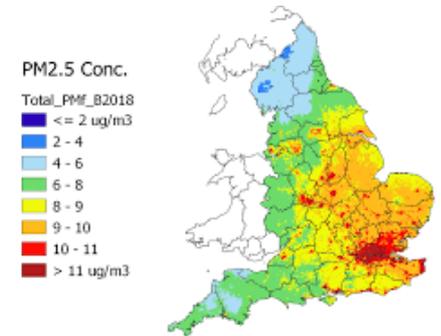
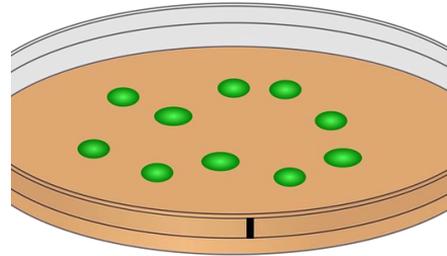
Systemic

- Referral pathways
- Engage with council and housing colleagues
- Education
 - Clinicians
 - Public
 - Patients



Next Steps

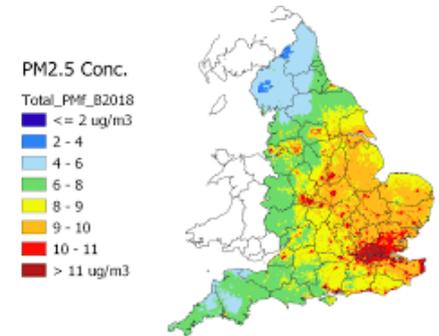
- Housing and Health Referral Pathway
 - Working with Council and Social Housing Providers
- Individualised Mould Testing
- PhD Research project
 - Impact on asthma control
- Extension to new UK centres
- Impact of Awaab's Law



Healthy
Homes Hub

Final Thoughts

- Air pollution is not just an outdoor air issue
- All clinicians should try to address it in clinic appointments – add to the social history
- Impact of Awaab’s Law on indoor exposures will hopefully be significant
- Respiratory is not the only health effect – but the easiest to appreciate
- Children spend the bulk of their time indoors – we should focus efforts on these exposures



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Thank you!

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