



# InSPIRE

Innovating UK clean air policies  
to prevent cognitive disorders

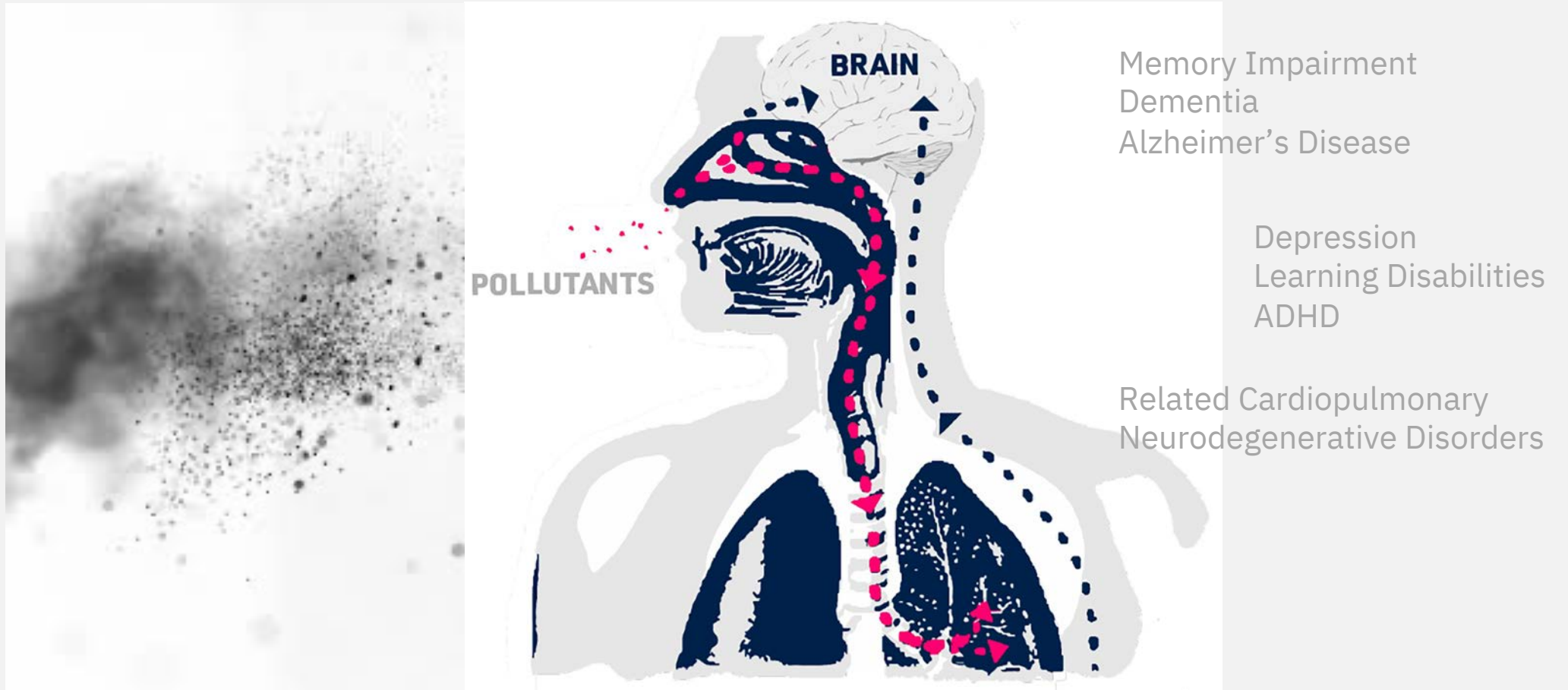


A photograph of a city street at sunset. The sun is low on the horizon, creating a strong orange and yellow glow that silhouettes a person crossing the road in the foreground. The street is lined with multi-story buildings, and a few cars are visible in the distance. The overall mood is serene and urban.

Our 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.

# Starting point

Birth • Infancy and Early Years • Childhood and Adolescence • Adulthood and Later Life






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**Small increases in air pollution linked to rise in depression, finds study**  
Exclusive: Cutting pollution levels may help to reduce rates of mental health problems, say scientists



**Air pollution particles in young brains linked to Alzheimer's damage**  
Exclusive: if discovery is confirmed it will have global implications as 90% of people breathe dirty air



U.S. **INTERNATIONAL** CANADA ESPAÑOL 中文

## 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.

## **Committee on the Medical Effects of Air Pollutants**

COMEAP advises the government on all matters concerning the health effects of air pollutants.

# **Cognitive decline, dementia and air pollution**

## **A report by the Committee on the Medical Effects of Air Pollutants**

Chairman: Professor Frank Kelly

Chairman of Subgroup on Cognitive Decline and Dementia: Professor Robert L Maynard



A wide-angle photograph of a city street during the 'golden hour' of sunset. The sun is low on the horizon, creating a strong, warm glow that fills the sky and reflects off the wet pavement. Tall, multi-story buildings line both sides of the street, their windows and architectural details silhouetted against the bright light. In the center of the frame, a person is captured in motion, crossing the street. Their figure is slightly blurred, suggesting movement. Other pedestrians and vehicles are visible in the distance, also bathed in the warm light. The overall mood is contemplative and cinematic.

**But that is not the whole story**

# Where people live matters

## Our Innovative Primary Prevention Equation

**PLACE = Social Determinants  
Health Inequalities**

**<=> Ambient PM<sub>2.5</sub> Exposure =>**

**Cognitive/Brain  
Health Outcomes**



# Challenge

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**Together with public stakeholders, we need to:**



Link outdoor air pollution and cognitive health.



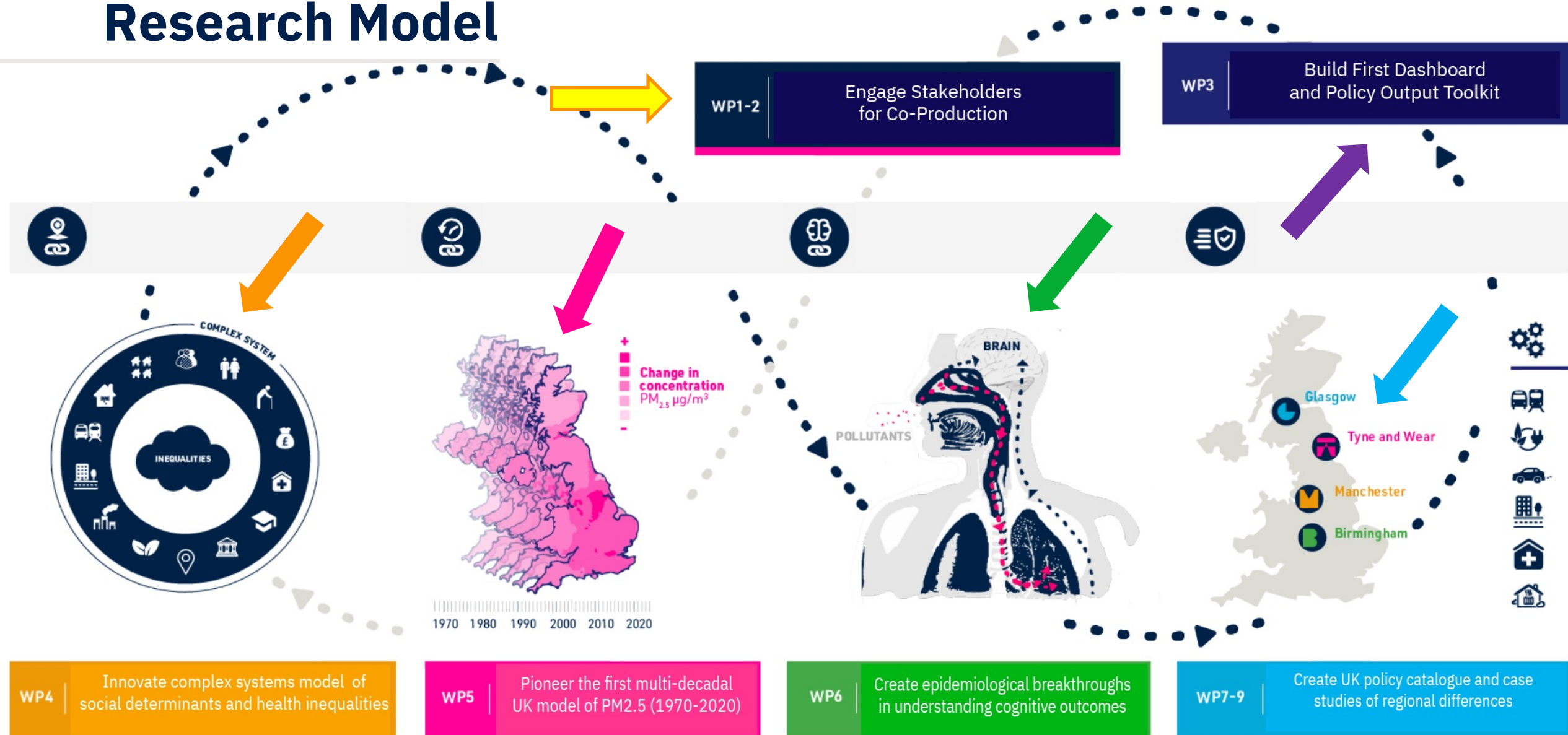
Understand the importance of place – particularly for vulnerable populations in the UK's major metropolitan areas.



Innovate primary prevention policies and strategies.



# Research Model





# Outputs and pathways to impact

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- Advancing **primary prevention strategies**.
- Pioneering **complex systems approach** to primary prevention.
  - Improving **policy process**.
- Establishing **economic risks and benefits**.
  - Alerting and informing the **public**.
  - Preventing **health inequalities**.

**This is our primary prevention legacy.**



A photograph of a city street at sunset. The sun is low on the horizon, creating a strong orange glow and long shadows. Several people are walking across the street. Buildings line both sides of the street, and a few cars are visible in the distance.

Mitigating the impact of air pollution on  
dementia and brain health

Setting the policy agenda





Contents lists available at [ScienceDirect](#)

## Environmental Research

journal homepage: [www.elsevier.com/locate/envres](http://www.elsevier.com/locate/envres)



Review article

### Mitigating the impact of air pollution on dementia and brain health: Setting the policy agenda



Brian Castellani<sup>a,b,c,e,\*</sup>, Suzanne Bartington<sup>d</sup>, Jonathan Wistow<sup>e,c</sup>, Neil Heckels<sup>f</sup>,  
Amanda Ellison<sup>c,g</sup>, Martie Van Tongeren<sup>h</sup>, Steve R. Arnold<sup>i</sup>, Pete Barbrook-Johnson<sup>j,b</sup>,  
Martha Bicket<sup>b</sup>, Francis D. Pope<sup>k</sup>, Tom C. Russ<sup>l,m</sup>, Charlotte L. Clarke<sup>e,n</sup>, Monica Pirani<sup>o</sup>,  
Matthias Schwannauer<sup>n</sup>, Massimo Vieno<sup>p</sup>, Rachel Turnbull<sup>q</sup>, Nigel Gilbert<sup>b</sup>, Stefan Reis<sup>p,r,s</sup>

This paper is the first to outline a policy agenda for addressing the impact of air pollution on brain health and dementia.

Across a two-year period, we engaged our consortium of 20+ academics and 11 cross-sector stakeholder organisations in a series of participatory and consensus-building workshops, meetings, and working groups, as well as conducted an umbrella review for the last ten years of research on the topic.

Our goal was to identify the major domains and priority areas in research, policy and practice needed to inform a policy agenda on the impact of air pollution on brain health and dementia across the life course.

# We arrived at three policy domains:

- Research and Funding
- Education and Awareness
- Policy Evaluation

Within these three domains there are 14 priority areas.

Setting the policy agenda.		
Domains and Priority Areas	Source for identifying priority area	Actionable Items
Domain A: Research and Funding		
1. Embracing a 'complexities of place' approach	Consortium Academics Stakeholders N = 6 Policy Papers	<ul style="list-style-type: none"><li>• Applying a complex systems perspective of air quality and brain health</li><li>• Drawing from the complexities of place literature in public health</li><li>• Augmenting conventional statistics with computational science and Bayesian modelling</li><li>• Taking an interdisciplinary methods approach to modelling</li><li>• Exploring feedback loops and complex configurations of factors to make sense of causality</li><li>• Exploring the role that health inequalities play in the impact air pollution has on brain health.</li><li>• Examining how places create brain health vulnerabilities, such that certain populations are more at risk from air pollution than others.</li><li>• Studying how vulnerable populations may respond to exposure to different levels of air pollution, even levels considered otherwise health.</li></ul>
2. Focusing on vulnerable populations in places	Consortium Academics Umbrella Review	
3. Modelling the impact of ambient PM2.5	Consortium Academics Umbrella Review	<ul style="list-style-type: none"><li>• Building high resolution, long-term exposure models</li><li>• Developing more comprehensive current models for linking aspects of PM<sub>2.5</sub> source types and composition to specific health outcomes</li><li>• Helping to develop current and historical models for those parts of the world where such models are significantly underdeveloped</li></ul>
4. Studying indoor air pollution	Umbrella Review	<ul style="list-style-type: none"><li>• Drawing on the wider literature linking indoor air quality to public health</li><li>• Focusing on this issue for school zones, populations living near busy roads or in cities, and for those vulnerable to even mild air quality issues</li></ul>
5. Making breakthroughs in pathways to disease for brain health	Consortium Academics Umbrella Review	<ul style="list-style-type: none"><li>• Exploring new and multiple pathways to disease beyond just the blood-brain barrier</li><li>• Improving study design and research methods</li><li>• Detailing pathways to disease links and how they are associated with specific forms of brain disease and cognitive impairment</li><li>• Identifying exposure dose levels and stages in the life course critical to brain health</li><li>• Grounding current and future research in a life-course and developmental framing</li><li>• Developing and studying cohort studies</li><li>• Restructuring research funding mechanisms</li><li>• Supporting high-risk, high-payoff science</li></ul>
6. Embracing a life course perspective	Consortium Academics	
7. Radically rethinking funding	Consortium Academics	
Domain B: Education and Awareness		
8. Making this unrecognised public health issue a known concern	Stakeholders N = 6 Policy Papers	<ul style="list-style-type: none"><li>• Developing a global and national agenda to make the unrecognised impact of air pollution on brain health known to the public, government officials, researchers, funding organisations, third-sector organisations, community groups, and business and industry.</li><li>• Initiating local, national, and international awareness campaigns</li><li>• Getting the word out to colleagues in public health and air quality through academic channels</li><li>• Developing lesson plans for primary and secondary schools</li><li>• Co-creating educational products to improve public engagement and collective corrective action</li><li>• Making sure messages are empowering, given that diseases like dementia have no cure</li><li>• Adding air pollution to existing stakeholder campaigns for brain health and dementia</li><li>• Including brain health to current stakeholder strategies around air quality improvement</li><li>• Highlighting known links between air quality and brain health and climate change, as well as the sustainable development goals and strategies</li><li>• Using current evidence on air quality and brain health to bolster existing air quality or brain health campaigns and to demonstrate co-benefits</li></ul>
9. Developing educational products	Stakeholders	
10. Attaching air pollution and brain health to existing strategies and campaigns	Stakeholders	<ul style="list-style-type: none"><li>• Translating historical and current ambient and indoor air quality datasets, dashboards, and models into useable, publicly accessible resources for citizens, healthcare providers, governments, and third-sector and private sector organisations.</li><li>• Developing screening and assessment tools for individual exposure, particularly during early life and at critical points in the life course where air pollution exposure is most impactful.</li><li>• Developing tools for assessing health behaviours, pre-existing conditions, or co-morbid conditions that prevent, slowdown, or exacerbate the impact of air pollution on brain health, including the progression of dementia post-diagnosis</li></ul>
Domain C: Policy Evaluation		
12. Conducting complex systems evaluation	Consortium Academics N = 6 Policy Papers	<ul style="list-style-type: none"><li>• Embracing a complex systems perspective of evaluation for air quality and brain health</li><li>• Drawing from the complexity turn in public policy evaluation to adopt best practices</li><li>• Augmenting conventional evaluation methods with participatory systems mapping, etc.</li><li>• mapping barriers and incentives to change and counterfactuals</li><li>• Engaging in policy evaluation via co-production</li></ul>
13. Engaging in co-production	Stakeholders Consortium Academics	<ul style="list-style-type: none"><li>• Drawing from the wider climate change and air pollution literature on co-production</li><li>• Recognising there are multiple approaches to engagement and co-production</li><li>• Articulating and improving the rigor of the engagement approach used</li><li>• Considering the influence regional, national, and international differences on engagement, as for example countries in the global south versus the global north</li></ul>
14. Evaluating current air quality policies for their brain health benefits	Stakeholders	<ul style="list-style-type: none"><li>• Drawing on existing policies for air quality and public health in general to develop, in the short-term, a catalogue of useful policy guidelines</li><li>• Exploring wider policy needs beyond just emissions reduction</li></ul>





May 2023

# Mitigating the Impact of Air Pollution on Brain Health and Dementia

POLICY AND PRACTICE BRIEF

## Authors

Mohaddeseh Ziyachi,<sup>a</sup> Brian Castellani,<sup>a,b,c,d</sup> Neil Heckels,<sup>e</sup> Charlotte Clarke,<sup>a,d</sup> Neil Fullerton,<sup>f</sup> Peter Barbrook-Johnson,<sup>g</sup> Martha Bicket<sup>e</sup>

- a. Wolfson Research Institute for Health and Wellbeing, *Durham University*, Stockton Road, DH1 3LE, United Kingdom
- b. Durham Research Methods Centre, *Durham University*, Stockton Road, Durham, DH1 3LE, United Kingdom
- c. Centre for the Evaluation of Complexity Across the Nexus, *University of Surrey*, Guildford, GU2 7XH, United Kingdom
- d. Department of Sociology, *Durham University*, Stockton Road, Durham, DH1 3LE, United Kingdom
- e. Research and Innovation Services, *Durham University*, Stockton Road, Durham, DH1 3LE, United Kingdom
- f. *Brain Health Scotland*
- g. Environmental Change Institute, School of Geography and the Environment, *University of Oxford*, United Kingdom

## Contact

Brian Castellani, PhD. FAcSS (Professor of Sociology; Director, Durham Research Methods Centre; Co-Director, Wolfson Research Institute for Health & Wellbeing Durham University, UK).  
Email: [brian.c.castellani@durham.ac.uk](mailto:brian.c.castellani@durham.ac.uk)

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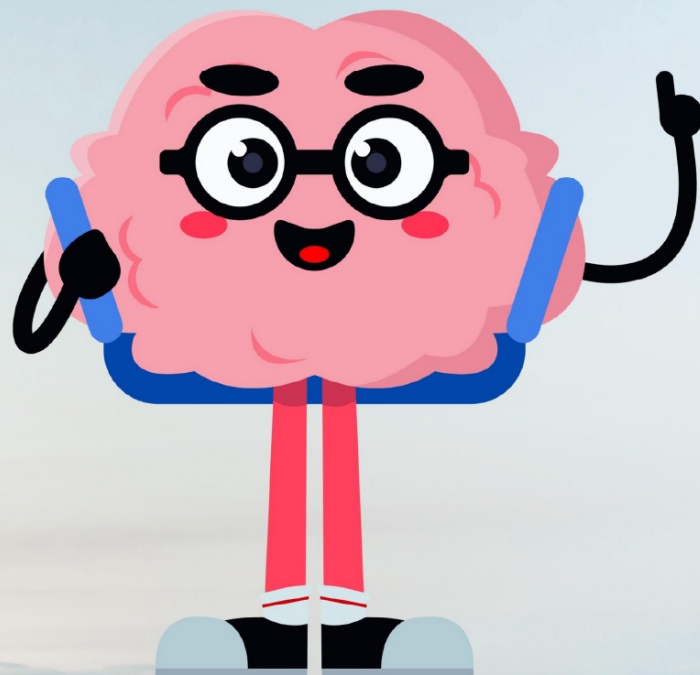
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- InSPIRE: developing a policy consortium to address the social determinants of clean air and brain health. (1 Nov 2021 - 31 Mar 2022) Economic and Social Research Council, Impact Acceleration Account, United Kingdom, RI200189, £6.5k.
- InSPIRE - Consortium Development Grant. (1 May 2020 - 17 Dec 2020) Medical Research Council, United Kingdom, RF010140, RF050391, RF200182, £41k.



# Clean Air and Happy Brain

LESSON PLAN FOR PRIMARY SCHOOLS



# Clean Air and Happy Brain

LESSON PLAN FOR SECONDARY SCHOOLS

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## 1. Embracing a 'complexities of place' approach

- Applying a complex systems perspective of air quality and brain health
  - Drawing from the complexities of place literature in public health
  - Augmenting conventional statistics with computational science and Bayesian modelling
  - Taking an interdisciplinary methods approach to modelling
  - Exploring feedback loops and complex configurations of factors to make sense of causality
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## 2. Focusing on vulnerable populations in places

- Exploring the role that health inequalities play in the impact air pollution has on brain health.
- Examining how places create brain health vulnerabilities, such that certain populations are more at risk from air pollution than others.
- Studying how vulnerable populations may respond to exposure to different levels of air pollution, even levels considered otherwise health.

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### 3. Modelling the impact of ambient PM<sub>2.5</sub>

- Building high resolution, long-term exposure models
- Developing more comprehensive current models for linking aspects of PM<sub>2.5</sub> source types and composition to specific health outcomes
- Helping to develop current and historical models for those parts of the world where such models are significantly underdeveloped

## 4. Studying indoor air pollution

- Drawing on the wider literature linking indoor air quality to public health
- Focusing on this issue for school zones, populations living near busy roads or in cities, and for those vulnerable to even mild air quality issues



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## 5. Making breakthroughs in pathways to disease for brain health

- Exploring new and multiple pathways to disease beyond just the blood-brain barrier
- Improving study design and research methods
- Detailing pathways to disease links and how they are associated with specific forms of brain disease and cognitive impairment
- Identifying exposure dose levels and stages in the life course critical to brain health

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## 6. Embracing a life course perspective

- Grounding current and future research in a life-course and developmental framing
- Developing and studying cohort studies

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## 7. Radically rethinking funding

- Restructuring research funding mechanisms
- Supporting high-risk, high-payoff science

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## 8. Making this unrecognised public health issue a known concern

- Developing a global and national agenda to make the unrecognized impact of air pollution on brain health known to the public, government officials, researchers, funding organisations, third-sector organisations, community groups, and business and industry.
- Initiating local, national, and international awareness campaigns
- Getting the word out to colleagues in public health and air quality through academic channels



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## 9. Developing educational products

- Developing lesson plans for primary and secondary schools
- Co-creating educational products to improve public engagement and collective corrective action
- Making sure messages are empowering, given that diseases like dementia have no cure

## 10. Attaching air pollution and brain health to existing strategies and campaigns

- Adding air pollution to existing stakeholder campaigns for brain health and dementia
- Including brain health to current stakeholder strategies around air quality improvement
- Highlighting known links between air quality and brain health and climate change, as well as the sustainable development goals and strategies
- Using current evidence on air quality and brain health to bolster existing air quality or brain health campaigns and to demonstrate co-benefits

## 11. Providing publicly available monitoring, assessment, and screening tools

- Translating historical and current ambient and indoor air quality datasets, dashboards, and models into usable, publicly accessible resources for citizens, healthcare providers, governments, and third-sector and private sector organisations.
- Developing screening and assessment tools for individual exposure, particularly during early life and at critical points in the life course where air pollution exposure is most impactful.
- Developing tools for assessing health behaviours, pre-existing conditions, or co-morbid conditions that prevent, slowdown, or exacerbate the impact of air pollution on brain health, including the progression of dementia post-diagnosis

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## 12. Conducting complex systems evaluation

- Embracing a complex systems perspective of evaluation for air quality and brain health
- Drawing from the complexity turn in public policy evaluation to adopt best practices
- Augmenting conventional evaluation methods with participatory systems mapping, etc.
- mapping barriers and incentives to change and counterfactuals
- Engaging in policy evaluation via co-production



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## 13. Engaging in co-production

- Drawing from the wider climate change and air pollution literature on co-production
- Recognising there are multiple approaches to engagement and co-production
- Articulating and improving the rigor of the engagement approach used
- Considering the influence regional, national, and international differences on engagement, as for example countries in the global south versus the global north

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## 14. Evaluating current air quality policies for their brain health benefits

- Drawing on existing policies for air quality and public health in general to develop, in the short-term, a catalogue of useful policy guidelines
- Exploring wider policy needs beyond just emissions reduction

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# Questions