Coordinating Research Action: Air Quality & COVID-19 Executive Summary

Background

Air quality is relevant to the pandemic for two reasons. Firstly, the quality of the air indoors and out is important in creating, sustaining or inhibiting conditions for virus viability. Secondly, air pollution is a potentially significant environmental risk factor for groups socio economically and physiologically vulnerable to COVID-19, including those with underlying respiratory or cardiovascular diseases.

Unprecedented changes in living and working patterns during the pandemic are likely to have had a significant, but as yet unquantified, effect on air pollution and our exposure to it. There are questions crucial to our nation's public health that need an interdisciplinary scientific response. Yet there is no UK group with a remit to coordinate across the many disciplines that need to co-operate to address COVID-related air quality knowledge gaps.

On 20 May 2020 an online workshop was held to begin coordinating research action on the interactions between air quality and COVID-19. The workshop was run by the Science and Technology Facilities Council (STFC) Air Quality Network (SAQN) in partnership with the UK Indoor Environments Group (UKIEG) and Air Quality Network UK (AQNUK) in response to requests by the UK Research and Innovation (UKRI) Clean Air Champions.

The purpose of the event was twofold. Firstly, to convene the UK-based research community and establish the current state of knowledge. Secondly, to begin coordinating priority actions that will address critical knowledge gaps. The event was open to researchers in industry, policy, third sector and academia. International participants were welcomed where they could address COVID-related air quality challenges of national importance. In total there were 239 registrants, and over 170 live attendees.

Prior to the workshop delegates completed registration forms capturing initial thoughts on key research priorities and knowledge gaps. The first part of the meeting was held in plenary with invited speakers[1] and provided the context for later discussions conducted via breakout rooms and digital discussion boards. The latter were pre-populated with ideas from the delegate registration forms and were further populated during and after the event.

Research Priorities and Knowledge Gaps

Several **key research priorities and knowledge gaps** were identified, which can be grouped into three interconnected areas:

1. How environmental factors – e.g. outdoor/indoor pollutants, hygrothermal conditions, ventilation and airflow – affect the virus survival, transmission and exposure mechanisms, as well as associated health outcomes. For example:

[1] Note: this document reflects the points discussed at the online workshop on 20th May. The calls to action do not necessarily represent the views of the individual speakers involved in the plenary session.

- To what extent air pollution outdoors and indoors affects viral transmission and/or associated health outcomes?
- How do environmental factors such as airborne pollutants, temperature and/or humidity, increase/reduce virus viability and/or risk of transmission?

2. The extent, significance and overall net effect of changes in emission and exposure patterns, resulting from current lockdown policies, through to the recovery period and the emerging 'new normal' in the upcoming years. For example:
    - Was there a significant net reduction in UK outdoor pollution levels during the COVID-19 lockdown period, and if so could we build on any lessons learnt, in order to support policies to reduce pollution in the near future[2]?
    - Was there an increase in exposure to indoor pollutants, especially within residential environments, during lockdown and/or shielding, due to prolonged time indoors and/or changes in activities at home? Could this have adverse health effects and to what extent can this 'natural experiment' be used to understand further the impact of indoor air quality and the overall impact of the pandemic on public health?
    - How will the recovery period, any further waves of infection and/or the emerging 'new normal', change how we use environments such as the workplace (including home working), schools, public spaces or transport? What will the impact of this be on outdoor and indoor emissions and exposures?
    - How do we design and test interventions so that they are simultaneously able to reduce the spread of the virus alongside maintaining comfortable and healthy working, learning and domestic environments, whilst also addressing - rather than contributing to - the challenges posed by fuel poverty and climate change mitigation/adaptation?
3. Longer term: impacts on air quality of societal, environmental and economic changes arising from COVID-19 and any other relevant policies. These include:
    - What are the synergies and tensions with climate action and sustainable development, particularly climate change adaptation and green recovery?
    - How can we better identify and protect vulnerable populations from the cumulative effects of poor air quality and other inequalities as well as infectious diseases?

Calls to Action

Based on the research priorities and associated suggestions arising from the discussion, the following **Calls to Action** were formulated, which are primarily relevant to researchers and research funding organisations, with some aspects being also relevant to local and national government:

1. Better and more comprehensive data on air quality and exposure is urgently needed, especially for indoor environments. This will require:
    1.1 Building upon and broadening the current urban-focused air quality research supersites; setting up a suite of nation-wide representative sites, indoors and out,

[2] Since the meeting was held, AQEG have published their report following the rapid call for evidence on Air Quality and COVID-19. The report contains evidence regarding UK outdoor pollution levels, and will be valuable in terms of building on lessons learnt in the future.

https://uk-air.defra.gov.uk/library/reports.php?report_id=1005

paired wherever possible, in urban and rural locations, for long-term multi-observation monitoring of air quality.

1.2 Agreeing on minimum standards and harmonised protocols for monitoring indoor air, to be adopted in separate monitoring campaigns and individual research projects;

1.3 New networks of intensive, and, or, high resolution monitoring stations in representative indoor public spaces are needed to understand the occurrence and transmission pathways of the virus in indoor environments, and any potential links with environmental factors including air pollutants. This will necessitate active sampling of air, as well as the swabbing of surfaces and could include other forms of sampling;

1.4 Running citizen science projects using low-cost sensors in homes and schools to help build a better understanding of indoor air quality and its significance for public health, to increase public awareness.

2. Connecting existing air quality models and data to inform predictions

2.1 Optimise collection and unify curation of the many types of relevant air quality models and data on both emission generating activities and exposure. For example, any data regarding the lockdown period, to help model emissions and, or, exposures and the associated health and societal impacts before, during and after lockdown. This could help inform approaches in the eventuality of a further wave of infection. Such information could include data from smart meters, household surveys, time use diaries, any other relevant personal exposure studies alongside outdoor pollution data from established and new air quality ground-based monitoring instruments and other Earth observation devices such as satellites.

2.2 Air quality data and models should be used to help address questions such as:

a) What is the net impact of working from home, in terms of indoor/outdoor emissions and personal exposure?

b) Does exposure to poor air quality make people more susceptible to COVID-19 and does it impact the severity of disease? and/or;

c) Are any links between COVID-19 incidence and air pollution attributable to other factors such as housing conditions and social inequality?

3. Control strategies indoors and potential links with other issues

3.1 There is emerging evidence that increased ventilation, bringing external air into buildings, may help control viral transmission but information is needed on optimal ventilation rates versus indoor occupancy levels.

3.2 Optimum ways should be identified of managing building ventilation through different seasons, and especially in winter, in the context of the UK's Net Zero commitment and inequalities such as fuel poverty. Consideration must be given to tailoring such strategies to mechanical and natural ventilation, whereby the vast majority of buildings in the UK are naturally ventilated;

3.3 Interventions such as regulation, standards and policies are needed to ensure that buildings and other public enclosed and semi-enclosed spaces (e.g. transport forms and stations) are designed/retrofitted and managed to combat exposures to poor air quality and reduce viral transmission risk.

4. Policies and tools for harnessing co-benefits; transforming shorter-term changes in behaviours into longer-term collective lifestyle and workplace changes.

4.1 Identification of policies and tools including digital ones, which can build on any positive changes in travel mode and/or emissions/exposures arising from lockdown and recovery policies, thus engraining positive changes in daily life, travel and work in the long term for improved indoor and outdoor air quality and better health and wellbeing;

4.2 Strategies or incentives should be introduced to test for, and mitigate the risk of, unintended consequences of COVID-19 policies on air quality emissions/exposures, particularly for socio-economically disadvantaged groups;

4.3 Interventions such as strategies, tools and policies are needed to increase public awareness and understanding of the value of good air quality, informed by improved access to current and future robust evidence on the links between air quality and the COVID-19 pandemic.

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