AIR QUALITY INFORMATION SYSTEM REVIEW STEERING GROUP

Year 1 Report

Prepared for:

Department for Environment, Food and Rural Affairs; and
UK Health Security Agency.

Air Quality Information System Review Steering Group

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This is a report from the Air Quality Information System review (AQIS) steering group to the Department for Environment, Food and Rural Affairs and UK Health Security Agency, on the work of the steering group in the first twelve months of the AQIS review. The information contained within this report reflects only the views of the members of the AQIS Review Steering Group, independent of government policy.

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Terms of Reference

The purpose of the AQIS Review steering group is to provide direction and oversight for a programme of work considering the effectiveness of the current air quality information system and to recommend possible updates to the Daily Air Quality Index (DAQI) and broader air quality messaging channels. The role of the steering group will be to advise on the scope of work needed to assess how an effective air quality information system can best function and what changes are needed to the current system.

The group will consider the nature, uptake, and impact of an air quality information system that seeks to both reduce people's exposure to air pollution and encourage personal action to reduce emissions. The steering group will decide what the review should prioritise, but foreseeable areas of interest include reviewing the latest evidence and understanding of:

- the range of and levels at which air pollutants impact human health (and their implications for cut-points used in the DAQI)
- the associated actions that the general public and at-risk groups are advised to take to protect their health, including differentiated advice for different groups
- actions that the general public can take to reduce air pollution, including specific actions that could be taken to lessen the severity of particular types of short-term episodes of poor air quality
- the system(s) by which advice could be most effectively communicated to the public (and at-risk groups)
- how to provide impactful messages and effective and actionable advice to different groups, considering people's responses to messages and the risk of unintended consequences
- the potential impact that improvements to the air quality information system could have and determine what measures of success should be for future evaluation

The steering group is expected to make final recommendations in December 2023

Membership

Chair

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Department for Environment, Food and Rural Affairs

Scientific Advisor to the Chair

Prof. Stephen Holgate
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Members

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Executive Summary

Defra, the UK Health Security Agency (UKHSA) and the Department of Health and Social Care (DHSC) have initiated the Air Quality Information System (AQIS) review, a two-year project to review the provision of air quality information in the UK and recommend ways it could be improved in future. AQIS is led by an interdisciplinary steering group of experts and representatives from central government, local government, and the public. The steering group has met six times between December 2021 and March 2023. To support the steering group, several evidence projects have been commissioned.

Over the first year of the AQIS review, the steering group has worked to identify the strengths and weaknesses of the existing air quality information system, considering the accessibility, appropriateness, and impact of current information provision. They have also reviewed the capacity of the existing baseline capacity of existing technology for air quality information provision. These discussions have generated several principles for future air quality information provision, which are likely to have a positive impact on public awareness of the issue:

- Health advice should be clear, actionable, evidence-based, and paired with advice about how to reduce personal contributions to air pollution.
- The cut-points used to determine whether the public is alerted to air pollution levels should reflect the desired outcome of alerting the public, and how the frequency of alerts is likely to affect public responses to them.
- Air quality messaging should be consistent across the UK, and accessible to all.
- Air quality public health messaging should be framed within the Government's wider public and environmental health agendas.
- Improved public messaging is needed on long-term exposure to air pollution.
- Wider accessibility to long-term air pollution metrics linked to home location may increase public engagement beyond vulnerable groups and severe episodes

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1 Background

1.1 Purpose of the review

As part of the Government's response to the Coroner's recommendations following the tragic death of Ella Adoo-Kissi-Debrah, the Department for Environment, Food and Rural Affairs (Defra) and the UK Health Security Agency (UKHSA) initiated a two-year project in 2021 to review the provision of information and related communication systems that are used to engage with the public on issues related to air pollution and health in the United Kingdom. The review was agreed as a priority for Defra, the Department of Health and Social Care (DHSC), UKHSA and the chairs of the Air Quality Expert Group (AQEG) and the Committee on the Medical Effects of Air Pollution (COMEAP). The AQIS review takes a comprehensive view of the air quality information system. The following types of information are therefore encompassed:

- Information systems that describe current and past measured concentrations of pollution; for example, those derived from monitoring networks.
- Information systems that generate short-range predictive forecasts and warnings on future air quality episodes, principally derived from models and targeted at the public and specifically at-risk groups.
- More general air quality information, for example generic information about the health or environmental effects of air pollution, or sources of emissions.
- Advice for the public and at-risk groups on how to reduce their exposure and contribution to air pollution.

The headline objectives of the review are:

1. To evaluate the extent of the use, application, and general effectiveness of current air quality information systems, including those provided by Defra through channels such as the UK-Air website, and complementary systems provided by other public and private organisations, and,
2. To provide recommendations to Defra on the scope and nature of the work needed to assess how air quality alert and advice systems can best function, and any changes that are needed to the current system. Beyond alerts and warnings, the review will consider lessons learnt and developments from wider environmental, health and behavioural interventions to improve the quality and reach of advice on air pollution and its health impacts.

A significant component of current air quality information systems is the provision of information to the public in the form of a DAQI. The DAQI provides a more simplified composite metric on air quality designed to communicate real-time and forecast levels

of outdoor air pollution in the short term in a way the public can understand. The AQIS steering group will consider how effective the DAQI is as a tool for communicating air quality information to the public. This may also include recommendations for further technical work to help improve DAQI as a health-based intervention.

Further details on the remit and potential scope of outcomes from the steering group advising the review can be found in an expanded form in the steering group terms of reference and meeting minutes, published on UK-Air.

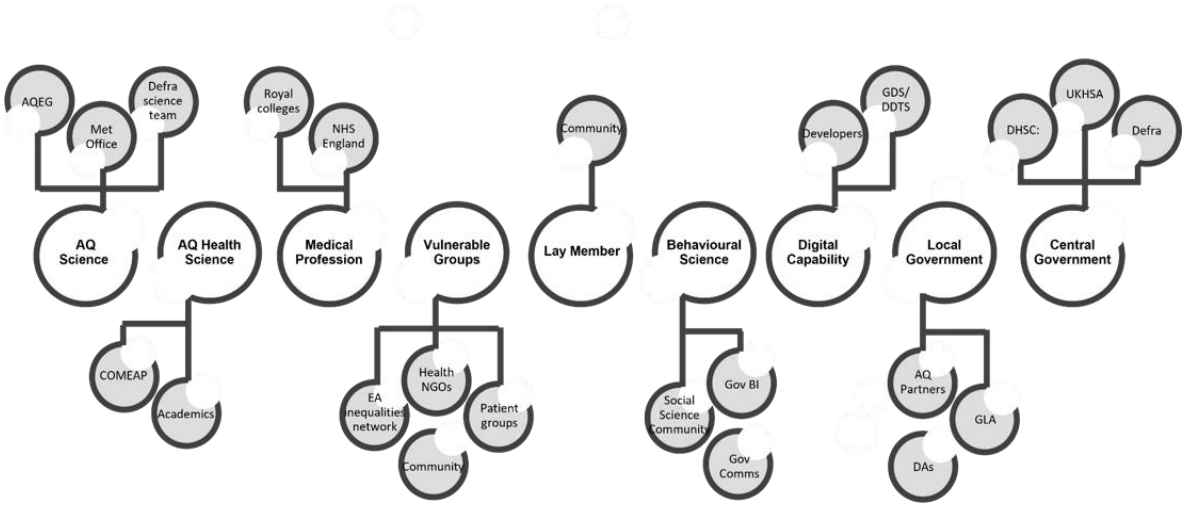
1.2 Steering group membership

The AQIS review is taking a holistic view of the effectiveness and value of air quality information for the public. To achieve this Defra and UKHSA have facilitated the formation of the AQIS steering group, drawing on external expertise and insight from a range of different stakeholders and disciplines. The membership of the steering group is drawn from scientific, health, policy and charity sectors and includes lay representation.

The organisational structure of the review is to use subject-matter and sectoral specialists and their networks as a conduit for dialogue and input from other communities. This is shown in schematic form in Figure 1.

In the first year of the review, individuals on the steering group have advised on different aspects of air quality information. This has been contributed to by their wider networks visualised in Figure 1- sometimes in the form of written submissions and reports on specialist topics, in other cases through verbal feedback. In the areas of the review where the need for further insight and information has been identified the secretariat have either undertaken that research and evidence gathering in-house, or commissioned external organisations to provide support.

Figure 1: Membership of the Steering group and wider evidence networks



1.3 Review mechanics and outputs to-date

The steering group have met seven times between December 2021 and April 2023. Members of the steering group have also met several times in working groups focused on specific questions. Several external organisations and individuals have contributed to these meetings over the course of the first year. These contributions are listed in Table 1 below.

Table 1: List of external contributions to steering group meetings

Individual /Organisation	**Meeting Attended**	**Contribution**
Jo Churchill MP, Defra Parliamentary Under-Secretary of State for Agri-Innovation and Climate Adaptation	04/03/2022	Provided ministerial endorsement for the work of the steering group.
Met Office	04/03/2022 29/04/2022 14/10/2022 02/02/2023	Advising on forecasting capacity and dissemination
Greater London Authority	29/04/2022	Presented evidence on the functioning and reach of London's air quality information services
UKHSA Behaviour Science and Insights Unit	14/10/2022	Presented evidence from UKHSA led project on DAQI messaging for people with asthma
Global Action Plan	14/10/2022	Presented evidence from internal research exploring communicating air quality information to children, and how GPs can help communicate air quality information.

Several externally commissioned projects, sub-group and network reports and discussions were initiated during the first year of the review. Some of these have reported back already, others are works in progress. The major outputs to date from the review are listed in Table 2 below.

Table 2: External Commissions and Reports

Activity	**Contributors**	**Output**	**Status**
Current and future air pollution modelling	AQEG members, Met Office, ECMWF, NCAS, ICL, Defra	Sub-group meeting Summary note to AQIS	Complete
Engagement on potential new uses of existing Defra data	AQEG members	Recommendations to AQIS via AL	On-going
Survey of people with lung conditions to assess current engagement with alert systems.	A&LUK	Alerting the Nation report	Completed
UKHSA air quality stakeholder event	UKHSA, attendees of the 2022 UKHSA Air Quality stakeholder event	Results of the AQ stakeholder event AQ communications survey	Complete
Rapid evidence assessment to identify groups at risk of adverse health effects from air pollution due to individual characteristics	AQIS Secretariat, Imperial College London	Written report, presentation of findings to AQIS steering group	On-going
Quick scoping review to identify groups at risk of elevated exposure to air pollution	AQIS Secretariat, Air Quality Consultants, Institute of Occupational Medicine, Aether	Written report, presentation of findings to AQIS steering group	Complete
Evidence review of the effects of exercise during	AQIS Secretariat, University of Leicester	Written report, presentation of findings to AQIS steering group	Complete

periods of elevated air pollution			
Formation of the AQIS qualitative research panel	AQIS Secretariat, Kantar	3 waves online community research, report / presentations to AQIS steering group	On-going
Formation of COMEAP AQIS sub-group	AQIS Secretariat, COMEAP Secretariat, COMEAP	Sub-group meetings, Report to AQIS	On-going

2 Insights from the steering group on current provision

The early meetings of the steering group focused on identifying existing baseline capabilities for providing air quality information to the public, and the strengths and weaknesses of the existing system. Later meetings identified potential areas of opportunity and helped guide the secretariat in commissioning further work, both in-house and external.

2.1 Technical capabilities of air pollution models and monitoring data

The steering group found that there is substantial existing technical capability for providing air pollution information. For example, a short review by the Air Quality Expert Group (AQEG) reported that the UK had a world-leading atmospheric emissions inventory that provides a level of information and granularity on sources of pollution that goes well beyond what is required to meet regulatory reporting needs.

The UK has an extensive national network of around 200 air quality measurement sites (the Automatic Urban and Rural Network, AURN), operated to high standards, that provide publicly available data in close to real-time. This is supplemented by local authority monitoring and some research data, although real-time and public accessibility of that data is patchier. Notably data from NO_2 diffusion tube networks and research supersites is often only released to the public many months after the measurements were made.

The combination of emissions inventory and monitoring data allow Defra to produce annual estimates of ambient air pollution concentrations at 1 x 1 km resolution for the whole of the UK. In some cities estimates of air pollution are made at higher resolutions than this, for example using the ADMS-Urban model which operates at the metre scale.

The technical capability to model air quality and produce short-range (0 – 5 day) forecasts was also considered to be advanced (see the summary note on current and future air pollution modelling by AQEG members and others). Whilst models can always be refined and improved further, the skill and resolution of existing systems was likely sufficient to reliably provide advice in advance of the onset of severe air pollution episodes. Models can provide these forecasts with geographic accuracy at the county-to-regional scale. [This would mean that a forecast would currently correctly identify which counties in England would be most affected by a high air pollution event, but not individual hotspots within those counties]. Air pollution forecasts are now being produced as ancillary data products of several operational weather forecasting models; for example, from the Met Office, European Centre for Medium-range Weather Forecasting (ECMWF) and NASA. Operational weather forecasts, and by extension air quality forecasts, therefore have very high levels of redundancy and robustness against system failures. The embedding of fine scale 'street-level' modelling of pollution is also well-advanced with this capability moving from research applications into more routine operational use.

In combination, the steering group considered that there was a significant existing capability to generate data (past, present, and future) on air quality in the UK. However, this was not in many cases being exploited to its fullest potential by users outside of the research community.

Whilst sustained investment in both monitoring and modelling is vital to support air quality information systems at the cutting edge of what is possible, a key conclusion from the early phase of the review was that providing better information to the public is not substantially constrained by any fundamental technical limitations, either in measurement or modelling. Whilst this indicates a positive starting position for a national AQIS, the optimal access and use of such data resources is a separate matter and may be less well-developed.

2.2 Problems with existing information system

Beyond underpinning technical and scientific capabilities, the steering group identified a range of issues that related to current **accessibility**, **appropriateness,** and **impact** of information for the public on air quality. Key review messages are identified below:

2.2.1 Accessibility

- Whilst a range of telephone and mobile air quality alert systems already exist in the UK, anecdotally steering group members and their networks reported a relatively low level of subscribers for these services amongst their constituents.

- The steering group provided anecdotal examples of where low participation in the use of alerting services could be attributed to a lack of awareness and signposting from health professionals. Such information sources may be helpful to those managing underlying health conditions where air pollution is an aggravating factor. Services that require opt-ins and sign-ups may create unintentional barriers to engagement with target groups.

- Members identified that there is often a poor user experience with alert systems, and that whilst information is often made publicly accessible, finding that information could be difficult and the format not always accessible to non-specialists.

- Existing air quality information sources tend to be directed at users with higher levels of data skills and scientific knowledge. There is a lack of relevant channels to communicate with harder to reach groups such as those who are digitally excluded or groups lacking English language skills

- Scientific literacy on air pollution, its causes and health effects were considered to be poor, with limited coverage of the topic in the school curricula, and educational provision rarely extending beyond primary education.

2.2.2 Appropriateness

- Defra air pollution forecasts are typically county-to-regional in geographic scope and lack street or postcode-level details that may help support direct behavioural adjustments; for example, providing guidance on the avoidance of hotspots in cities or by roads.

- The health advice provided alongside air pollution warnings may not always reflect the latest scientific evidence or the best available forecast resolution and is often too general. For example, blanket advice to avoid outdoor exercise may dissuade people from exercising at all, or unnecessarily caution against exercise during periods of the day when pollution may actually be low. This may cause harms in the long term.

- Since the last DAQI review, scientific evidence has increased, and clinical advice/management has been updated which isn’t reflected in current health advice which accompanies the alerts.

- Different sources of information can result in a lack of consistency in data or messaging between providers of air quality information. Persistent disagreements between forecasts, or inaccurate forecasts may damage public trust. Media reporting of severe air pollution episodes typically defaults to the worst-case forecast.

- Current alerting systems do not communicate the accumulation of risks that occur when air pollution stay high over any days. At present air pollution is presented as a short-term hazard, similar to severe weather episodes with little emphasis being placed on providing data and advice on longer-term, for example annual exposure.

- There is now some divergence between the current DAQI cut-points and scales for air quality and those warning cut-points which might be inferred from new PM targets in the Environment Act (2021), the 2021 updated World Health Organisation (WHO) Air Quality guidelines, or other proposals for lowered air quality limit values.

- Current information systems which focus on very high-air pollution episodes and related health advice puts the onus on at-risk individuals to changing behaviour. Air pollution affects everyone with negative effects on health throughout the life course, from pre-birth to old age and disproportionately affects those in more vulnerable groups. There is little to no public communication or messaging related to changed behaviours that would lead to reduction in polluting activities and emissions.

2.2.3 Impact

- There is a lack of evidence on the extent to which individuals change their behaviour based on current alerting systems, including those receiving alerts directly (for example to their phones), or less targeted forecasting of air pollution levels (for example through weather apps). In part this may be because data sources are promoted generically and do not require/request any feedback from users. There may be value in more targeted delivery in the future with an emphasis on evaluating behavioural change impact on the user.

- Central and local government may not necessarily be viewed by some sections of the public as the most appropriate or trusted messenger for air pollution alerts. For example, vulnerable groups to air pollution exposure with underlying health conditions are considered more likely to respond to information provided through their health practitioner with this information seen as specific and tailored to their needs. Wider promotion and dissemination to the population is unlikely to have the same impact on those that may benefit most from receiving and acting on information provided.

- There is not always consistency in messaging between different information providers. This can relate to a previous point made around short-term alert messages and long-term pollution annual trends. It does not translate that if an area has few or no alerts that air quality is good on a long-term basis. Annual averages in this case could indeed be high.
- No matter how scientifically advanced the underlying information systems may be, overly technical and unrelatable information will reduce engagement and impact.
- Without a general understanding of air quality information and the difference between long and short-term exposure, specific alerts may not be understood and considered to be confusing and/or contradictory.

3 Improving future provision of information – early insights

Initial discussion by the steering group identified a range of changes to the existing provision of information on air quality that were considered both technically possible and likely to have positive impacts. At this stage in the review steering group's advice is at a relatively high level, setting out a general vision for air quality information rather than specifics of its delivery. Key agreed principles include:

- Health advice should be clear, actionable and evidence based. Any provision of health advice should consider all-round wellbeing and be tested to avoid unintended adverse consequences. It should also include advice about how to personally reduce contributions to air pollution. Education should be improved on how to reduce exposure to air pollution to reduce chances of both long- and short-term health effects.
- Any revision to DAQI cut-points should consider what the desired outcome of alerting the public is, and how frequency of alert may impact behaviour change. There may be a role for AQEG and COMEAP in determining whether a revision of relevant pollutants and concentrations is needed.
- Timely and accurate air quality information should be accessible to all and reflect differences in requirements that exist in delivering equitable outcomes on the basis of protected characteristics, language and accessibility needs.
- Messaging on air quality, actions and advice should be consistent across the whole of the UK, even if the cut-points for warnings differ based on geographic

factors. In some cases, the nature of the hazard might require locally targeted information (for example moorland fires, industrial accidents).

- Consideration should be given to how the effects of air quality and health are framed within wider public health and environmental agendas (e.g., obesity strategy; net zero). Linkages between different health objectives and strategies should be made clear, for example between active travel and health, net zero and reduced pollution emissions.

- Improved public information is needed on year-round exposure to pollution, going beyond warnings of severe episodes for high-risk groups. Such information may be highly relevant to health providers who may need to find links between symptoms and possible persistent air pollution exposure.

- Wider accessibility to long-term air pollution metrics linked to home location may increase public engagement beyond vulnerable groups and severe episodes. For example, annual air pollution data may be made easily accessible alongside other widely used national datasets, for example schools performance, crime statistics and so on.

4 Priorities for next stage of the AQIS Review

Having established the current baseline capability and principles for future development, the review identified a number of priority areas for further development. The next year of the review should consider two distinct but interrelated elements of the air quality information system:

- The provision of air quality alerts (messages/advice triggered by specific poor air quality conditions and targeted at specific at-risk groups);

- Development of wider air quality information (general messaging and public/professional awareness including information to promote actions and behaviour change for emissions reduction).

An improved air quality information system should be seeking to achieve communication that is fit for purpose, and accessible to all. Such a system should explain why air pollution is a considered a hazard and who is most at risk from harm. A key requirement for Defra to consider in next steps is that future alert systems should not put sole onus for change on the most vulnerable and should add emphasis to reaching the public more widely to change polluting behaviours. The steering group agree that advice provided during air pollution episodes should support the public to take action to reduce their exposure, but also provide advice on ways the public can reduce their contribution to air pollution. The second of these two aims would be new

and go beyond existing strategies that aim to provide alerts prior to and during an elevated pollution event. Taken in combination such an approach should support:

- Increased public awareness of the major sources of air pollution and the day-to-day actions people can take to reduce air pollution emissions.
- Increased awareness of the harmful health effects arising from air pollution and the activities people can take to reduce that exposure.
- Greater awareness of where to access real-time air quality information, forecasts, and historical data of relevance to their local environment.
- Improved public confidence in source of information that are provided on air pollution more generally, through increased transparency on how such data is generated, quality assured and independently validated.
- Provision of advice and information that the public find engaging and where individuals have both the agency and motivation to action.

5 Forward Work Programme

Defra and UKHSA have developed a work programme that has been guided and shaped with input from the steering group and which the group supports. This is currently being delivered in five streams of activities, summarised in Figure 2 below. Taken in its totality the steering group considered that this this would cover the breadth of evidence and advice needed when considering the design of a future information system. The workstreams were considered well placed to address the following requirements for year 2:

- Further precision in the definition of who the key target audiences are for air quality information, their various information needs and how best to reach them.
- Improving the communication of air quality risks: more evidence is required to inform strategies that can best to communicate what are the short-term hazards alongside longer-term annual air pollution risks.
- To consider whether a technical refresh of the DAQI pollutants and cut-points is required to reflect changing national air quality standards and international guidelines. Pollutant-specific forecasts should also be considered since these may allow for better directed advice on actions to reduce emissions depending on prevailing source.

- To evaluate the use of higher time-resolution in forecasts rather than a single daily index, and to produce annual summaries of pollution at the postcode/street level to help bridge the gap between day-to-day perceptions of pollution and DAQI forecasts.
- Developing a communications plan that provides clear and consistent messaging that identifies air pollution as both an acute hazard to some communities and a general hazard to all.
- Identifying the most trusted messengers for air quality information, including those working in the healthcare, charitable and commercial sectors.
- Considering how evidence systems may be designed to allow for an evaluation of the impact and effectiveness of air quality information systems, current and future.

Figure 2: AQIS Workstreams