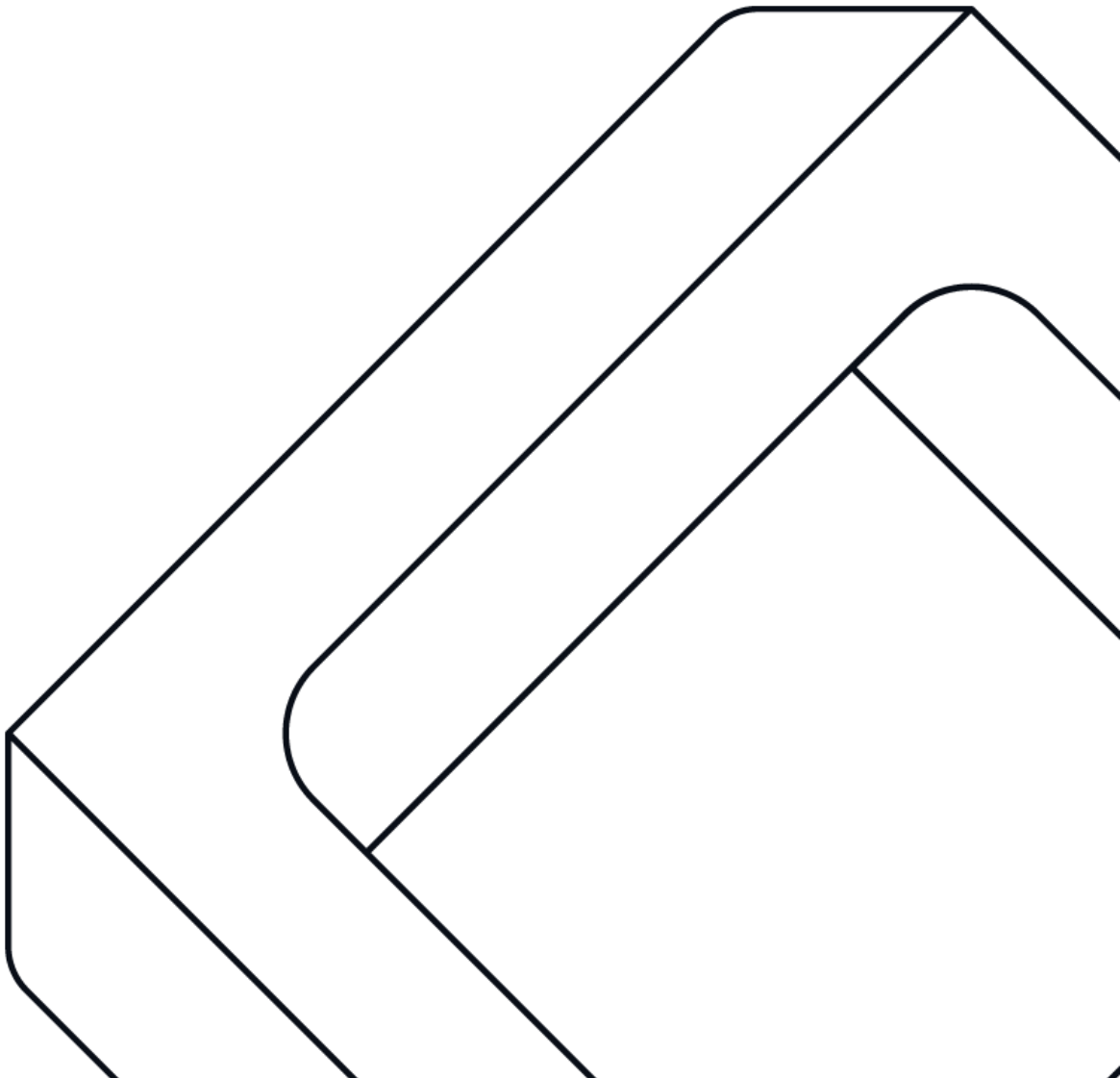
Air quality qualitative research panel

February 2024



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Glossary

Air pollution: The extent to which air is polluted by airborne contaminants. The Daily Air Quality Index provides information on levels of the following pollutants: nitrogen dioxide, sulphur dioxide, ozone, particles smaller than 2.5µm (PM2.5), and participles smaller than 10µm (PM10).

Air quality: The extent to which air is clean and unpolluted. This has an inverse relationship to air pollution – high air quality equates to low air pollution.

CPOD: Chronic Pulmonary Obstructive Disease.

DAQI: Daily Air Quality Index, which has been developed to provide information about levels of air pollution in a simple way and give recommended actions and health advice based on this. The index is numbered 1-10 and divided into four bands (low, moderate, high and very high).

HCPs: Healthcare practitioners, including GPs, pharmacists, consultants, midwives, health visitors and asthma and diabetes nurses.

1. Executive Summary

1.1. Background to the research

In December 2021 Defra, the UK Health Security Agency (UKHSA) and the Department for Health and Social Care (DHSC) launched the Air Quality Information System (AQIS) review in response to growing awareness of the need to improve the provision of air quality information to the public.

This report details the findings of qualitative research commissioned by the group steering the review to explore how the public can be supported to reduce their exposure and contribution to air pollution.

Overall research objectives were to:

- Establish deeper understanding of the knowledge, attitudes and behaviours of the general population and 'at risk' groups, with regard to air pollution (avoiding it, and reducing contributions to it).
- Elicit insight into the barriers and facilitators that influence behaviours in this context, and other factors relating to communications that seek to change behaviours.
- Develop communication strategy that takes into account the understanding and insights generated in the project.

The research was conceived as a collaborative project conducted with 30 members of the public over a period of six months, so that insights and materials could be developed iteratively and longitudinally. The research was conducted across three waves of activity, addressing specific research questions that related to the key overall objectives, and involved panel members participating in group discussions and online tasks.

Findings should be interpreted as indicative, as this sample was a relatively small and hetereogeneous so may not be fully generalisable to the whole of the population.

1.2 Key findings

Air quality was not top of mind for participants and there was a lack of awareness of and clarity on: the causes of air pollution, and how to reduce it; its overall impact on people and nature; and how to mitigate experiencing the health risks of air pollution. Participants were unfamiliar with different air pollutants and did not know what the main causes of air pollution are. There was limited awareness of indoor air pollution and how domestic behaviours can affect this. They were also unaware precisely how air pollution can negatively affect human health. Few participants were aware of air quality information.

When comparing the findings of this research from previous studies[1], it appears that public opinion on, and the salience of the issue, has not developed significantly in around ten years. The findings from this research suggest that this is due to the complexity of the topic and the fact that there are inhibitors to behaviour change working at multiple levels, beyond individual decision-making. For example, at a social level, there will need to be work to raise awareness of air quality as an issue, people do not talk about air pollution or see how other individuals or organisations are acting to reduce it, which reduces motivation to change and fails to provide a sense that individual action can make a difference. Additionally, participants perceived there to be a lack of reliable infrastructure to support individuals to make relevant choices: in this research participants emphasised the future importance of provision of a joined-up public transport network, electric vehicle charging points and access to low-carbon heating systems.

There were also variations in terms of participants' situations, which affected individuals' propensity to change their behaviour. Key dimensions for these variations were around confidence in health and perceived agency to act in response to air pollution. Those who felt less confident about their health were more motivated to act in relation to air pollution in general, especially to reduce their exposure to air pollution. Those who perceived they had greater agency felt more able to act to change their behaviour, especially around their contribution to air pollution. This meant that different groups had different perceptions of actions that were relevant for them, and different channels through which they can be reached. This means that future communication strategy needs to take this into consideration and provide a range of behaviour options to ensure that everyone can feel as though they can engage in this context.

Within this broader set of requirements for change, participants agreed there is a role for communication to:

- Raise awareness of the topic generally, especially regarding the health impacts of air pollution, pollutants and sources of air pollution, and what people can do to reduce their contribution and exposure to air pollution. Ideally this would be provided in a 'share-able' format to encourage people to disseminate it throughout their social networks. It will be important to specify what precisely people can do, taking into consideration the range of different situations people find themselves in, ensuring that there are options relevant for people on lower incomes, without access to cars, who live rurally and/or who have restricted mobility.

- Target participants more at risk of the negative health impacts of air pollution, giving details of symptoms to be aware of and how to reduce risk, via signposting by healthcare practitioners. This may also be appropriate at 'moments of change' in people's lives, such as having children or being diagnosed with a relevant health condition.

- Establish access to simple, up to date, localised air quality forecasts via weather forecasts, web pages and apps, disseminated by weather information providers and news channels.

- Support the provision of information that guides purchase decisions, such as air quality product ratings, online calculators to assess the costs of different choices and opinion pieces from influencers and testimonies from general public users that provide 'word of mouth' feedback on different options.

- Develop means of enabling people to see the impact of their past decisions or potential future decisions, for example by allowing them to input information about their own local area or property so they can see relative levels of air pollution (both indoors and outdoors).

The current Daily Air Quality Index was explored with participants and, although this was generally well received and understood, some developments were suggested by participants, especially around simplifying the colour coding, and clarifying the meaning of the readings and how people can best respond to the advice given.

Further guidelines also emerged regarding how to best communicate in this context:

- Information framed around health harms is particularly impactful, especially if the information focuses on the extent and details of the harms.

- Information is most successful where it uses impactful headings, clear broken-down sections, lay terms and is delivered in a 'layered' manner, linking readers on to further information if they wish to access it.

- Use of a ‘red, amber, green’ traffic light system for communicating risk is familiar and well established, and so is generally interpreted correctly.

- Use of infographics can help to increase understanding and salience of air quality if these are kept simple, positive, actionable and ‘share-able’.

2. Background and aims

2.1 Background to the research

Air pollution is an environmental threat to human health and, while air pollution is harmful to everyone, its harms are not felt equally. It is a particular risk to some people, including elderly people, young children, and people with underlying respiratory and/or cardiovascular conditions. In addition, some groups and communities experience poorer air quality where they live, work or go to school and are therefore disproportionately impacted by pollution. With advanced warning of poor air quality people can modify their behaviour to reduce their exposure to air pollution, which could help reduce the severity of any symptoms they experience. The provision of timely air quality information may also allow people to modify their behaviour to reduce their personal contribution to air pollution.

The UK-AIR website is currently Defra's main channel for sharing air quality information with the public. A fundamental component of UK-AIR is the Daily Air Quality Index (DAQI), which provides near real time air quality measurements to alert the public about short-term changes in levels of air pollution, as well as providing a short-range air quality forecast. The current DAQI is based on recommendations made in 2011 by the Committee on the Medical Effects of Air Pollutants, to provide accessible information to the public on air quality.

Defra, the UK Health Security Agency (UKHSA) and the Department for Health and Social Care (DHSC) have launched the Air Quality Information System (AQIS) review in response to growing awareness of the need to improve the quality and provision of air quality information to the public. The AQIS review also forms part of the government's commitments to address matters of concern raised in the Prevention of Future Deaths coroner's report (April 2021) following the inquest into the death of Ella Adoo-Kissi-Debrah. The review is being guided by an external steering group consisting of multi-disciplinary experts spanning air quality science, health science, behavioural science and digital communications, as well as lay representation, representation from health charities and local and central government. The role of the steering group is to provide direction and oversight to the review, ultimately to propose a series of actionable and evidence-based recommendations for changes that could be made to improve the government's provision of air quality information.

This report details the findings of qualitative research commissioned by the steering group to explore how the public can be supported to reduce their exposure and contribution to air pollution. The research was conceived as a collaborative project conducted with members of the public over a period of six months, so that insights and materials could be developed iteratively and longitudinally. The research was conducted across three waves of activity, addressing specific research questions that related to key overall objectives.

2.2 Research questions

Overarching research objectives

The overall objectives of the research were to:

- Establish deeper understanding of the knowledge, attitudes and behaviours of the general population and at-risk groups, with regard to air pollution (avoiding it, and reducing contributions to it).
- Elicit insight into the barriers and facilitators that influence behaviours in this context, and other factors relating to communications that seek to change behaviours.

- Develop communication strategy that takes into account the understanding and insights generated earlier in the project.

Wave 1 focus

- What are participants' pre-existing perceptions and understanding of air pollution?
- What do participants think of current air quality information provision?
- What drives participants towards certain information sources?
- What air quality information do participants want/expect to be able to find?
- Who do participants want to receive air quality information from?

Wave 2 focus

Behaviour change

- How can air quality information support people to take actions to reduce their personal contribution to air pollution?
- How can air quality information support people to take actions to protect their health from the effects of air pollution?

Communicating risk

- How does the choice of language/numbers used in air quality risk communication impact how people understand/interpret the message being conveyed?
- How does the choice of colour used in air quality risk communication impact how people understand/interpret the message being conveyed?

Wave 3 research questions

Leveraging existing opportunities

- What is the role of verbal communication in the dissemination of air quality information and what are the peer-to-peer opportunities afforded by interpersonal relationships (social, familial, professional, educational)?
- To what extent are there 'Moments of Change' in an individual's life course that might provide opportunities to leverage air quality related behaviour change?
- Which are the most influential factors and key actors when making decisions that have a long-term impact on future polluting behaviour?

Testing new materials

- How do participants interpret and respond to air quality risk communications, where risk is defined based primarily on longer-term pollution levels, rather than short-term health effects?
- Can infographic presentation of data increase understanding and salience of air quality messages?
- What elements of the wording and framing of new air quality messaging on air pollution and air pollution health impacts do participants find more or less helpful and/or engaging?

3. Methods

3.1. Qualitative methods

Qualitative research was conducted over three waves of activity. Participants were recruited to participate in online tasks (lasting around 30 minutes) and a 90-minute online group discussion (conducted across six group sessions) at each wave.

The focus of each wave was as described in section 2.2 above and the topic guides used to direct the group discussions can be found in the appendices to this report.

Wave 1 research was conducted between 13th and 27th March; Wave 2 research was conducted between 19th June and 3rd July; and Wave 3 research was conducted between 18th and 30th September.

3.2. Sample

The sample involved 30 participants overall, including five per group as specified below.

Table 1. Sample table

Group no.	Group type	Further group-based criteria
1 & 2	General population	1 person living in an area within decile 1 of the most deprived geographical areas and 1 person within decile 2 (total for both groups) Excluding pregnant people, parents of children under age 5, people with respiratory or cardiovascular health vulnerabilities and those aged over 65
3	Pregnant people/parent or guardians of children under 5	1 pregnant person, 4 parents/guardians of under 5 year olds 1 person living in an area within decile 1 of the most deprived geographical areas and 1 person within decile 2
4	People diagnosed with respiratory health vulnerabilities	4 people with diagnosed asthma (2 mild impact, 2 moderate impact), 1 person with Chronic Obstructive Pulmonary Disease (COPD) 1 person living in an area within decile 1 of the most deprived geographical areas
5	People diagnosed with cardiovascular health vulnerabilities	3 people with cardiovascular conditions, 2 people with type 2 diabetes 1 person living in an area within decile 1 of the most deprived geographical areas
6	Older adults	All aged at least 66 years old 1 person living in an area within decile 1 of the most deprived geographical areas

Within the sample, all participants were aged 18-65 (excluding those in group 6), and 26 were from England, 2 from Wales and 1 each from Scotland and Northern Ireland.

Fig. 1 Map of UK regions showing locality of participants

There were 14 men and 16 women, and 8 participants were from minority ethnic backgrounds. In terms of the types of areas in which they lived,11 participants lived in in urban settings, 12 lived in suburban areas, and 7 in rural locations. There was a mix of household incomes represented across the sample, with 13 participants having incomes of less than £30,000 per annum.

Most participants took part in each research wave, although not all participated in each. All 30 took part in both the group discussions and online tasks at Wave 1. At Waves 2 and 3, 25 participants took part in the group discussions and 26 in the online tasks.

3.4. Report structure

The research gathered a great deal of detail regarding the specific research questions for each wave and this can be found in the wave debriefs, which can be found in the appendices to this report. In contrast, rather than being structured to provide the answers to every research question, this report has been developed to provide an overall narrative for what emerged in the research and to clarify the key insight regarding how best to increase awareness of air quality and to encourage behaviour change to reduce people's contribution and exposure to air pollution.

3.3. Interpreting the findings

This qualitative research has limitations associated with it. It drew on a relatively small sample of heterogeneous participants. This means that we had a circumscribed set of participants to draw insight from who were each living in a unique set of circumstances: a similar sample of people would be living in different conditions and situations and therefore may bring alternative perspectives to the research. In addition, as the research developed over time, it may be that participants became educated in relation to air quality issues and/or entrenched in their views, meaning that their responses would not be fully reflective of the opinions or behaviour of people who had not been taken through the research process. Finally, there is a well-documented 'action-intention' gap[2] encountered in behavioural research, and a social desirability bias[3], so it may be

that responses participants gave illustrate what they wanted to do ideally, or what they believed would make them appear in a positive light to others, rather than accurately reflecting what would happen in a real-world encounter.

In this context, these findings need to be interpreted with care and treated as indicative rather than being generalisable to the whole of the population. The conclusions and recommendations set out some ideas for communication and intervention based on the feedback and insight elicited in the research, but this does not constitute an exhaustive list of possible action points. Other research projects are also being conducted as part of the AQIS Review and so these findings need to be considered with reference to this other work too.

Most of the findings in this report were consistently raised by participants and where there were disparities the range of responses has been set out. Throughout the report, verbatims are used to illustrate and summarise the findings. In some cases, these verbatims have been abridged for clarity.

4. Findings

4.1. Context

This section sets out the context in which participants were responding to the issue of air quality, including the factors contributing to current behaviours, individual variations in participants' confidence in their own health and sense of agency about their lives and what opportunities this provides for shifting behaviour.

4.1.1. Understanding of air quality as a concept

Participants' understanding of air quality as a concept was very limited at a spontaneous level. It was not a priority for most participants and was considered to be a complex topic, with many inter-related factors that made it difficult for participants to engage with at a personal level. It was often talked about as an intangible and widespread issue, over which participants had very limited individual control or influence. Participants did not regard air quality as a standalone environmental issue and tended to associate it closely with the climate change agenda. [4]

Linked to this, participants lacked a clear understanding about what air quality is and what contributes to or undermines it. They were generally unaware of different air pollutants (e.g., particulate matter, nitrous oxides) and how different industries and/or activities contribute to air pollution (e.g., agriculture). The major sources of air pollution were assumed by participants to be transport, industrial emissions and energy generation, although the exact reasons how and why these contribute to air pollution were unclear to most. Emissions from construction sites, domestic wood or coal burning, farming/agriculture, and paints and cleaning products were perceived as having a minor or, in the case of the latter source, no impact on air pollution at all. Many participants were surprised to learn that domestic heating is such a large contributor to air pollution in comparison to industry. Indoor air quality was not normally a focus of attention and understanding of what contributes to it was low. [1]

Understanding of the effects of air pollution largely focused on the physical impact on health and, when asked to make free associations with the term 'air pollution', participants mentioned concepts such as breathing, respiratory conditions, asthma and disease. Participants broadly recognised the key groups that are more at risk from the health impacts of air pollution, which they listed as people with lung conditions, children, pregnant and frail people.

There was also recall across the groups of recent court judgments relating to the deaths of Ella Adoo-Kissi-Debrah from exposure to air pollution and of Awaab Ishak from exposure to mould. However, the effects on mental and brain health, e.g., that air pollution can induce depression and mood disorders, and impair cognitive development, were lesser known by participants. A few participants were aware of the impact on food production, in relation to crop growth and animal breeding, although these participants represented a small minority of the sample.

Some participants who were more 'at risk' in relation to air pollution had higher awareness of air quality as an issue and voiced concerns about the immediate and longer-term impacts of air pollution on themselves and their families. This was particularly the case for some older participants, those with cardiovascular disease and COPD and carers of young children/pregnant women. For these participants and some urban dwellers in heavily polluted areas, local air quality was a tangible, visceral concern. They described 'feeling' and 'seeing' the negative impact of air pollution, particularly from traffic in their immediate environment, when looking out of their windows, and playing near and walking along busy roads. Some urban participants spontaneously mentioned the impact of wood burners on their local air quality, and participants living in rural areas also pointed to bonfires and local agricultural practices as contributing to poor air quality. Proximity to an industrial plant was a concern for one participant.

"I don't wake up and think about air quality. We take it for granted."

(General population group)

"For me it's gone really high up on my list. We recently bought a house and we compromised to buy the house that we really wanted and we bought a house right on a dual carriage way and it's so busy all of the time and I see all of the traffic. So I'm really concerned about air quality and the pollutions levels. I want to move, to be honest, when we come out of this fixed term. So I am worried about air pollution."

(Carers group)

"I live next to a dual carrigeway in Southampton, I used to take pride in keeping my white plastic around the windows clean. Now I've given up cleaning them as within 2 weeks they are black again."

(General population group)

"I live near where the steelworks are...and I suppose as I get older it's more of a worry, especially if you've got a heart condition, you notice things about the air. Whereas if I go to the Lake District, it's completely different - I feel like I can breathe there, whereas at home it's a priority and it becomes more of a priority the older I'm getting because I'm understanding the importance."

(Cardiovascular conditions group)

4.1.2. Awareness of air quality information sources

Air quality information had low salience for most participants and few were aware of the availability of daily air quality readings. As a result, most participants had not actively sought air quality information, whether at a national or local level. As most participants tended to feel that air quality information lacked relevance to them (due to a low perceived level of risk and having other, more pressing concerns, such as the cost of living) and the relative intangibility of the topic, some participants questioned whether seeking air quality information would benefit them. However, over the course of the research, as participants became sensitised to the topic of air quality, awareness of and interest in air quality information increased. For example, some participants began to notice and seek out daily air quality forecasts on weather apps.

A small number of participants were already aware of air quality information. For example, some cited pollen count readings, although this was not always recognised as air quality information. Some participants also recalled seeing daily readings at the bottom of weather app information. One participant mentioned that they had received an email from the financial journalist Martin Lewis, encouraging renters to consult www.addresspolution.org to find out whether their local air pollution was high and, if it was, to ask their landlord to reduce their rental rates.

Despite initial levels of awareness, most participants were keen to know more, particularly regarding the extent of the impact of air pollution on their health. Participants also felt that accessible, daily forecast information would help to raise the profile of air quality as an issue. They also believed that it could prompt people to think about how they may respond to minimise their exposure to air pollution. The role of information is discussed in more detail in section 4.2.

"I didn't know air quality information was out there, I don't know where to look for it."

(Carers group)

"There's nothing specifically out there about air quality - there is lots about climate change but not linked to air quality."

(Respiratory conditions group)

"I might think twice about going out that day [if air pollution levels were high] and stay inside with my air purifier."

(Carers group)

They should provide air quality forecasts that are focused and localised and not a vague regional forecast."

(Older adults group)

4.1.3. Factors affecting behaviour in relation to air quality

When talking about what affects behaviour in relation to air quality, participants' responses highlighted a range of contextual factors that can be classified with reference to the Individual Social Material (ISM) model[5] (Fig. 2) that has been adopted by the Scottish Government. This model shows that three different contexts – the Individual, Social and Material – influence behaviour, so need to be explored when considering long-term substantive change. Participants raised issues at each of these contextual levels in relation to changing behaviour around air quality, which emphasises that multiple approaches are likely to be needed to support behaviour change. It may also go some way towards explaining the relative inertia among the general public over time that is apparent when comparing the findings of this research to studies conducted previously.

Fig. 2 The Individual Social Material model

Fig 2: Darnton, A., & Horne, J. (2013). *Influencing behaviours - moving beyond the individual: ISM user guide*. The Scottish Government. http://www.gov.scot/publications/influencing-behaviours-moving-beyond-individual-user-guide-ism-tool/

At the Individual level, as already mentioned, participants were unclear about the nature of air quality and the impact of air pollution on themselves and nature, and so were not particularly

focused on why there is a need to change behaviour in this context, whether for themselves or others. Critically, participants were generally unaware of how their own activities contribute to air pollution. They tended to assume that only a few were relevant (e.g., car use) and/or that there were constraints on them so that it was difficult to change their behaviour in relation to these activities (e.g., they needed to drive or were unable to afford an electric vehicle). This often meant that participants were unclear about what they could realistically do to reduce air pollution.

At the Social level, participants noted that air quality is not a salient issue socially and is not a topic of conversation they would normally talk about with their friends, family and/or acquaintances. Participants could not think of any organisations, 'influencers' or 'opinion leaders' relevant to air quality and were unsure what the role of different institutions were in this context. A lack of belief that air quality is being prioritised by other organisations fed into participants' sense that nothing is being done to tackle air pollution, thereby reducing their own motivation to do so. While some participants had previously come across air quality information, most had not, and so there was a sense that this type of information could be better communicated.

At the Material level, participants assumed that greater use of public transport would be a key means of improving air quality but criticised current infrastructure as expensive, unreliable and not sufficiently joined up to enable more widespread use of it. When participants realised that heating infrastructure was a contributor to air pollution, they pointed out how current infrastructure overwhelmingly favours fossil fuels, which reduces their choices.

> "But I don't know what to do to change, you know I can only do one thing and that's not going to make any difference, just one person doing it…[we need] guidance on what to do and how to do it."
>
> **(Cardiovascular conditions group)**
>
> "This is where some of the frustration comes in. You want to do things on your level, small things and you do but then you read of these incidences like that [negative media stories about air pollution] and it's like: what's the point. A million people doing a small thing makes a difference but then when you have a company pumping out high levels of pollution you just think...well."
>
> **(General population group)**
>
> "Ultimately 100,000 little people could be doing these things, then you get two big businesses chucking out pollution and then it negates everything that everyone is tying to do. We need to have assurances that bigger businesses are doing their bit as well."
>
> **(General poplation group)**
>
> "[Public transport is] not convenient enough for me. Too many obstacles, no toilets as this would really affect me. Time is massively less when travelling by car."
>
> **(Carers group)**

4.1.5. Individual variations

Within the research, variations between participants became apparent. Key differences related to participants' confidence in their own health and their sense of agency about their lives.

Those with lower confidence in their own health tended to be those more sensitised to health issues and included people with respiratory conditions and/or cardiovascular conditions, people caring for children or others with respiratory and/or cardiovascular conditions and pregnant people. This also included some people living in urban settings and/or those living near to industrial complexes that they felt contributed to air pollution. Although they were not always focused on air pollution and/or understood the impact in detail, these participants tended to have some awareness of the effect air pollution could have on themselves and others.

By contrast, those with higher confidence in their own health tended to be members of the public without health conditions, or whose health conditions affected them only mildly. These participants were less aware of or concerned by the negative impact of air pollution on themselves and others. If they were aware of it, they were generally more positive that its negative impact would decline in the future and so tended to feel it was less of an important issue. Rural dwellers were less likely to be concerned about air pollution than those living in urban areas, due to the assumption that air pollution is primarily caused by road transport and industry.

In terms of agency, there was also variation across participants in terms of how much choice and control they felt they had within and over their lives to change their behaviour in relation to air pollution. Much of this related to participants' resources: participants on lower incomes generally had less ability to make choices around purchases (e.g., regarding vehicles and heating systems) than others. Participants with moderate or severe health conditions, or impaired mobility, had reduced choice in relation to changing their mode of transport – or had already changed their behaviour to accommodate air pollution to the extent that they felt they could do nothing more.

This meant that participants fell into four overall categories, which are below accompanied by an example 'persona' to illustrate the archetype.

Low confidence in health, low perceived agency: 'Resigned'

> Teri (pseudonym) has a cardiovascular condition and lives in a polluted area. She can see polluted air when she goes out and can feel it on her chest. She worries that this will worsen as she ages. Her cardiologist has told her to move to somewhere less polluted but she doesn't think she'd be able to get a job easily in an unpolluted area.

This participant type tended to be people with health conditions that impact moderately or severely on their day-to-day life. They lacked confidence about their health and faced the most restrictions regarding how they lived their lives. They varied significantly in terms of their age, mobility and economic activity and so participants' personal situations affected the size and reach of their networks (e.g., mobile younger workers generally had larger networks than retired people with impaired mobility).

This group were generally more focused on health topics and were more spontaneously aware of air pollution than other groups. This was due to the visceral effect they could feel it had on them, especially those living in more heavily polluted areas. Some participants (two in this research sample) had moved house and reported that air pollution in London had contributed in some way to this decision. One participant reported that their cardiologist had recommended that they move to improve their quality of life, as air pollution was having such a negative effect on this.

These participants were particularly likely to feel that they had limited choices and that they have already taken as much action as they can in this context (e.g., moving house). This commonly led them to feel that the onus should be on government and industry to act to support them, although they were sometimes cynical that this would happen.

This group felt that the best way to reach them would be through healthcare practitioners signposting them on to relevant information. These participants also felt that having more information on how to manage their condition at times of high air pollution would also be helpful.

> ' *We know it's bad [the air quality], it's always going to be bad until someone comes down heavy on the people doing the pollution."*
>
> **(Cardiovascular conditions group)**

Low confidence in health, high perceived agency: 'Concerned'

> Hannah (pseudonym) is married and mum to 2 year old son, Bertie. They live in a fairly large house but to be able to afford it compromised on the location – a busy main road. Sometimes she feels guilty because she worries about how the exhaust fumes might affect Bertie. She would like to move house but they are on a fixed-term mortgage so it is not possible at the moment.

This type of participant tended to be a parent or carer who was sensitised to health issues in the context of babies and children, and who were motivated to change their behaviour to improve the health outcomes of their children. This group tended to have a relatively large social network to lean on, including family, friends, colleagues and the families or their children's friends. They were generally interested in environmental issues, often thinking about them in relation to their children's future.

Once this participant type had focused on the topic of air pollution, they tended to feel anxious, worried and guilty, and concerned about the impact it would have on them and their family. They were not clear about how they could best act, as they were weighing up the need to act on this issue with how to respond to other environmental issues and the cost of living crisis.

Issues which may inhibit their behaviour included that others depend on their care, so they may need to drive children around (who are too young to walk long distances) or heat their home so it is warm enough for young children. This participant type was also commonly concerned that taking particular actions, such as walking more in winter, may be unsafe for them and/or their family.

Key motivations for this group are that they want to limit the impact of air pollution on their children's health. They are open to information during pregnancy, when choosing and moving house and when choosing a school. Key channels for reaching them are through healthcare practitioners, their children's schools and social media platforms.

> "I don't know if I'm a bit frightened about it. I feel like, I know where I live, it must be bad for air pollution. I don't know if I would be a bit scared if I could see what the pollution levels were...." "
>
> **(Carers group)**

High confidence in health, low perceived agency: 'Detached'

David (pseudonym) is in his mid 20s with no long-term health conditions or care responsibilities. He does not feel that he is directly affected by the quality of the air day-to-day and thinks this is more of a concern for people with asthma, lung conditions and young children. He believes everyone can do their bit but that it does not have much impact unless government and big business are on board.

This group tended to be confident about their health and so were not particularly worried about it in the context of air pollution but tended not to feel they had a high degree of agency in their lives to make changes in response to air pollution. This was partly due to being busy with their lives and pre-occupied with concerns other than environmental issues. Their social networks varied according to their individual situations but tended to be relatively wide and to include friends, family and work colleagues.

In relation to air pollution, these participants tended to be relatively indifferent and unconcerned about it as a topic. These participants lacked a reason to engage, especially in the context of limited understanding of the impact air pollution has on health. They were also generally cynical about the actions government and industry are taking, which reduced their motivation to change theirs.

However, some appreciated that this may change in the future, depending on their personal circumstances, e.g., if they were to have children or if their parents developed health conditions. Where participants expressed this to be the case, they generally felt that they had limited ability to improve air quality or act to avoid air pollution.

Key opportunities for engaging this audience are to educate and raise awareness via social networks, especially social media, whether through interesting stories that start conversations or via influencers. This group would benefit from information and clear guidance about the impact of air pollution on everyone, how they can adapt their behaviour to reduce their contribution to air pollution and actions everyone can take to avoid exposure to it.

"I don't wake up and think about air quality. We take it for granted."

(General population group)

High confidence in health, high perceived agency: 'Engaged'

Andy (pseudonym) is retired and lives in a trendy area of Manchester. He has become more aware of air pollution recently and its effects on individuals and nature. With no long-term health conditions himself he does not feel directly affected by poor air quality, although he is concerned about the wider effects locally, nationally and globally. Now he is not working he has more time to read about air quality in the paper and has raised his concerns with his MP.

These participants tended to be older people who, despite this, were confident about their health and, as they were often retired, felt they had a relatively high degree of control over their lives and how they act and spend their time. Many were also thinking about the legacy they are leaving to future generations and so were highly environmentally engaged, although were sometimes cynical about the interests that may be negatively affecting the environment. Their social networks varied,

once again according to age and mobility, with the oldest participants in this group having the most restricted networks.

These engaged participants tended to be passionate about the effect poor air quality is having on humans and nature; although, due to their relative confidence about their own health they tended not to focus on the need to protect themselves from air pollution. They were particularly frustrated that governments and business are not moving faster to make change happen.

However, when talking through the different options for reducing their exposure and contribution to air pollution, these participants emphasised that their lack of mobility may sometimes mean that their ability to change behaviour is restricted in some circumstances: for example, they may only be able to walk for limited distances and they may be caring for a partner with health needs.

Relevant channels for reaching this group includes healthcare practitioners signposting to information as appropriate, educating via grandchildren and community networks (e.g. hobbies, clubs, churches, day centres) and providing clear guidance about adapting behaviour (e.g., travel choices).

> "I'm increasingly interested in recent years as I've become more aware of environmental health issues caused by air pollution."
>
> **(Older adults group)**

4.1.4. Opportunities for behaviour change in relation to air quality

Opportunities for behaviour change are wide and varied and relate to the different levels of the Individual, Social, Material model; and whether the focus is on reducing contribution to air pollution or reducing exposure to air pollution.

Individual level opportunities

Participants were consistently unclear about the impact that air pollution has on health, and how they can avoid their exposure to it, and so a key means of motivating action will be to clarify this with the public. It may also be relevant to highlight to some, for example to the more environmentally concerned carers and engaged older participants, about the negative impact on nature as well.

Participants tended not to know what the main things are that people can do to reduce their contribution to air pollution, so showing what these actions are will help to encourage action. To maximise uptake, these will need to include low-cost options that are relevant for people in all situations, for example including people without a car and who are less mobile, or who use different heating options. These will need to be presented to show that the actions are easy and convenient to put into practice. Where actions also have other benefits (such as improving health), it may also be relevant to present them in this context.

Another issue was that participants tended to doubt that taking action at an individual level would make a difference: ideally communication would show what the impact of individual actions can be (e.g., across a number of years) and how this may improve people's health and wellbeing.

> "Everyone can see it makes sense to do this [e.g., change to low-carbon heating], but if it is

not affordable, then it is not affordable."

(Older adults group)

Social level opportunities

Action will need to be taken at the Social level to raise awareness of air pollution and the evidence from this research is that this is best done using opinion leaders and influencers and communicating any actions that are being taken by local communities, government and industry. This would ideally communicate the impact of collective action, showing how individual actions can make a difference in terms of reducing air pollution.

Another important action at this level is in providing reliable and easily accessible information that will help participants to avoid exposure to air pollution as appropriate, whether via daily air quality readings that guide short-term choices or giving access to information that supports longer-term decision-making.

"We're influenced by our peers, even subconsciously."

(Carers group)

"They should provide air quality forecasts that are focused and localised, and not a vague regional forecast. And for those with asthma."

(Older adults group)

Material level opportunities

Participants consistently stressed the importance of improving the reliability of transport infrastructure to enable them to make positive choices in this context. This would include increasing access to punctual public transport that enables people to make joined up journeys via public transport, and improving electric vehicle charging point infrastructure so that people can be more confident in making choices to buy and use electric vehicles.

Participants also assumed that government would be able to support companies in developing technological nudges that will help in this context, such as cars whose engines automatically switch off at lights and do not idle, and developing delivery logistics that reduce air pollution (e.g., combining road transport deliveries, increasing electric fleets).

Where there is the need for both the public and businesses to change behaviour, participants suggested financial incentives, especially around encouraging switches in domestic energy sources (e.g., grants for heat pumps) and transport choices (e.g., subsidies for electric vehicles).

Participants also felt that it will be important for government to send a strong message that the country is united in relation to addressing air pollution and to set rules and regulations for industry, enforcing them and issuing penalties where needed.

"Just giving us information doesn't help. We know it's bad, it's always going to be bad until someone comes down heavy on the people doing the pollution."

(Cardiovascular conditions group)

Actions to reduce contribution to air pollution

Many participants assumed that car use would be a major focus for reducing contribution to air pollution. However, in the context of current transport infrastructure and participants' individual situations, many felt that driving less and/or at different times was difficult to achieve, especially those who were living rurally, needed to commute to an office and/or had families they needed to transport to school or other activities.

More achievable actions suggested were:

- Turning off engines while stationary.
- Reducing home deliveries and/or collecting deliveries from local central pick up points.
- Encouraging the purchase and use of electric vehicles.
- Reducing national and international flights.
- Encouraging active travel.

Participants were asked to choose an action to put into practice as part of the research and it was interesting to observe that those participants who chose to travel somewhere via active travel tended to experience more feelings of wellbeing than they had expected.

As mentioned previously, participants did not generally realise that domestic heating and/or appliances contributed to air pollution and so there is an opportunity to educate the public to a greater extent in this regard. Homeowners were more empowered in this context than renters, and may be encouraged by:

- Provision of more information about the choices available (e.g., especially alternatives to gas heating).
- Greater confidence that infrastructure exists and that experts are available to advise/install relevant systems (e.g., regarding heat pumps).
- Greater financial incentives, and information about the support available, to install appropriate heating systems and/or connect to appropriate infrastructure.

Indoor pollution was another area of which participants were relatively unaware. However, there is promise in using this as an issue, as participants felt they have a large degree of control over this, as long as information can be provided regarding precisely how people can improve indoor air quality.

"I live in a little village which does not have any public transport facilities. Also being disabled I need to have a car to get me from A to B"

(Older group)

"I saw more wildlife and noticed more public ongoings. Even out of breath, the air felt fresher. Many benefits for your mental health" Behaviour task: use public transport or active

travel for short journeys
(Carers group)

"I've got a guy who comes in every year to service the gas boiler and, because I trust him completely and I live alone, I give him the keys so he can do the service whilst I'm at work. And he's said the same about heat pumps: that they're no good in old build properties and they're just too expensive at the moment."

(Cardiovascular conditions group)

Actions to reduce exposure to air pollution

Participants were not particularly conscious of what actions they can take to reduce their exposure to air pollution, although some were already doing this by avoiding going outside when pollution levels were high.

Participants were not initially convinced that walking as far away from the road on the pavement as possible would reduce exposure to air pollution, although discussed how this could be effectively illustrated by showing dark, polluted vegetation on grass verges next to busy roads.

Participants sometimes suggested other actions that could be taken to reduce exposure to air pollution, including avoiding activity outside and closing windows. However, participants with restricted mobility mentioned that reducing outside activity was irrelevant for them in their situation.

Instead, participants sometimes suggested that wearing face masks could be encouraged to reduce people's exposure to air pollution. This illustrates that without clear information, there is the possibility that people may take action that they think will improve their health outcomes but, in fact, may place them at greater risk.

"I wouldn't consciously do anything to reduce air pollution for me."

(Carers group)

"I can only do what I can do. I can't walk far, I don't have to walk on a main road [lives rurally], our house is set back from the road. I'm limited in what exercise I can do because of my back. Really I can't do any of these actions."

(Older adults group)

"The first thing we ever heard about face masks was Covid. But they are never spoken about with pollution. But you see builders wearing them so you assume it's to avoid toxins."

(Cardiovascular conditions group)

4.2. Role of information

This section explores how information could help to shift people's behaviour around their contribution and exposure to air pollution.

4.2.1. Overarching role of information in this context

In the context of participants' limited understanding of air quality and actions they took to reduce their personal contribution and exposure to air pollution, two overarching roles for air quality information were identified. Firstly, information that raises awareness of air quality as an issue; and secondly, information that influences and motivates specific target behaviours.

Information around the topic itself, including the main sources of air pollution, its impact on health and how people's actions contribute towards it were recognised by participants as key knowledge gaps and areas of interest to support with information.

Participants in 'at risk' groups welcomed more targeted information that highlights the issue in direct relation to their personal set of circumstances and helps them understand the reason for their increased risk, the symptoms, what impacts to be aware of and how to mitigate against these.

Regarding influencing behaviours, there was consensus across the groups that simple, immediate and localised air quality forecasts would be important for supporting short-term, day-to-day decision-making. Participants suggested that hourly or periodic street-level readings throughout the day, alongside specific advice, would help them to make informed decisions about how to act (e.g., keeping windows shut or avoiding busy roads at certain times). Comparisons were drawn with pollen count readings included in daily weather forecasts, which participants widely acknowledged and reported, in some cases, trigger discussions within their own personal networks.

4.2.2. Key sources and messengers

Overview

Air quality information is not an established information category so there was uncertainty among participants about where they would currently go to obtain information on this. A range of potential information sources and messengers were suggested, although it became apparent that the organisation and channels for communicating would be influenced by the type of information participants were thinking about.

Raising awareness

Participants cited the NHS website, the BBC and local and national newspapers as trusted organisations and channels, with broad reach, that could provide impartial and balanced information. Charities were also regarded as offering a trusted and potential alternative perspective, for example Asthma UK providing tailored information to specific audiences.

Participants tended to be sceptical about central government providing and promoting information about air quality, as some assumed that central government would take a party-political view rather than a neutral standpoint. Participants also perceived government as having the potential to 'cover up' poor health outcomes related to poor air quality and would naturally support big businesses, whose interests were suspected to undermine air quality and human health. Having said this, GOV.UK and local government were regarded more positively as relatively trustworthy sources of neutral information.

Some participants also assumed that a government department would have some responsibility for air quality, although they were unsure where this would sit. While participants were mostly unaware of Defra or UKHSA, a few cited the Environment Agency as an appropriate body. This may suggest that there is an opportunity for Defra or UKHSA to be positioned as national 'expert' organisations on the issue of air quality, or as an intermediary that brings together expertise to consider, advise and inform on these issues.

Participants mentioned the BBC, Met Office, AccuWeather and Google (via weather reporting in a range of formats, such as TV, apps, online and widgets) as trusted and reliable sources for accessing daily air quality readings. They assumed that local air quality forecasts would be part of local news and weather reporting.

> "The car and chemical industry lobby government and so the government has not done as much as they should because of them."
>
> **(Older adults group)**
>
> "Government information should be impartial but at the same time the same Government is allowing certain things to happen and certain companies to do certain things, then there's a question mark there. A charity may be more objective in the presentation of their information."
>
> **(General poplation group)**
>
> "It [Met Office] seems separate to any political agenda - they are just telling you statistics and data."
>
> **(Carers group)**

Providing targeted information

Participants strongly felt that healthcare practitioners (HCPs), including GPs, pharmacists, consultants, midwives and health visitors, should play an important role in supporting tailored conversations around air quality, and therefore influencing action. HCPs were viewed as being well-placed to signpost to relevant information on the health effects of air pollution and how to reduce risk in response to individuals' circumstances. For example, pregnancy and having a baby was perceived by parents and carers as an ideal time to raise the issue of air quality and provide tips on how to avoid exposure to the foetus and newborn. However, some participants expressed concerns that many HCPs may have limited expertise and time to offer on this topic. Only one participant (who had a cardiovascular condition) reported experiencing a HCP raising air quality as a concern.

Healthcare settings, for example GP and hospital waiting areas and pharmacies, were recognised as opportune spaces for displaying accessible air quality information. Participants imagined that this may prompt patients to proactively raise air quality questions or concerns with their HCP, which would mean they would be given or signposted to more detailed information if they wanted it.

Some groups also identified personal and online social networks as a channel for sharing knowledge and information about air quality, which they felt had the potential to influence action. The networks that different participants reported having access to varied substantially, primarily influenced by age and physical and economic activity.

Older participants tended to have smaller networks on average, so this channel may have less relevance to them. However, for many, older people talking with acquaintances at local community locations was an important means of prompting, sharing and discussing news stories and public interest topics, some of which related to air pollution.

Others with larger personal networks, including work colleagues, neighbours and people with shared interests and hobbies, reported more frequently discussing current affairs and issues affecting their community with others. These participants recounted conversations within their networks on topics relating to air pollution, including the Ultra Low Emission Zone, local traffic calming measures and construction work. However, participants acknowledged that triggers will be required to support conversations about air quality, due to the current low salience and understanding of the issue.

Some participants, largely those aged 20-40 years old, highlighted the relevance of social media platforms such as Instagram, Tik Tok and X (formerly Twitter) for enabling users to share information, for example via 'stories' or 'shorts', to motivate behaviour change.

> "Very unsure where to start, I could go on to Google to find out but I wouldn't know if they [the websites accessed via the search engine] were trusted sources."
>
> **(Respiratory conditions group)**
>
> "If I went to the pharmacy and the air quality was bad then I would expect to see a poster up and if I had a cough as well I would expect to receive a leaflet from the pharmacist"
>
> **(General population group)**
>
> "I'm here on my own for many hours, often the only person I see is the postman."
>
> **(Older adults group)**

4.2.3. Individual variations

While the messages that participants suggested delivering to change behaviour in this context were broadly similar across the sample, there was variation between the four persona types mentioned above.

Those in the 'Resigned' group, whose health conditions moderately or severely impacted their daily lives, welcomed information from health specialists, especially their HCPs and independent health charities. Such information would ideally encourage them to consider their circumstances and provide advice on how to reduce the impact of air pollution on their health. These participants suggested positive real-life stories and testimonials relaying what others in similar situations had done to reduce their exposure to air pollution. They felt that this had the potential to motivate them to act and reduce their scepticism and feelings of relative helplessness in this context.

'Concerned' participants were enthusiastic to receive information on how to reduce the impact of air pollution on their children. They recognised HCPs, such as midwives and health visitors, with whom they had regular contact during their pregnancy and their children's early years, as being well placed to provide clear and actionable steps to lessen exposure to air pollution on a day-to-day basis. Education providers, including nursery and primary schools, would be key sources of information for infant and junior aged children to raise the profile of air quality information and motivate families through local campaigns and actions, both to reduce contribution and exposure to air pollution.

In contrast, those within the 'Detached' group, who tended to be confident in their health and so less concerned about the impact of air pollution on themselves, suggested above the line marketing with broad reach, including TV and outdoor advertising, news stories and social media

campaigns. This group felt that more generalised and light touch information that highlights the impact of air pollution on everyone and demonstrates how individual action can make a difference may motivate them to consider making easy changes.

'Engaged' participants, who were highly motivated to make changes to reduce the impact of air pollution on nature and human health were keen to hear from, and engage with, organisations with responsibility to promote change in others. They welcomed information from government agencies and local authorities, as well as the NHS, via their GP and local health centres. As this group was largely formed of older participants with grandchildren, schools were also noted as a source of information on environmental concerns: participants were frequently 'educated' by their grandchildren on issues linked to the environmental agenda and nudged to make changes in their behaviours accordingly. One participant recalled their 4-year-old grandchild, who had recently started in reception class, encouraging them to switch to driving an electric car.

4.2.4. Risks and opportunities for information

While this research identified a clear appetite for and opportunities to raise the profile of air quality as an environmental concern and to provide actionable advice to support individuals to limit their exposure to poor air quality, some risks were also recognised in doing so.

Some participants, particularly those within the 'Concerned' group and to a lesser extent the 'Resigned' group, expressed caution at being exposed to too much information and detail about poor air quality. These groups tended to feel a degree of anxiety about the impact it could have on their health and, where relevant, their family. Subsequently they were concerned that air quality information had the potential to heighten their anxiety about the topic. Carers in particular expressed worry and guilt about choices they had made, some of which they felt they had very little control over but which they knew had the potential to affect their families, such as moving house. The 'Resigned' group felt their need for more air quality information was low, believing they could already 'feel' the quality of the air, due to the effect it had on their breathing, and that they had exhausted most avenues to address its impact on them.

With this in mind, the need for clear and balanced information, which both informs individuals about the issue of air quality and empowers them to take achievable and impactful actions at an individual level is required to prevent scaremongering and disengagement with the topic. Participants across the sample felt that overtly negative content, without clear calls to action, may risk overwhelming and depressing people and leading them to become dismissive of their role to take collective action. Wherever possible, participants wanted information to be framed to present them with some kind of actionable choice to show that their behaviour could make a difference to air quality outcomes.

Participants consistently emphasised the importance of governments being open about the topic of air pollution. They perceived government to be saying very little on the subject and called for greater transparency about sources of air pollution and government initiatives to address it. However, they suspected government was in a difficult position to do this because of its close relationships with big businesses and wanting to avoid jeopardising relations in favour of growing the economy. Identifying opportunities for government to be more visible and engaged in the topic and championing the air quality agenda would be likely to resonate with people and provide the benefit of highlighting that a collective approach is being taken to improve air quality.

> "I don't know if I'd want to know about [pollution] levels here. I'm not in a position to just up and leave. I think it might give me health anxiety."
>
> **(Carers group)**

"If the air quality is bad what can I do? I have to go about my daily life."

(General population group)

"Just giving us information doesn't help. We know it's bad [the air quality], it's always going to be bad until someone comes down heavy on the people doing the pollution."

(Cardiovascular conditions group)

4.3. Raising awareness

This section explores how best to raise awareness on this topic, including what messages would be relevant, how information can be presented to optimise uptake and how information can be disseminated. Participants were shown stimulus materials to support discussion on these topics, which can be found in the appendices to this report.

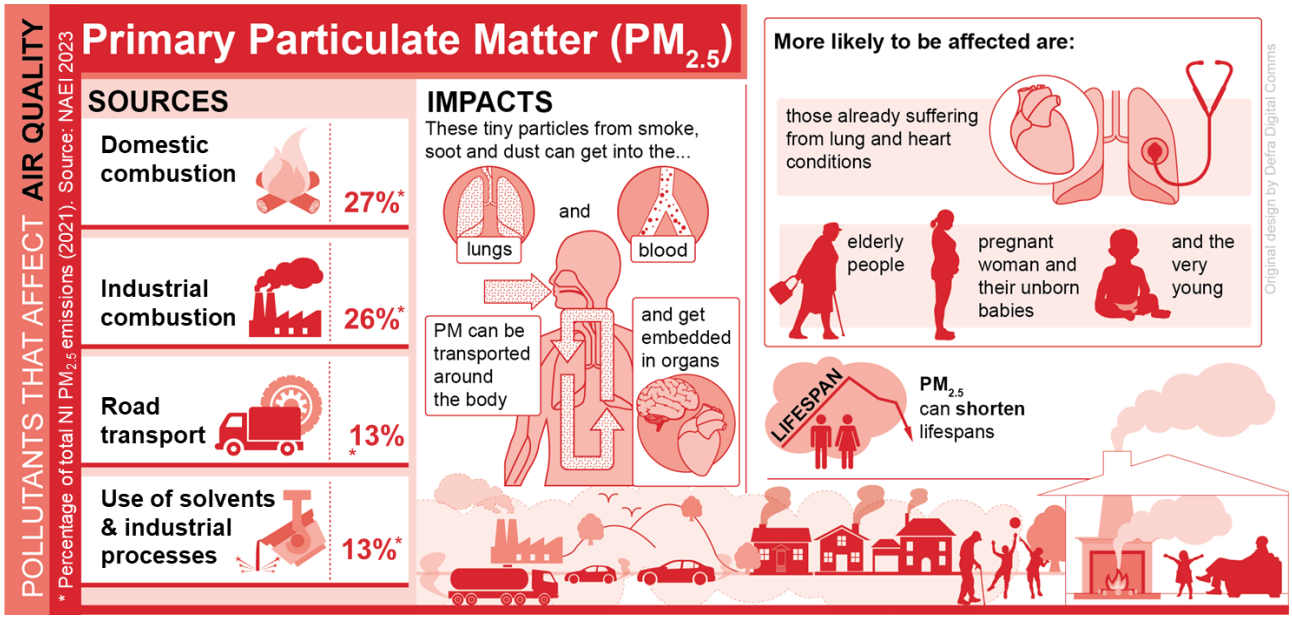
4.3.1. Key messages

When prompted to select what type of local air quality information they would like to receive on this topic, participants were interested in finding out about:

- Sources of emissions in their local area.
- What is being done to improve air quality in their local area.
- Real time air quality conditions for their local area.

In relation to general awareness raising, participants expressed an overwhelming interest in understanding more about the health impact of air pollution. This was the most motivating reason to engage with the topic: when participants were presented with an example of an infographic that discussed PM2.5 and its impacts (Fig. 3, also see Appendix 3.2.2), they were fascinated to engage with detail that they had not previously known about.

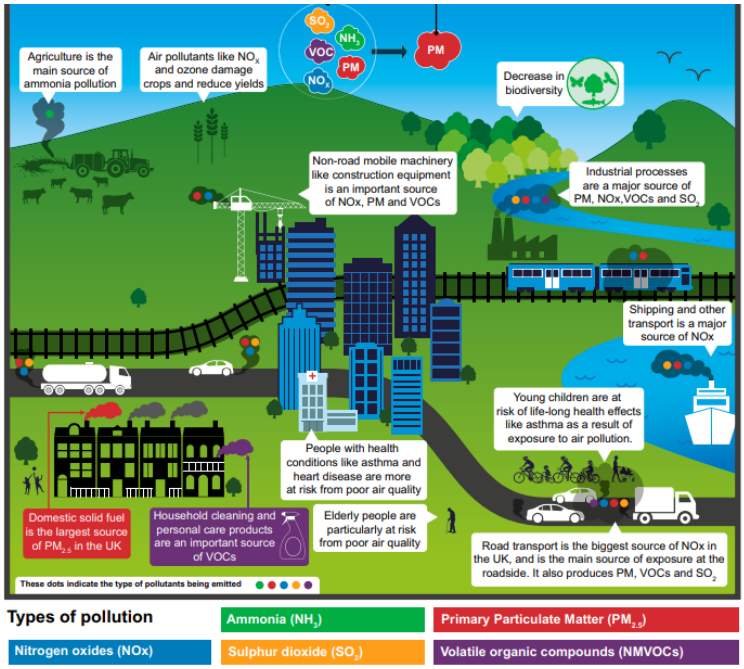
Fig. 3 Primary Particulate Matter infographic



For example, which organs particulate matter can affect and how individuals might recognise potential symptoms of being affected (feeling out of breath, having a sore throat or eyes or a persistent cough). Further areas of interest included the impact of air pollution on life span and information on the effect air pollution can have on everyone, not just 'at risk' groups. As mentioned previously, participants tended not to spontaneously link indoor air quality with air pollution but were interested in learning more.

On sharing a second infographic showing different types of pollutants (Fig. 4/Appendix 3.2.3), while participants felt that it gave some information of which they were previously unaware, they wanted clearer background explanation of common pollutants. This included the range of pollutants, what they are, their sources, how they affect people, and which pollutants are the most important or harmful and why.

Fig. 4 Types of pollutants infographic



Providing an indication as to how levels of pollutants have changed over time, to inform participants as to whether air pollution in general is improving or worsening, and whether behaviour change has or can influence this trajectory, was also of interest to many participants.

4.3.2. Presentation considerations

Participants favoured clear, simple and accessible air quality information that was easy to understand quickly. The research highlighted that air quality information will be encountered, on the whole, by people who are unlikely to be seeking out air quality information proactively and will be novices to the issue and therefore new to interpreting scientific or technical information. On top of this, they will probably be encountering this type of information when they lack time to focus and/or are faced with a great deal of competing data. This means that the information must be: simple; easy to digest, understand and respond to; and be relevant to people's day-to-day lives. It also needs to be available through familiar and reliable information channels with broad reach, such as TV, apps, and radio.

Within this, participants stressed that air quality information needs to be presented using non-technical language that assumes no prior knowledge of the topic. Information that focused primarily on chemicals and their levels was experienced by participants as technical and off-putting. Abbreviations and acronyms should ideally be avoided where possible, as once again, these were perceived as requiring specialised knowledge to access and had the effect of disengaging lay readers.

Participants emphasised that to support comprehension, text formats should be broken down and structured with easy-to-read headings, use plain English and, wherever possible, provide information in a layered way, so that top level content is provided with the facility for readers to access more in-depth and detailed content if desired.

Participants identified infographics as a helpful and engaging medium for communicating complex information quickly, as long as these are concise, clearly set out and easy to navigate. Participants favoured the bold colours, imagery and icons used in the infographics tested, and believed that this type of format would engage readers and make information more distinctive. However, they felt that these types of formats should be used appropriately and in line with the tone of the content, so for example the style should not be upbeat when the content is not.

Additional presentation considerations for infographics included:

- Positioning information keys (where used) so that they are close to the content they are explaining.
- Where symbols are used, ensuring that this is done consistently across the infographic and is explained in the key, and colour is used consistently to help communicate meaning.
- Where infographics are complicated, simplifying content to focus on one or two elements, possibly creating a series of simplified infographics.

Social media platforms were also discussed in the research. Participants often suggested converting infographics into interactive or dynamic resources, including 'stories' and 'shorts' containing audio and subtitled narratives, animations and clickable features to help reveal the story or additional information. It was felt that such 'share-able' content would help to trigger conversations online and face-to-face, ultimately influencing behaviour change. As highlighted above, participants agreed that clear calls to action would ideally be integrated into share-able information to show how people can respond effectively.

"Everything is presented in such a faster way now and the pace of life is fast and can be complicated, with many aspects to juggle, so a cursory glance should be informative, but for those who need it the option is there to get more."

(Generation population group)

"It should be kept simple [number charts and colour schemes] and then have the option for people to click somewhere to receive more detailed information."

(Generation population group)

"Make it accessible in everyday life to get the message out there on the importance of air pollution, like news, apps, home screens on web browsers…"

(Carers group)

4.3.3. Role of healthcare providers

Participants consistently suggested that GPs and pharmacists could play an important role in raising awareness about air quality, especially for the general population and older people. These participants proposed that GPs and pharmacists, through general appointments and via NHS Health Checks, could start to normalise conversations around air quality. Participants felt that HCPs could ask questions such as: 'Do you have a wood burner in your home?', 'What times of the day do you exercise?' or 'Do you tend to cycle on busy roads?' to prompt patients to think about exposure to air pollution and consider making lifestyle changes in response.

Pregnancy and having a baby was identified by parents and carers as an ideal time for midwives and health visitors to raise the issue of air quality with expectant and new parents. These participants emphasised how parents want to take all steps possible to protect their unborn or new baby and so would be likely to read and act upon information and advice provided by midwifery and health visitor teams. Parents and carers were particularly interested in understanding how air quality can impact on the developing foetus and pregnant person as well as the impact on young children, including on cognitive development and the respiratory system. These participants also wanted to know what conditions children are more at risk of developing if they are exposed to air pollution over time. They were also particularly interested in the impact of internal air pollution.

Beyond check-ups, participants felt that in certain circumstances HCPs should proactively offer air quality information and advice. For example, participants with respiratory and cardiovascular conditions wanted to know about the effects of air pollution and why they are at a higher risk of experiencing the negative impacts. Asthma reviews and consultant appointments could present ideal opportunities for sharing this information and supporting discussions about how to mitigate symptoms, and manage patients' conditions in the future (e.g., what to avoid and when, and when reliance on medication or inhalers may increase). For those who display new symptoms, such as a persistent cough, participants suggested that HCPs could ask questions about exposure to air pollution; during seasonal times of high air pollution, pharmacists could offer information to people purchasing antihistamines and display information about how to limit exposure to air pollution.

"If I went to the pharmacy and the air quality was bad then I would expect to see a poster up and, if I had a cough as well, I would expect to receive a leaflet from the pharmacist."

(General population group)

4.3.4. Role of others

Education was recognised as an important channel for the dissemination of messages, so that air quality is embedded into everyday thinking. Participants agreed that pre-schools and primary schools were influential spaces in this context, and that teachers constitute role models for children in promoting learning and setting good behavioural examples. For this age group, participants imagined that activities should be fun, engaging and visual. They assumed that air quality would ideally be integrated into everyday learning, similar to how children are expected to write the day's date and weather each day, rather than be experienced as a one-off campaign or learning opportunity. Having said that, parents and grandparents in the sample recognised the impact of school environmental initiatives, such as walking to school week, in which households are encouraged to rethink their reliance on the car.

For secondary school pupils participants felt that learning about air quality should be integrated into the existing school curriculum to teach students holistically about the different aspects of the topic. For example, they suggested that science lessons could teach about the chemistry and biology of air pollution, geography could teach about the environmental aspects of air pollution and personal, social, health and economic (PSHE) lessons could encourage pupils to consider the social responsibility aspect of the topic. Participants agreed that there is a need to find ways to make air pollution an everyday concern for young people, so that it reaches and influences young people and does not just become a topic learnt about in school. One participant, with a secondary-aged child, highlighted a recent trend among teenagers to monitor UV levels on Tik Tok and suggested that this is something that could be replicated in relation to air quality. Approaches that are delivered in partnership with education providers via social media platforms could therefore provide opportunities to influence understanding and behaviour change among this age group.

Young people were perceived as having significant influence on their parents and grandparents and so participants felt that this influence should be harnessed across communities. Participants recognised that young people encourage their parents and grandparents to think differently about environmental concerns in a way that older people may not consider. Participants acknowledged that young people tend to be more positive, energetic and passionate than older people and frequently bring solution-focused approaches to environmental subjects. Participants therefore felt that young people's involvement in decision-making and the creation of campaigns and information around air quality should be encouraged by organisations across society.

> "Young people are talking much more about climate change and air pollution than when I was younger. But they are the voice of the future."
>
> **(Carers group)**
>
> "Teachers are such role models for kids and it sets a good example from a young age."
>
> **(Carers group)**
>
> "Children are really switched on about climate change and air quality. They are pushing for climate activism."
>
> **(Respiratory conditions group)**

4.4. Influencing action

This section discusses responses to stimulus materials that were shared in the research to understand how best to influence behaviour change in relation to air pollution, especially around reducing exposure.

4.4.1. Influencing short term behaviour

Participants were open to the idea of receiving a daily forecast of air quality, especially if it is easily accessible and provides localised up-to-date information. They felt that this type of information has the potential to influence:

- Whether people choose active travel options (walking, cycling, scooting).
- When people exercise and where (e.g., particular routes taken, where children play).
- When people use their cars (e.g., avoid peak polluting times).
- When to open windows and/or hang out washing.
- Whether people with asthma take their inhaler when leaving the house.
- How much medication people with relevant conditions take.

If this were to be provided, participants emphasised that the information would ideally:

- Be easily accessible, for example providing it via an existing weather forecast (broadcast or app) or a well-communicated webpage.
- Be provided at town/area, or ideally street level, so that people would be able to access detailed information to help guide any decisions (e.g., when to walk or which routes to take).
- Be easy to understand, with information provided at top line level, using established information norms (such as a 'red, amber, green' rating).
- Indicate the time of day when pollution levels are due to be highest and lowest.
- Provide simple advice on how to respond to air quality information, including what to do when air quality is good, as well as bad.
- Give the option to access more detail easily if desired (e.g., descriptions of air quality levels).

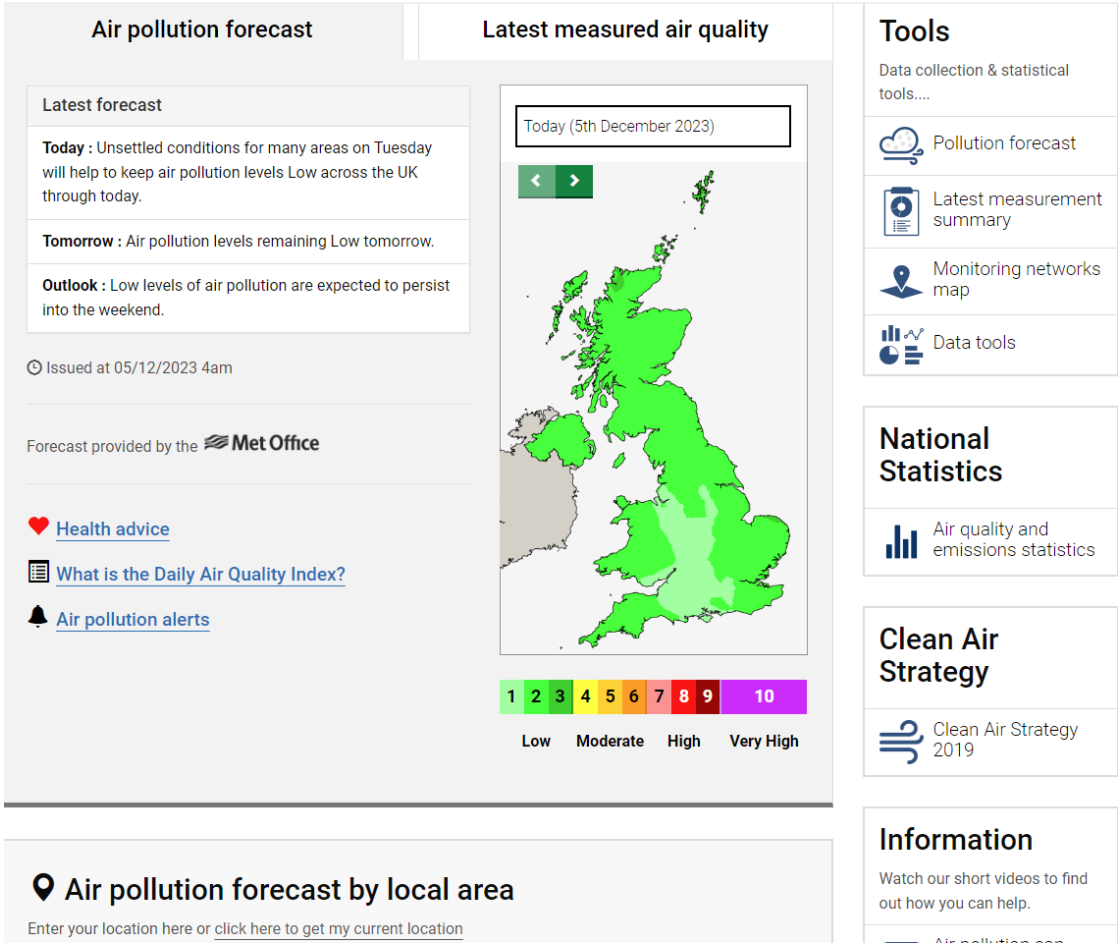
Participants with respiratory and cardiovascular conditions were particularly keen for daily forecasts to signpost to further information to prompt understanding of how air quality can impact their condition and how they can respond. Some imagined being able to use this type of information to track their symptoms in relation to air quality, for example on a calendar, which over time could help to guide their management of their condition and support discussion with their HCPs.

4.4.2. Responses to the current DAQI

Participants were directed to the current DAQI online and asked for their responses to it via various tasks, the details of which can be found in the appendix to this report (Fig. 5/Appendix 1.3.2.).[1]

[1] https://uk-air.defra.gov.uk/

Fig. 5 Screenshot of the Online Daily Air Quality Index



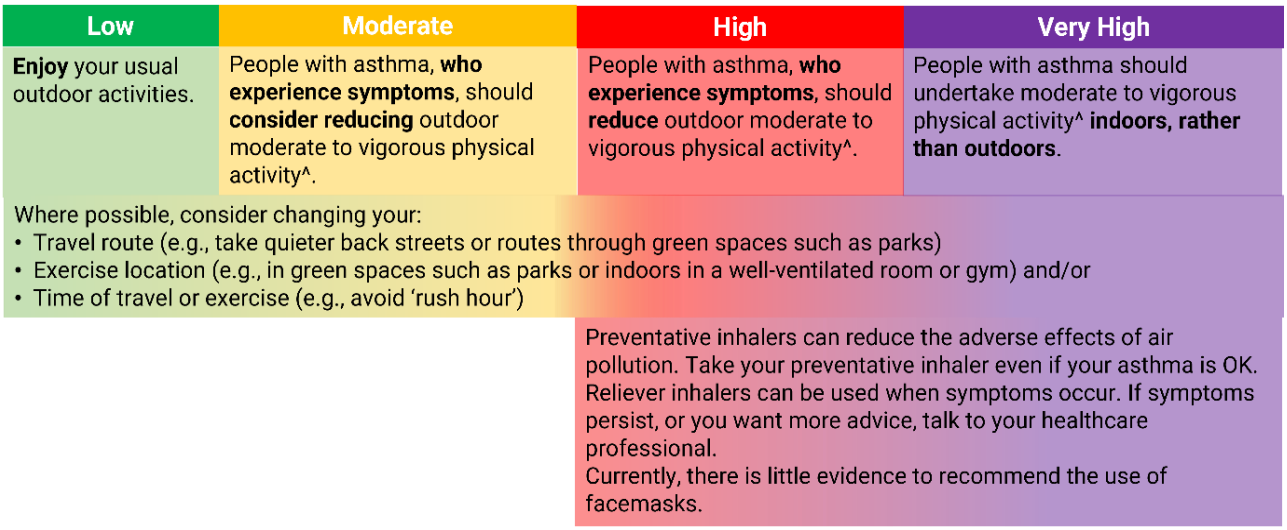
Participants were generally positive about it, finding it easy to understand and interpret overall. Most understood that green or blue indicated a positive level of air quality and red indicated a negative reading. The combinations of features such as colours, words and numbers helped to reinforce to participants the meaning of the readings given.

However, some participants felt that in its current form there were too many bands and that these should be simplified to traffic light colours (red, amber, green), with the removal of purple for the worst rating. Some participants also queried the meaning of some of the descriptors: not all were clear about what the difference is between the 'high' and 'very high' ratings. There was also some confusion over the language and concepts: while the majority of participants assumed that a 'high' reading related to air pollution, two participants in the research assumed that a 'high' reading related to air quality and so misinterpreted this band as a positive air quality rating.

When participants interacted with the DAQI webpage, not all realised that the map is interactive or that they needed to scroll to the bottom of the page to locate the search function. Repositioning this at the top or side of the page could be considered. When asked directly about their understanding of what is being measured, participants were unable to respond easily and so suggested that more detail be provided about this. However, most did not want to be overwhelmed with information and so suggested that this is provided in a 'layered' way, with the facility to hover over the rating or click onto it for more detail.

Participants with respiratory conditions were invited to feed back on some information (Fig. 6) devised by Asthma UK to help guide behaviour related to the DAQI ratings, which can also be found in section 2.3.3. in the appendix.

Fig. 6 Recommended action and health advice for people with asthma



Participants welcomed information created in collaboration with an expert group such as this and felt that the information given was clearly set out, concise and visually striking. They agreed that the advice given was realistic and that the actions suggested were easy to understand and follow. If provided alongside the DAQI, they felt that this would help to strengthen understanding of the link between air pollution and respiratory conditions.

However, not all felt that this added any new information that they were previously unaware of. Some were also unclear about the structure and layout of the information, suggesting that the use of a simplified table would be easier to understand. They also felt that many people would be likely to face barriers to the advice given, for example around changing their travel routes, exercise locations or the timing of these.

4.4.3. Communicating risk

Within the research, participants were shown a range of different means of communicating risk, including framings and visual representations of, and language relating to, risk.

Framing risk

Participants looked at text from the GOV.UK website that presented information about the impacts of air pollution framed in different ways (which can be found in Appendix 3.3.13).[2] They tended to prefer information setting out the impact of pollution on a human body over a lifetime, rather than framing it in terms of the cost to the country and the NHS. This former framing was felt to be more human-centred and to have personal relevance; some participants strongly felt the latter approach to be distasteful, as it reduces human experience to money. Participants were particularly interested to hear how air pollution can affect people negatively, especially in ways that were not always obvious to them, such as in relation to heart health, cognitive decline, dementia and low birth weight.

Participants were also asked to compare different ways of expressing air pollution levels that are used in the United States and China (see Appendix 2.4.6-7). The American system frames the levels in terms of health impact, using: 'good', 'moderate', 'unhealthy for sensitive groups' and

[2] Health matters: air pollution - GOV.UK (www.gov.uk)

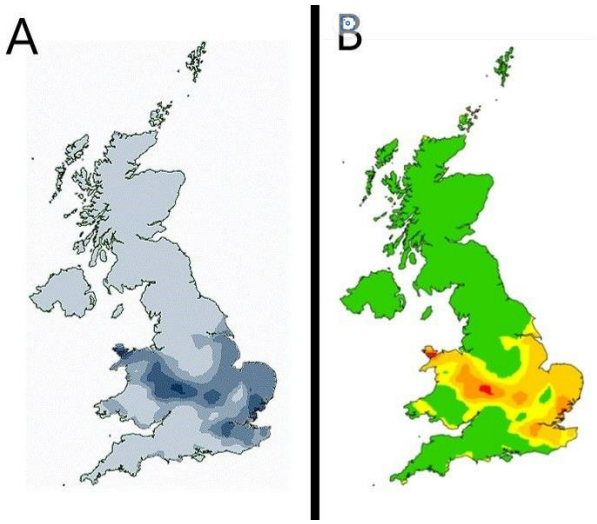
'unhealthy'. The Chinese approach is to frame risk in terms of pollution and uses the levels: 'good', 'lightly polluted', 'moderately polluted', 'heavily polluted' and 'severely polluted'.

When asked to interpret the meanings of these different levels, while both framings provoked concern and anxiety, the Chinese framing induced more anger in participants. It can be inferred that this is due to the encouragement to the reader to focus on the cause rather than the impact on health. Participants had no clear preference for either framing.

Visual representations of risk

In the research the 'red, amber, green' system was compared with a use of a single colour gradient (where light communicated low air pollution and dark communicated high air pollution). This example can be found in Fig. 7 and Appendix 2 in sections 4.1-5.

Fig. 7 Two different approaches to communicating air pollution levels on a map



The single gradient system was less successful in communicating to participants about which areas were 'safe' and how intermediate areas compared with the highest and lowest levels of pollution. Participants tended to prefer the 'red, amber, green' system as they felt it was more familiar, visually striking and enables easier differentiation between bands of air pollution.

'At risk' descriptors

Additionally, participants were asked about their preferences for different descriptions of the 'at risk' groups who may be more negatively affected by air pollution than others. Words such as 'susceptible', 'vulnerable' and 'sensitive' were rejected, either due to them not being clear enough or implying value judgements regarding the individuals involved. Instead, participants felt that it was better to refer to people who are 'at greater risk' or 'at higher risk' from the effects of air pollution to indicate that no one is completely safe.

> "The brighter colours make it easier to differentiate at a glance the different levels of pollution and is visually more appealing."
>
> **(Online feedback on the 'red, amber, green' system for communicating risk)**
>
> "Clearer difference in colours and more visually striking. Also uses colours commonly associated with 'bad' and 'good."

(Online feedback on the 'red, amber, green' system for communicating risk)

4.4.4. Openness to sharing personal information for short term air quality information

Participants were asked about their interest in sharing information to receive air pollution alerts. Reponses to this varied and a range of suggestions emerged that met different needs and expectations.

One suggestion was to develop a local council opt-out system, based on postcode areas. The benefit of this was seen to be that the level of information shared was minimal (postcode only) but would allow access to localised air quality forecasts, and that individuals could tailor information to a greater extent according to individual preferences if they wanted to.

Another idea was to add this facility into the existing NHS app. This was often suggested by those already using the app, and so they were content to share their data in this way. They assumed that the app already holds information on their current health conditions, so it would be an ideal channel for communicating targeted information about air quality.

Some participants also proposed the development of a healthy living app relevant for families, that could encourage users to sign up to set targets for outdoor exercise, with air pollution information being passed on in relation to this.

Whatever the delivery model, participants felt that alert messaging, whether provided via app notifications or text messages, would be a key aspect of this information. Ideally, they wanted to be able to choose the message frequency and the level at which the alert is sent (e.g., every day, when air quality is 4+). Once again, the ability to access different layers of information was important, so that information would initially be provided at an overall level, with the option to click through to more detailed information if desired. Participants were keen to learn about the reasons for air pollution levels being high, for example if this was due to traffic or weather conditions, and felt that this may help to provide basic education about air pollution over time. Where information on choices for acting are provided, participants wanted to see a range highlighted and be reassured that information will not be presented too negatively so that it scares people.

4.4.5. Influencing behaviour longer term

Participants were positive about understanding levels of air pollution in a location, and how these had changed over time, to support longer term decision-making. Participants were shown a mocked-up government website page (Fig. 8a-b) to help explore this issue, that provided air quality information about a dummy postcode. This can also be found in Appendix 3.3.1.

Fig. 8a - Mocked-up government website page: Air quality information by postcode - Alert

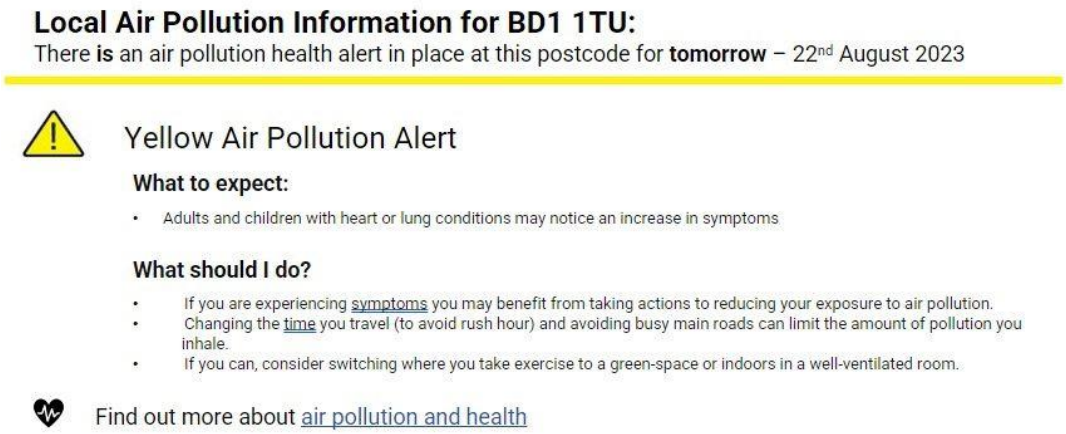
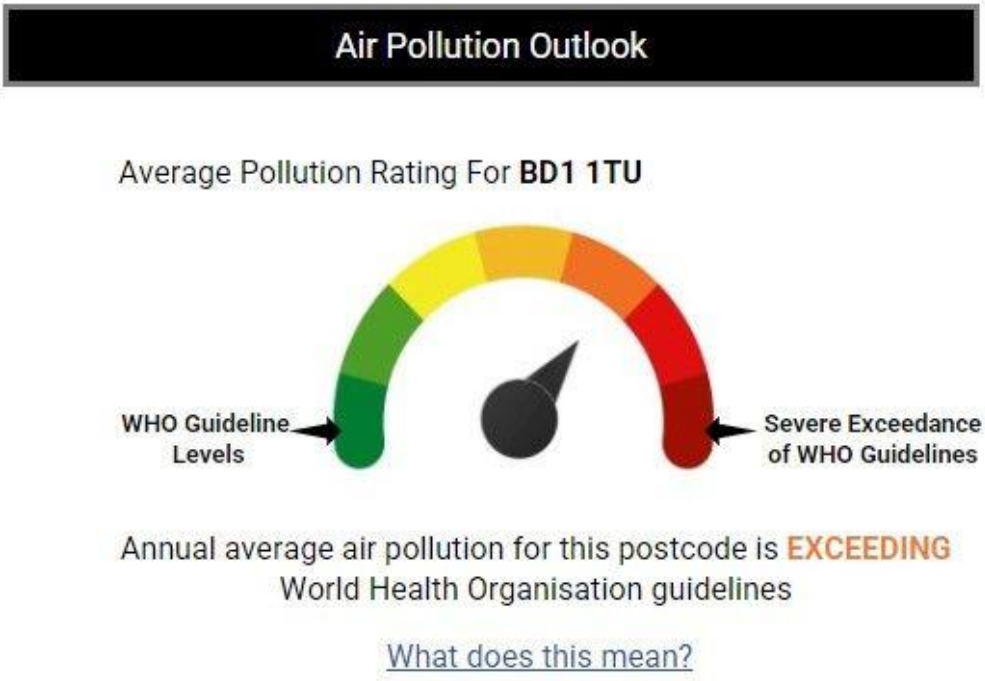


Fig. 8b - Mocked-up government website page: Air quality information by postcode - Rating



The way the page was structured for the research contained a range of different elements - an alert (Fig. 8a), a rating (Fig. 8b), a reading and a map. When they initially accessed the page, participants were often confused by the amount of information presented and how it linked together. While all the different types of the information were potentially useful, participants emphasised the importance of ensuring that these work together cohesively, are explicitly explained and that the symbols and colour coding system used (ideally a 'red, amber, green' system) is consistently and clearly brought together via a key. Participants also reported that their expectation would be that these elements would have a chronological flow, from short term to longer term risk, so that today's reading would be at the top of the page, followed by that for the next day, finishing with the annual reading.

Ideally, the information would be provided via concise text, short sentences and bullet points. Once again, participants were keen for further information to be available, especially around:

- How the rating has been collated, what contributes to it and/or what it is based on.
- Advice on how individuals can help improve the rating (if relevant).
- Links to further health advice where relevant (e.g., if pollution is high).

4.4.6. Openness to sharing personal information for longer term air quality information

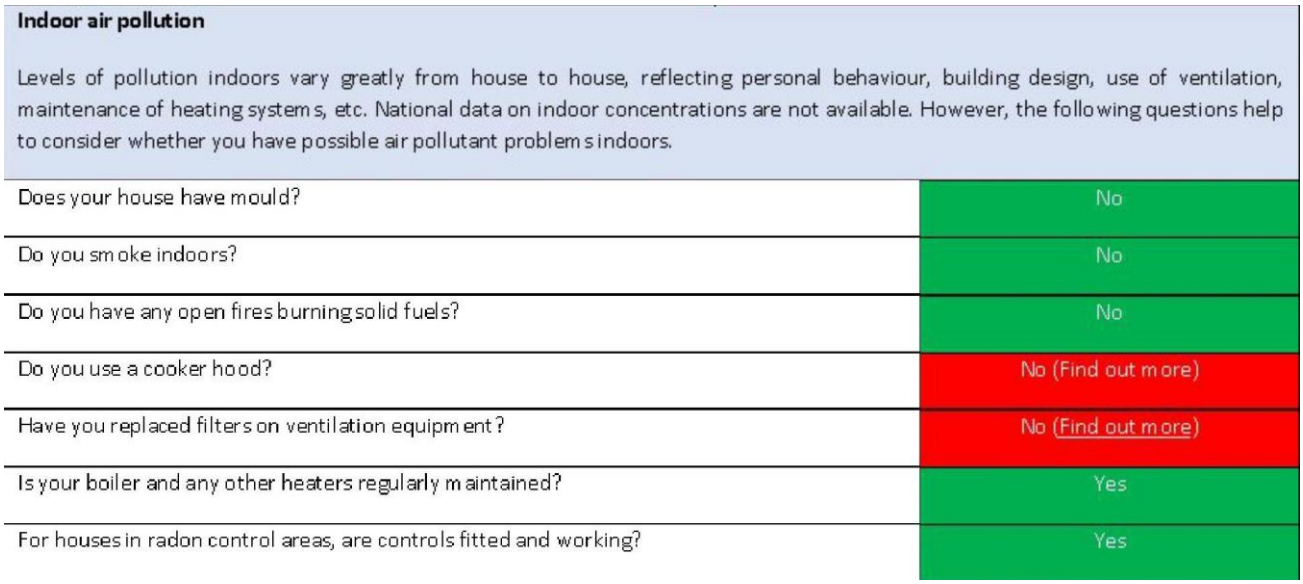
Participants were also asked to comment on longer term air quality information: a mocked-up website was again provided, which can be found in Appendix 3.3.7. The top half of the web page (Fig. 9a) allowed participants to explore the air pollution of an area over time; the bottom half (Fig. 9b) enabled them to input details to obtain an indoor air quality statement for their property.

Fig. 9a. Mocked-up government website page: longer term air quality

Outdoor air pollution (green shows compliance, red shows non-compliance, orange shows compliance with UK legislation but not WHO Guidelines)

Annual $PM_{2.5}$ concentration	6.8 µg/m³ (2023) 7.3 µg/m³ (2022) 7.1 µg/m³ (2021)	WHO Guideline: 5 µg/m³ ×	UK target: 10 µg/m³ ✓
Annual NO_2 concentration	6.0 µg/m³ (2023) 7.8 µg/m³ (2022) 6.5 µg/m³ (2021)	WHO Guideline: 10 µg/m³ ✓	UK target: 40 µg/m³ ✓
Number of exceedances of 200µg/m³ NO_2 as 1 hour mean in 1 year	12 (2023) 7 (2022) 22 (2021)	Not applicable	UK target: Up to 18 ✓
Peak season (summer) ozone concentration	48 µg/m³ (2023) 57 µg/m³ (2022) 64 µg/m³ (2021)	WHO Guideline: 60 µg/m³ ✓	UK target: XX µg/m³ ✓
Number of exceedances of 100µg/m³ ozone as 8 hour mean in 1 year	6 (2023) 4 (2022) 15 (2021)	Not applicable	UK target: Up to 10 ✓
Are other air pollutants present at levels above legislation or WHO guidelines?		No	

Fig. 9b. Mocked-up government website page: indoor air pollution statement



Indoor air pollution

Levels of pollution indoors vary greatly from house to house, reflecting personal behaviour, building design, use of ventilation, maintenance of heating systems, etc. National data on indoor concentrations are not available. However, the following questions help to consider whether you have possible air pollutant problems indoors.

Does your house have mould?	No
Do you smoke indoors?	No
Do you have any open fires burning solid fuels?	No
Do you use a cooker hood?	No (Find out more)
Have you replaced filters on ventilation equipment?	No (Find out more)
Is your boiler and any other heaters regularly maintained?	Yes
For houses in radon control areas, are controls fitted and working?	Yes

Local air pollution statement

The local pollution statement provided information about concentrations of different pollutants in the local area, with a 'red, amber, green' rating to show the extent to which these levels comply with UK and World Health Organisation air pollution guidelines.

While participants were interested in sharing household details to obtain a pollution statement for their property, overall they found the style of this statement overwhelming and difficult to comprehend. This was mostly due to participants feeling that the information provides a great deal of technical detail that they do not understand – they were unclear about what the different pollutants were and what the concentrations and levels meant. Although the 'red, amber, green' system helped participants to understand whether levels were relatively higher or lower, this did not overcome reservations about the information.

Participants therefore suggested that where this type of information is given, there would ideally need to be an introduction to what is being shown, what the pollutants are and what the information shows about the way the levels of pollutants have changed over time.

Participants wanted some of the terms explained, especially the pollutants themselves and what constitutes 'solid fuel'. They also asked for a clearer explanation of how air pollution has changed over time, for example with a visual representation of this, such as an arrow showing upwards or downwards movement.

> "This is to be honest far too technical and scientific for me and would just immediately make me want to click off when talking about annual concentrations of different chemicals. I really have no idea what it means."
>
> **(General population group)**
>
> **"**It's honestly like Greek to me."
>
> **(Cardiovascular conditions group)**

Indoor air pollution statement

Participants were keen to receive details about how to improve indoor air pollution, as they felt that this would:

- Enable them to access accurate information tailored to them.
- Improve understanding of behaviours linked to indoor air quality and empower people to consider changes within their home.
- Possibly lead to better indoor air quality for users.
- Provide information that could help when buying/renting homes.

Participants were positive about the form of this statement, as it was set out as a questionnaire that participants could answer easily, with the results highlighting their answers with the 'red, amber, green' system to show areas of concern. This more concrete focus on participants' homes made the indoor air pollution statement clearer and easier to understand than the local area statement. The questions asked helped participants to understand which factors contribute to indoor air pollution and the way the answers were presented gave direction in terms of how to make changes to improve indoor air quality. However, participants felt that the statement could be improved by, once more, providing links to further information, especially regarding background information about what affects indoor air quality and the details of particular pollutants (e.g., radon).

> "Having this information can help me decide on what adjustments I should make in my home"
>
> **(General population group)**
>
> "I would be interested to know the results!! Even though I would have to Google some things to put in the correct info."
>
> **(Respiratory conditions group)**

4.4.7. Information to support decision-making

Participants also suggested other ways of supporting their longer-term decision-making around household purchases, such as when buying white goods or household appliances, a car or upgrading heating systems. They agreed that this could help to raise awareness about the implications these different decisions had for air quality and direct appropriate behaviour.

One aspect that participants believed would be useful was that of enabling comparison of different purchase decisions. This led them to suggesting the development of an air quality rating, similar to existing energy rating stickers on white goods, or encouraging comparison websites to refer to the impact of products on air quality. They were also keen to hear about how to access impartial information that explains which products are better for air quality and why.

Participants emphasised that, in the context of the cost-of-living crisis, if there are any cost benefits to buying goods or services that are positive for air quality, it would be motivating to show people

what this means in practice. They therefore talked about supporting people to estimate long-term savings, for example by providing online calculators that show the difference in costs between different options or ensuring that there are clear channels for accessing any relevant information on grants, including eligibility criteria and details of how to access them.

More generally, participants were also interested in hearing about the benefits of different products and services, such as via opinion pieces that promote positive experiences of purchases that reduce contributions to air pollution. They were especially likely to be open to hearing from experts, celebrities and/or influencers who were promoting the benefits of specific decisions in this context.

> "A lot of people probably can't afford to prioritise the environment."
>
> **(General population group)**
>
> "They say you will save all this money on your bills [by installing a heat pump] but when you try to work it out and the cost of installing it, you'd have to have it for about 20 years before you'd even make that money back."
>
> **(General population group)**

5. Implications

These findings have overarching implications for communication about reducing contribution and exposure to air pollution and present two key information tasks.

The first task is to raise awareness about the topic, which can be further sub-divided into:

1. **General awareness raising** that:
    - Establishes air quality forecasts as a social norm.
    - Provides information about the health impacts, pollutants and sources of air pollution, and what people can do to reduce their contribution and exposure to air pollution.
    - Presents the information via infographics, local news stories, weather apps/reports and share-able information that can trigger conversations online.
    - Disseminates the information via general media, social media, the NHS, schools, charities, weather information providers and local news channels.
2. **Targeted awareness raising** that:
    - Highlights the risks of exposure to air pollution to relevant individuals, giving details of the health impacts to be aware of and how to reduce risk.
    - Uses posters, leaflets and online information channels, and engages GPs, pharmacists, consultants, midwives, health visitors and asthma and diabetes nurses to signpost relevant individuals to further information.
    - Focuses on key 'moments of change' for raising awareness, such as when people are having children or are diagnosed with a condition that places the individual at greater risk of negative health impacts from air pollution.

The second task is to influence behaviour around reducing contribution and exposure to air pollution, which once again can be separated into:

1. **Activity to influence shorter term decision-making** that gives people access to simple, up to date, localised air quality forecasts via weather forecasts, web pages and apps, which are disseminated by weather information providers (such as the Met Office) and news channels.

2. **Activity to influence longer term decision-making** that:

    - Aims to support people to compare purchase options, clarify costs and see the benefits of different purchase options, for example via the provision of formats like: air quality product ratings, online calculators to assess the costs of different choices, opinion pieces from influencers and testimonies from general public users.

    - Enables people to see the impact of their past decisions or the potential impact of future decisions, for example by allowing them to input information about their own local area or property so they can see relative levels of air pollution (indoors and outdoors).

    - Is provided via GOV.UK, comparison websites, influencer social media accounts and new, dedicated resources for this purpose.

    - Focuses on 'moments of change' such as moving house, choosing a school, changing domestic heating systems and purchasing white goods, domestic appliances or vehicles.

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[1] These overall findings echo a previous research study that found that, although general public audiences were aware of the concept of air quality at a high level and commonly talked about it in terms 'air pollution', they had shallow understanding of it (Defra Air Quality User Needs Report, Kantar, 2021).

[2] Kollmuss A and Agyeman J (2010) Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research. Vol. 8, No. 3

[3] Vesely S and Klöckner CA (2020) Social Desirability in Environmental Psychology Research: Three Meta-Analyses. Front. Psychol. 11:1395. doi: 10.3389/fpsyg.2020.01395

[4] This recalls the research of another study in which participants were similarly unaware of the connection between climate change and air pollution (Individuals' interpretation of air quality information: customer insight and awareness study, University of Brighton, 2011).

[5] This model has been developed from Southerton et al's (2011) International Review of Behaviour Change Initiatives, in which the Individual, Social and Material contexts were used to examine the effectiveness of environmental behaviour change interventions.