Committee on the Medical Effects of Air Pollutants (COMEAP)

2022 Annual Report

Contents

If you require any information about the references used in these reports, please email the committee's secretariat at air.pollution@ukhsa.gov.uk

Many of the documents referred to in this report are available on the GOV.UK website.

Preface

I am delighted to be writing the preface to the first annual report of COMEAP since taking up the position of Chair in 2021, particularly as 2022 marks the thirtieth year since COMEAP was established.

The report showcases the breadth of topics covered by the committee, which in 2022 ranged from dementia to climate change, as well as technical issues relating to quantifying health effects of air pollution and particle toxicity.

In 2022, we were just emerging from the COVID-19 pandemic and most of our meetings were virtual, but we were able to hold our first in-person meeting for nearly 3 years in November 2022 in Birmingham. The emerging evidence relating to the potential impact of air pollution on COVID-19 was considered in several meetings (for a statement to be published in 2023).

One of COMEAP's key publications in 2022 was a substantive report on dementia. This documented a likely causal association with air pollution exposure, which received wide media attention. We published 6 statements and advice notes. These include a response to the new WHO Air Quality Guidelines published at the end of 2021 (which recognise that air pollution has detectable health effects down to very low levels) and our advice to Defra regarding the health effects of air pollution, to inform the Environment Bill air quality target setting. We also participated in the Defra, UKHSA and DHSC Air Quality Information Systems (AQIS) review, intended to improve air quality information communication.

A perhaps less visible, but highly important, role of COMEAP is to review the scientific evidence to define exposure-response relationships between air pollution and health outcomes. This was the subject of 2 of the statements produced in 2022, prepared by our Quantification of Air Pollution Risks in the UK (QUARK) Sub-group. This work supports evidence-based calculation of the burden of disease and health impact assessments and is used as a national reference for cost-benefit analyses. QUARK also considered various important methodological issues related to quantifying health risks.

We sadly lost a member of the committee during the year, Paul Wilkinson, who passed away suddenly and unexpectedly. He was a renowned environmental epidemiologist who made many valuable contributions to COMEAP's work during his 9 years as a member. We reflected on his insightful and collaborative work during our final meeting of 2022.

At a virtual away-day at the start of 2022, we took the opportunity to review the way in which COMEAP functions. We have resolved to continue with virtual shorter meetings with one-two meetings per year in-person/hybrid, to reduce our carbon footprint, and help with flexibility and inclusivity. We also resolved to include early career researchers in the work of COMEAP and have been able to do so in preparation of forthcoming reports and statements, as well as

helping identify evidence on emerging topics. We agreed to trial an approach, developed by the Joint Synthesis and Integration of Epidemiological and Toxicological Evidence subgroup (SETE) of the committees on Toxicity (COT) and Carcinogenicity (COC) of Chemicals in Food, Consumer Products and the Environment, to summarise and visualise the integration of toxicological and epidemiological data. We also resolved to take steps to improve the visibility and accessibility of COMEAP's work, for example by providing lay summaries for reports and substantive statements. Another step was to reinstate the publication of an annual report, so that an accessible summary of the committee's work is readily available.

We were delighted that our lay member, Ruth Chambers, was awarded an OBE in 2022 in recognition for her services to the environment.

Finally, I would like to thank the COMEAP members for their commitment and expert contributions and also acknowledge the excellent support and inputs provided by the COMEAP secretariat.

Professor Anna Hansell

COMEAP Chair

Terms of reference

At the request of the Department of Health and Social Care (DHSC) to:

- advise the UK health departments on the effects on the health of both outdoor and indoor air pollutants on the basis of data currently available
- assess the need for further research
- liaise as necessary with other government bodies to assess the effects of exposure and associated risks to human health

Code of practice

COMEAP aims to follow the Government Office for Science's Code of Practice for Scientific Advisory Committees.

Queen's birthday honours list

In 2022 Ruth Chambers was awarded an OBE in recognition of her services to the environment. Particular appreciation of her role in serving the committee as lay member since 2013 was expressed by COMEAP members at the June 2022 COMEAP meeting.

Note of thanks

Miss Eleanor Sykes left the Secretariat in March 2022. Miss Sykes was thanked for her contributions to the committee and, in particular, for her support to the Adverse Birth Outcomes sub-group.

In memoriam

The committee was saddened by the untimely death of Professor Paul Wilkinson, who had served on the committee since 2013. Professor Wilkinson worked at the London School of Hygiene and Tropical Medicine for 30 years and was a world-renowned environmental epidemiologist. His work was at the forefront of research on climate change, air pollution and the built environment and health. Professor Wilkinson made huge contributions to COMEAP's work, particularly in developing methods to quantify the effects of air pollution on health.

Introduction

This report identifies the main activities of the committee and the advice which the committee has provided to Government during 2022. The committee met 5 times over this period. The meetings were a mixture of full day meetings to discuss the business of the committee and shorter, focused meetings to discuss single issues. All of the meetings, except the November 2022 meeting were virtual; the November meeting was hybrid.

Detailed work has also been undertaken in a number of sub-groups of the committee. There have also been 4 virtual half day meetings of the Quantification of Air Pollution Risks in the UK (QUARK) sub-group (a standing sub-group), and a meeting of an ad hoc group on the economic valuation of morbidity associated with air pollution. There have been 3 meetings of the COVID-19 sub-group, one meeting of the Differential Toxicity of Sources and Constituents of Particulate Matter sub-group and one meeting of the Adverse Birth Outcomes sub-group. In addition, a workshop was held in January, providing members with an opportunity to discuss current and future ways of working.

The advice provided by the committee has been in a number of forms, often communicated to other government departments by the committee's secretariat following discussion at meetings of the committee, but also as statements, reports and advice notes. This advice has been used by government departments as an input to their work of formulating advice to the public, undertaking cost-benefit analyses and developing policy.

COMEAP publications in 2022

The following section provides information on work that has been published by COMEAP in 2022. Links to the publications are provided for further information.

COMEAP 'Statement on update of recommendations for quantifying hospital admissions associated with short-term exposures to air pollutants'

COMEAP updated its recommendations for quantification of hospital admissions associated with short-term exposures to air pollutants, specifically particulate matter (PM), nitrogen dioxide (NO_2) and ozone (O_3). This work was intended to inform cost-benefit analyses undertaken to support the development of air quality targets under the Environment Act 2021. The approach adopted to evaluating the evidence was designed to meet the relevant timescales.

QUARK members examined recent meta-analyses of studies evaluating the associations between (total, all-cause) respiratory and cardiovascular hospital admissions and short-term exposures to PM, NO_2 and O_3. They selected summary effects estimates from single pollutant models, derived from the global literature, which they regarded as the most suitable for use as

concentration-response functions to quantify hospital admissions associated with short-term exposures to air pollutants.

The statement also provided advice about correlations between pollutants and the implications for using coefficients for more than one pollutant for the same health end-point within the same assessment. The statement drew the attention of policy-makers to the potential for localised interventions designed to reduce NO_2 to increase localised concentrations of O_3. It also explained that consideration should be given to the uncertainties regarding causality for some pollutant-outcome pairs, when deciding which pollutant-outcome pairs to include in core assessments or in sensitivity analyses.

Air pollution: quanitfying effects on hospital admissions

COMEAP 'Statement on quantifying mortality associated with long-term exposure to $PM_{2.5}$'

COMEAP updated its recommendations for quantifying mortality associated with long-term exposure to fine particle air pollution ($PM_{2.5}$) in outdoor air, which is an important input to policy development. A new concentration-response function (CRF) was selected from a recent meta-analysis of the available global literature by Chen and Hoek (2020).

As part of this work, the committee, and its quantification sub-group QUARK in particular, spent time discussing studies in populations with low-level exposures and the shape of the resulting concentration-response curve. Members decided that it was not appropriate to recommend a cut-off value for quantification; instead linearity should be assumed down to very low or even zero $PM_{2.5}$ concentrations, when quantifying the mortality burden attributable to particulate air pollution.

The committee also discussed the issue of cessation lag, which is the delay in the reduction of mortality following reductions in concentrations of $PM_{2.5}$ because some of the health effects of previous exposure could persist for some time. Members confirmed the lag structure which had been previously recommended (30% of the total risk reduction in the first year after pollution has been reduced, 50% reduction across years 2 to 5 and the remaining 20% reduction distributed across years 6 to 20 with smoothed annual values).

The statement reflects members' discussions regarding the importance of including a discussion of the uncertainties to accompany any quantification using these methods. For instance, the recommended CRF has not been adjusted for effects of other correlated pollutants, in particular NO_2. This means that mortality estimates will likely include effects caused by these other pollutants. Therefore, if mortality effects estimated using this coefficient are added to estimates of mortality effects associated with other pollutants, this will likely give an overestimate of both the effects of the pollution mixture and of the benefits of reducing concentrations.

Particulate air pollution: effects on mortality

COMEAP Report ‘Air pollution: cognitive decline and dementia’

COMEAP published a report led by a sub-group established to examine the evidence linking exposure to air pollutants with cognitive decline and dementia. Sub-group members reviewed nearly 70 epidemiological studies which examined possible links between air pollution, cognitive decline and dementia in older people.

Members concluded that the evidence is suggestive of an association between ambient air pollutants and accelerated decline in cognitive function. Several possible biological mechanisms were considered. COMEAP concluded that the effects of air pollutants on the cardiovascular system have a secondary effect on the brain. Namely, damage to the cardiovascular system from long-term exposure to air pollutants could affect the blood supply to the brain.

The committee also examined mechanisms that could have direct effects on the brain, including translocation of particles into the brain. Based on the available evidence, it remains unclear whether there is sufficient translocation of particulate material from exposure to ambient concentrations to cause damage to the brain. The evidence suggests possible links between the generation and release of free radicals and the induction of an inflammatory response in the brain. As this evidence was from animal and in vitro studies using higher than ambient exposures, it was not clear how informative these studies may be about effects in human populations.

The committee’s view was that the current evidence base linking air pollutants with dementia was inadequate for direct quantification. However, members suggested it may be possible to develop an indirect method of quantification of the effects of particulate air pollution on vascular cognitive impairment or vascular dementia. This would require a review of the evidence regarding the quantitative link between cardiovascular endpoints and effects on cognition.

Air pollution: cognitive decline and dementia

COMEAP ‘Statement on the differential toxicity of particulate matter according to source or constituents: 2022’

The Sub-group on Differential Toxicity of Sources and Constituents of Particulate Matter, which had been tasked with updating the committee’s 2015 statement on this topic, took its recommendations to the committee. The resulting updated statement was published in July 2022.

COMEAP’s previous statement had concluded that the evidence available at the time did not indicate that any one source or component was more strongly related to health effects than mass concentration ($PM_{2.5}$). Since then, 2 comprehensive reviews (ANSES, 2019 and USEPA,

2019) had been published on the topic. The revised statement is based on these systematic reviews and others published until December 2020.

The updated statement concluded that, although the recent body of evidence added weight to the conclusion that different constituents are likely to have different toxicological actions, the evidence does not consistently indicate specific components of PM that are more toxic than others. Members therefore recommended that, at present, $PM_{2.5}$ remains the most suitable metric for evaluating health impacts.

Statement on the differential toxicity of particulate matter according to source or constituents: 2022

COMEAP statement 'Response to publication of the World Health Organization Air Quality Guidelines 2021'

COMEAP members provided a statement in response to the publication of the World Health Organization (WHO) air quality guidelines (AQG) which were updated in 2021. Members welcomed the guidelines and regarded them as suitable long-term targets. This statement reflects a number of comments and observations from the committee.

WHO's long-term AQGs for PM, NO_2, and O_3 were developed based on evidence from studies of spatial variation in long-term average concentrations of air pollutants. Members noted that short-term AQGs for PM, NO_2 and O_3 were developed from the long-term AQGs for these pollutants. This approach, using 99th percentiles of daily concentrations observed in distributions with a mean equal to the long-term AQGs, is different from previous approaches used to determine short-term AQGs. Previous approaches, as in the 2005 WHO guidelines, were based on evidence of effects following short-term exposures.

Members stressed that the AQG should not be regarded as thresholds below which there are no health impacts, rather the AQGs are levels below which there is less certainty about the existence of an effect. In this statement, members highlighted their previous advice to Defra: that epidemiological studies had not provided evidence of a threshold concentration of $PM_{2.5}$ below which there were no effects on the populations studied. Members suggested that the lack of a threshold for effect at the population level should not be interpreted to mean that there is no threshold for effect at an individual level, as this will vary based on individual factors.

Nonetheless, COMEAP's view was that even low concentrations of pollutants are likely to be associated with adverse effects on health. Therefore, continued reductions, even where concentrations are below the AQGs, are also likely to be beneficial to health.

COMEAP observed that the Guideline Development Group (GDG) also produced good practice statements (GPSs) for some PM components, including black carbon/elemental carbon (BC/EC), sand and dust storms, and ultra-fine particles (UFP). Members noted that the recommendations regarding sand and desert dust were unlikely to be relevant to the UK. The

UK had a network of BC/EC monitors but limited UFP monitoring. COMEAP considered that increased UFP monitoring would deliver several benefits, for example, improved knowledge of population exposure and the facilitation of epidemiological studies.

COMEAP statement: response to publication of the World Health Organization air quality guidelines 2021

Advice note 'Fine particulate air pollution ($PM_{2.5}$): setting targets - update'

COMEAP members provided advice to Defra on the health evidence relevant to setting $PM_{2.5}$ targets in July 2021. In the light of revised WHO Air Quality Guidelines published in September 2021, members issued an updated advice note.

COMEAP noted that the revised Air Quality Guideline for $PM_{2.5}$ (5µg/m^3 as an annual average) confirmed its previous advice that the more recent evidence indicated that $PM_{2.5}$ had harmful effects on people's health at lower concentrations than had been studied previously. Members therefore strongly support a reduction of $PM_{2.5}$ concentrations, ideally to (or below) the WHO guideline value of 5µg/m^3. However, they noted that the new guidelines may be challenging to meet immediately and recognised that Government needed to balance health benefits of policies and interventions against costs.

WHO had noted that the burden of air pollution-related diseases was unevenly distributed. COMEAP had previously advised Defra that reducing exposure of a whole population would achieve greatest overall public health benefit. Nonetheless, it had recommended that Defra should investigate whether proposed or implemented interventions reduced inequalities in exposure or had undesirable consequences for inequalities and this advice remained unchanged.

Fine particulate air pollution ($PM_{2.5}$): setting targets

Advice note 'in response to Defra's May 2022 evidence report and impact analysis to inform the public consultation on Environment Act $PM_{2.5}$ targets'

Defra introduced stricter targets for $PM_{2.5}$ in 2022. These targets focused on the requirement in the Environment Act 2021 for $PM_{2.5}$ targets to be set. This note raised specific points on the evidence provided by Defra on how the targets were developed and provided some recommendations to Defra.

It was recommended that Defra should consider the role of local authorities and others in continuing to improve air quality, even where legally binding targets were met. Defra were also encouraged by COMEAP to publish the interim $PM_{2.5}$ targets, as members thought they would play an important role in progress to maximise health benefits.

The note also reflected members' recommendations on exposure, including the importance of considering inequalities in $PM_{2.5}$ exposure and recommended the use of monitoring and/or modelling to assess whether disparities in exposure are reduced in the future from the setting of these targets. It was also highlighted in this note that the relationship between long- and short-term concentrations of $PM_{2.5}$ should be examined. This was to ensure that the targets for long-term exposures protect people from effects of short-term episodes of elevated exposure.
On compliance with targets, COMEAP members mentioned the importance of reducing other pollutants, these included NO_2 and O_3 in addition to $PM_{2.5}$. This was to ensure there were no unintended consequences of these pollutants when focusing on reducing $PM_{2.5}$ concentrations. Members recommended the use of the impact pathway approach to assess the costs and benefits of plans to deliver compliance with the revised targets. Lastly, members emphasised the need to continue to engage internationally, so that transboundary pollution does not prevent the targets being met.

COMEAP advice note: Environment Act $PM_{2.5}$ targets

Journal publications arising from COMEAP work

Some COMEAP members contributed to a critical review on road traffic derived non-exhaust particles, which was published in the peer reviewed journal, Environmental Science and Technology, in 2022. This article built upon the Non-Exhaust Emissions (NEE) statement, published by COMEAP in 2020.

A review of road traffic-derived non-exhaust particles: emissions, physicochemical characteristics, health risks, and mitigation measures

Other topics covered in 2022

Chief Medical Officer's annual report 2022

The 2022 Chief Medical Officer's (CMO) report focused on air quality. The report looked at indoor and outdoor air pollution, outlining the health problems associated with air pollution and achievable solutions to reducing air pollution. On 30 March 2022, COMEAP members were approached to review the CMO's report by the Department of Health and Social Care (DHSC). Several members reviewed relevant sections of this report over summer 2022. The final report was published on 8 December 2022.

Chief Medical Officer's annual report 2022: air pollution

Health Effects of Climate Change report chapters on air quality

COMEAP members were invited to comment on proposed chapters on air quality in the Health Effects of Climate Change (HECC) report. Members were requested to provide comments on the proposed outlines for the report chapters, provide specific comment on the approaches for quantification, provide feedback on the approaches for reviews and inform the committee of any appropriate resources that may be helpful for the development of the report.

This topic was discussed at the May 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Joint Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) and Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM) sub-group on Synthesis and Integration of Epidemiological and Toxicological Evidence (SETE)

In their January 2022 workshop, members highlighted a need for greater integration of evidence from different disciplines, including, epidemiology, toxicology, and exposure assessment, in developing COMEAP's views. At the COMEAP meeting held on 11 May 2022, members were informed about a new report[1] by SETE that had reviewed possible approaches to integrating epidemiological and toxicological evidence. It was agreed to explore how the guidance could be used in COMEAP's work.

As a result, a short workshop took place in 2022 to apply the SETE approach to integration and visualisation of evidence, using examples of COMEAP's recent and on-going work. These examples were discussed at the November meeting, to get members' views as to whether this

[1] Report of the Synthesis and Integration of Epidemiological and Toxicological Evidence Subgroup (SETE) of the Committee on Toxicity and Committee on Carcinogenicity

approach would be helpful in clarifying and communicating COMEAP's conclusions. It was agreed to continue trialling the application of SETE guidance to COMEAP's future work. This topic was discussed at the May and November 2022 COMEAP meetings.

Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

COT work on inhaled microplastics

COMEAP was asked to comment on a draft COT statement on microplastics during the May 2022 meeting.

In the November 2022 meeting, a recent WHO report on dietary and inhalation exposure to nano- and microplastic and human health was provided to members.

This topic was discussed at the May and November 2022 COMEAP meetings. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Lung cancer and air pollution

The topic of lung cancer and air pollution was discussed during the November 2022 COMEAP meeting. Information on new research on how air pollution causes lung cancer in never smokers was provided by Professor Charles Swanton of the Francis Crick Institute. The research focused on environmental pollution as a risk factor for lung cancer in never smokers.

Epidemiological and experimental studies had shown that air pollution ($PM_{2.5}$) exposure caused lung cancer by promoting mutations that occur spontaneously in normal cells. These findings raised questions about assays currently used to assess carcinogenicity and suggested that assays to assess the ability of chemicals to promote existing mutations, rather than induce mutations, might be needed. Members were asked to discuss a number of questions in the context of current views on chemical carcinogenesis.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Issues currently under discussion

Adverse birth outcomes report

DHSC requested COMEAP to examine the effects of air pollution on early life, due to growing interest from the public and government. As a result, the sub-group on Adverse Birth Outcomes has considered the evidence linking adverse birth outcomes with maternal exposure to air pollution during pregnancy.

The committee undertook a programme of work based on a scoping review conducted by the National Institute of Health Research (NIHR) Health Protection Research Unit (HPRU). This included: i) an assessment of strength and consistency of epidemiological evidence linking ambient air pollutants with adverse birth outcomes, ii) identification of evidence of biological mechanisms by which air pollutants could affect adverse birth outcomes, iii) quantification of specific adverse birth outcomes associated with air pollution, and iv) production of recommendations from current meta-analyses or confirmation of whether new meta-analyses should be undertaken to provide recommendations.

The last full sub-group meeting was held on 7 February 2022, members agreed there would not be another meeting to discuss the report. For the remainder of 2022, members and secretariat focused on preparing a final draft and lay summaries of the report.

This topic was discussed at the March 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Air Quality Information Systems (AQIS) review

The AQIS review project was outlined to COMEAP members in March 2022. This is a joint project between Defra, UKHSA and DHSC to look at improvements to air quality information communication. This issue was highlighted by the Prevention of Future Deaths Report following the death of Ella Adoo Kissi-Debrah, who was the first person in the UK to have air pollution exposure named as a factor of a cause of death (Coroner of Inner South London, 2021). This report raised an urgent need to review the current provision of air quality information.

Members were content with the questions the project intended to address. COMEAP members expressed the importance of ensuring the advice given by the Daily Air Quality Index (DAQI) was beneficial overall, and not detrimental to public health. Discussions focused on the trade-offs between positive and negative aspects of behavioural change, how air quality forecasting could be applied to the DAQI, mechanisms by which short-term exposure causes symptoms, the specific effects of exercise, and messaging and support for people with asthma.

Members expressed interest in participating in a sub-group to take forward the work to inform the ongoing AQIS review. This sub-group was established in late 2022, with the first meeting commencing in January 2023.

This topic was discussed at the March, May, and November 2022 COMEAP meetings. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Cardiovascular Morbidity Report

There was a brief discussion, in the March 2022 meeting, of the Cardiovascular Disease Morbidity Report. Members thought it was important to ensure that summaries of the report should explain when the literature review had been undertaken. As discussed in the November 2022 meeting, the secretariat was liaising with colleagues at the London School of Hygiene and Tropical Medicine, who had worked on the report with the late Professor Paul Wilkinson. Once the outstanding queries on aspects of the report have been resolved, the report would be prepared for publication.

This topic was discussed at the March and November 2022 COMEAP meetings. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

COVID-19 and air pollution: state of the science statement

A COVID-19 sub-group was formed to examine the available literature on the relationship between COVID-19 and air pollution. This sub-group met on 4 occasions during 2022 to develop a statement on the available science. The emphasis of the statement has been on evaluating the studies within the published literature with individual level data.

Sub-group members will continue to develop the statement and requested a further discussion with the full committee to confirm their thinking, before publication.

This topic was discussed at the May and November 2022 COMEAP meetings. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Air Quality Expert Group (AQEG) report: indoor air quality

As part of the committee's work programme, it was agreed that COMEAP would respond to the AQEG report on Indoor Air Quality in the UK. In November, members were asked to consider the report and what comments COMEAP might wish to provide in response to the report. Members also discussed the transferability of the epidemiological literature on outdoor air to evaluating indoor pollution. This was informed by recent discussion within the QUARK Sub-group.

Members agreed with the suggestion to develop a statement on indoor air, which would include COMEAP/QUARK thinking on exposures in microenvironments, in addition to COMEAP's response to the AQEG report.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Methodological work undertaken by QUARK in 2022

Approach to be taken by COMEAP for literature reviews

COMEAP first published a short summary of its proposed approach to literature reviews in 2020. At the COMEAP meeting in May 2022, members agreed to update the document in the light of a report by the Committee on Carcinogenicity and the Committee on Toxicity (COC/COT) Synthesis and Integration of Epidemiological and Toxicological Evidence subgroup (SETE) sub-group (and related discussion of 'evidence triangulation' by QUARK – in the context of causal inference methods – at its meeting on 17 September 2021, which was reported to COMEAP members at the 15 November 2021 COMEAP meeting).

As well as amendments to reflect the value of evidence triangulation, some short text has been included in the protocol to explain QUARK's views regarding confidence and prediction intervals around summary effects estimates from meta-analyses. This discussion has occurred in the context of QUARK's work looking at the heterogeneity of coefficients for the same pollutant-outcome pair, and consideration of transferability to the UK situation. QUARK's view is that, for quantification estimates such as health impact analyses, confidence intervals are a more appropriate expression of uncertainty than prediction intervals.

This updated protocol has now been published and is available at Updated summary of approach to be taken by COMEAP for evidence reviews and syntheses.

COMEAP recommendations for the quantification of health effects associated with air pollutants

In 2020, COMEAP published a summary of COMEAP recommendations for quantifying the health effects of air pollutants. Since then, a number of statements and advice notes including new or updated recommendations for quantification have been published, meaning there was a need to update the summary. QUARK discussed and agreed a revised statement which was proposed for publication on the COMEAP website. The full committee agreed the changes to this document in the November 2022 meeting, and this will be published on the COMEAP website.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Shape of the concentration-response function

QUARK also discussed the shape of the concentration-response function. In 2022, a summary of COMEAP's view on the available studies in populations with low-level exposures was published as an Annex to COMEAP's statement on quantifying mortality associated with long-term exposure to $PM_{2.5}$. This explains that COMEAP/QUARK did not consider that available evidence was sufficient to recommend any change from the assumption of a (log-) linear concentration-response function when quantifying the mortality effects associated with long-term exposure to $PM_{2.5}$. QUARK continued to monitor relevant developments and discussed new publications from the Health Effects Institute (HEI)-funded studies at the QUARK and COMEAP meetings in October and November 2022 respectively.

It was agreed that an update to COMEAP's published statement would be needed, to include discussion of these new studies. However, it was decided that, given the likely timescales for publication of the harmonised analyses and the HEI's panel's commentary on them, QUARK would review these before preparing updated text.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Heterogeneity in results in epidemiological studies: transferability

QUARK also discussed the transferability of study results in epidemiological studies to the UK situation. This involved designing and carrying out a simulation study using data from short-term studies. A paper was prepared by a small QUARK working group and has been submitted for publication. QUARK also discussed other possibilities for investigating heterogeneity, which may include using studies of long-term exposure and/or work to identify the factors which were the underlying sources of the observed heterogeneity.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Multi-pollutant model approaches and measurement error

QUARK has been discussing methodological issues related to the impact of measurement error (exposure misclassification) on the associations found in epidemiological studies. This can impact the size of the associations reported and may result in effect transfer between pollutants in the case of multi-pollutant models. A Symposium on the impact of exposure measurement on the health effect estimates was organised by 2 QUARK members at the Conference of the International Society for Environmental Epidemiology 2022. During the full COMEAP meeting in November 2022, it was suggested that QUARK should consider next how epidemiological estimates could be adjusted to take the measurement error into account.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

Ad-hoc group on economic valuation of morbidity related to air pollution

An ad-hoc group on economic valuation of morbidity related to air pollution was formed in 2022, in response to a need identified by QUARK. The scope for the group is to discuss and propose ways for improving the methods used to value morbidity associated with air pollution. This work intends to inform cost-benefit assessments of policies related to air pollution.
The first meeting of the ad-hoc group was held online in September 2022. A number of presentations and talks were given, covering background and an introduction, economic valuation and research, patients' perspective and a general discussion.

Following the presentations, the group discussed the methods which are currently used and also possible ways for improving these. This topic was previously discussed in the QUARK Sub-group (October 2022), and an update was provided by the Chair of the ad-hoc group in the main November meeting in November 2022.

This topic was discussed at the November 2022 COMEAP meeting. Minutes of the committee's discussion are available at Committee on the Medical Effects of Air Pollutants.

References

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Annex A. COMEAP membership

Committee on the Medical Effects of Air Pollutants

Chair

Professor Anna Hansell, Chair (Professor of Environmental Epidemiology, University of Leicester)

Members

Professor Alan R Boobis (Emeritus Professor of Toxicology, Imperial College London)
Professor Nicola Carslaw (Professor in Indoor Air Chemistry, University of York)
Ms Ruth Chambers (lay member)
Professor Martin Clift (Professor, Biomedical Sciences, Swansea University)
Professor Roy Harrison (Queen Elizabeth II Birmingham Centenary Professor of Environmental Health, University of Birmingham)
Professor Mathew Heal (Professor of Atmospheric Chemistry, University of Edinburgh)
Dr Mike Holland (Freelance consultant in economic assessment of environmental policies)
Professor Klea Katsouyanni (Professor of Public Health, Imperial College London)
Professor Duncan Lee (Professor of Statistics, University of Glasgow)
Dr Mark Miller (Senior Research Fellow, University of Edinburgh)
Dr Ian Mudway (Senior Lecturer, School of Public Health, Imperial College London)
Professor Gavin Shaddick (Executive Dean, School of Engineering, Physical and Mathematical Science, Royal Holloway, University of London)
Mr John Stedman (Air Quality Analysis and Policy Support Knowledge Leader, Ricardo Energy and Environment)
Dr Heather Walton (Senior Lecturer in Environmental Health, Imperial College London)
Professor Paul Wilkinson (Professor of Environmental Epidemiology, London School of Hygiene and Tropical Medicine) (until September 2022)

Secretariat

Ms Alison Gowers
Dr Karen Exley
Dr Artemis Doutsi
Dr Christina Mitsakou
Dr Naomi Earl
Miss Eleanor Sykes (until March 2022)

Annex B. Register of members' interests

This is the register of members' interests (2021). It is also available on the COMEAP website.

Member	Personal interests: name of company	Personal interests: nature of interest	Non-personal interests: name of company	Non-personal interests: nature of interest
Professor A Boobis OBE	Barclays Bank	Shareholder	European Commission (Horizon 2020) (until May 2019)	Research grant/contract
	Bank Santander	Shareholder	–	–
	BT Group	Shareholder	–	–
	Centrica	Shareholder	–	–
	Iberdrola SA	Shareholder	–	–
	National Grid	Shareholder	–	–
	Lloyds	Shareholder	–	–
	Owlstone Medical (no remuneration)	Member of the Scientific Advisory Board	–	–
	ILSI (International Life Sciences Institute) (no remuneration)	Member and Board of Trustees	–	–
	ILSI Europe (no remuneration)	Member of Board of Directors	–	–
	Health and Environmental Sciences Institute (no remuneration)	Member of Board of Trustees	–	–
	Various ILSI Europe working groups on generic risk assessment issues	Member/co-chair	–	–
	Swiss Centre for Applied Human Toxicology (no remuneration) (until Dec 2020)	Member of Science Advisory Board	–	–
	Michigan State University MSU Center for Research on Ingredient Safety (CRIS)	Member of External Advisory Committee	–	–
	Agency for Innovations in Food and Chemical Safety Programme, Science, Technology and Research, Singapore (A*STAR)	Member of Scientific Advisory Board	–	–
	ISO/TC126/Working Group 10: 'Intense Smoking Regime' (nominated by UK Department of Health)	Chair/convenor	–	–
	WHO Study Group on Tobacco Product Regulation (TobReg)	Member	–	–
	Joint FAO/WHO Expert Committee on Food Additives (Residues of Veterinary Drugs) (JECFA)	Member	–	–

Member	Personal interests: name of company	Personal interests: nature of interest	Non-personal interests: name of company	Non-personal interests: nature of interest
	Joint FAO/WHO Meeting on Pesticide Residues (JMPR)	Member	–	–
	Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT)	Chair	–	–
	WHO Core Expert Group on human health risks from exposure to nano- and microplastics	Member	–	–
Professor N Carslaw	No shareholdings	–	Alfred P. Sloan Foundation	2 research grants
	No personal consultancy	–	EU COST Action INDAIRPOLLNET	Action Chair, network grant
	–	–	EPSRC	Research grant from March 2020
	–	–	NERC	Co-I on network grant
	–	–	Homelynk	Co-I on grant
	–	–	Reckitt Benkiser	Small research consultancy project
Ms R Chambers	Greener UK	Senior parliamentary affairs associate working on the Environment Bill	–	–
	–	–	–	–
Professor J Grigg	Novartis	Member of advisory board for asthma medication	–	–
	GlaxoSmithKline	Consultancy, provision of advice on asthma medication	–	–
	Vifor Pharma	Member of advisory board on asthma medication	–	–
	AstraZeneca	Provision of advice on asthma medication	–	–
	Hodge Jones and Allen Solicitors	Medical evidence to an inquest on air pollution	–	–
Professor A Hansell (Chair from June 2021)	Greenpeace	Annual membership and occasional small donation for over 35 years	UKRI (UK Research and Innovation)	Research grants and peer review of applications
	–	–	European Commission	Research grants
	–	–	National Institute of Health Research	Research grants
	–	–	British Heart Foundation	Research grants
	–	–	Health Data Research UK	Research grants
	–	–	European Space Agency	Research grants

Member	Personal interests: name of company	Personal interests: nature of interest	Non-personal interests: name of company	Non-personal interests: nature of interest
Professor R Harrison	Green Life Buildings Ltd	Shareholder	Natural Environment Research Council	Research grants
	Nextgen Nano Ltd	Shareholder	–	–
	Renovare Fuels Ltd	Shareholder	–	–
	Teysha Technologies Ltd	Shareholder	–	–
	Intro Crowd	Shareholder	–	–
	Leigh Day	Author of expert report	–	–
	King Abdulaziz University, Jeddah, Saudi Arabia	Adjunct Distinguished Professor	–	–
	Quarry Battery Company	Bondholder	–	–
	REWS	Bondholder	–	–
	AB Group	Bondholder	–	–
	NQ Minerals	Bondholder and shareholder	–	–
	Engen Group	Loan Note	–	–
	Forschungsvereinigung Automobiltechnik e. V. (FAT)	Author of literature review	–	–
	No paid work or sponsorship from industry	–	–	–
Dr M Holland	UK government (Defra, DoH) and related bodies (for example, Environment Agency, Climate Change Committee)	Consultancy	European Association of Environmental and Resource Economists	Member
	UK national governments (Scotland, Wales)	Consultancy	Chemicals stakeholder forum (Defra)	Member (as independent expert on socio-economic analysis)
	Hillingdon, Hounslow Local Authorities	Consultancy	Imperial College, London	Honorary Research Fellow
	European Commission (DG Research, DG Environment, DG Transport and Energy, European Environment Agency, JRC Sevilla)	Consultancy	–	–
	Other international organisations (OECD, IAEA, ADB, IEA, WHO, WorldBank)	Consultancy	–	–
	Governments of various European Countries (France, Netherlands, Norway, Sweden)	Consultancy	–	–
	NGOs (European Environment Bureau, Health Environment Alliance.	Consultancy	–	–
	Various consultancies (eftec, CEH, Wood, Ricardo-AEA, IIASA, wca-environment, Eunomia, exponent)	Consultancy	–	–

Member	Personal interests: name of company	Personal interests: nature of interest	Non-personal interests: name of company	Non-personal interests: nature of interest
Professor F Kelly (Chair until June 2021)	ERG, Imperial College London	Director	Medical Research Council (MRC)	Research grant
	Dyson	Consultant	European Commission	Research grant
	–	–	National Institute for Health Research (NIHR)	Research grant
	–	–	Natural Environment Research Council	Research grants
Dr M R Miller	British Heart Foundation (BHF) University of Edinburgh	Salary	British Heart Foundation (BHF)	Research grants
	Lloyds	Shareholder	European Commission	Research grant
	Halifax	Shareholder	Natural Environmental Research Council (NERC) Medical Research Council (MRC) National Natural Science Foundation of China (NSFC)	Research grant
	World Wildlife Fund	Small regular monthly donation >8 year	Natural Environmental Research Council (NERC) Medical Research Council (MRC) Earth System Science Organization (ESSO) Ministry of Earth Sciences (ESSO-MoES) Indian Department of Biotechnology (DBT) Newton-Bhabha Fund	Research grant
			Colt Foundation	Research grant
			Research Promote Foundation Cyprus	Research grant
			Chief Scientist Office, Scotland	Research grant
			National Research Foundation of the United Arab Emirates	Peer review of grant applications (commissioned)
			Czech Science Foundation	Peer review of grant applications (commissioned)

Member	Personal interests: name of company	Personal interests: nature of interest	Non-personal interests: name of company	Non-personal interests: nature of interest
			World Heart Federation	Member of Air Pollution Expert Group
Prof G. Shaddick	University of Exeter	Salary	EPSRC European Commission World Health Organisation NIHR Pfizer Ltd Met Office Innovate UK, BEIS NERC	Research grants or contracts
	Royal Mail	Shareholder	University of Bath, Imperial College London	Honorary positions
Mr J Stedman	Ricardo	Salary	Ricardo (research contract Modelling of Ambient Air Quality)	Principal Air Quality Consultant

Annex C. QUARK sub-group membership

Committee on the Medical Effects of Air Pollutants Sub-group on Quantification of Air Pollution Risks (QUARK)

Chair

Dr Heather Walton

Members

Dr Mike Holland
Professor Klea Katsouyanni
Professor Duncan Lee
Professor Gavin Shaddick
Mr John Stedman
Professor Paul Wilkinson

Co-opted members

Dr Dimitris Evangelopoulos (Imperial College, London)

Secretariat

Dr Christina Mitsakou
Dr Artemis Doutsi
Dr Karen Exley
Dr Naomi Earl
Ms Alison Gowers

Annex D. Adverse Birth Outcomes sub-group membership

Committee on the Medical Effects of Air Pollutants Sub-group on Adverse Birth Outcomes

Chair

Professor Jonathan Grigg

Members

Professor Debbie Jarvis
Dr Heather Walton

Co-opted members

Professor Peter Brocklehurst (University of Birmingham)
Dr Julia Fussell (Kings College London)
Professor Eric Jauniaux (University College London)
Dr Rachel Smith (Imperial College London)
Professor Mireille Toledano (Imperial College London)

Secretariat

Dr Philippa (Pippa) Douglas
Dr Naomi Earl
Dr Karen Exley
Ms Alison Gowers
Miss Eleanor Sykes (until March 2022)

Annex E. COVID-19 sub-group membership

Committee on the Medical Effects of Air Pollutants sub-group on air pollution and COVID-19

Chair

Professor Anna Hansell

Members

Professor Alan R Boobis
Professor Martin Clift
Professor Nicola Carslaw
Professor Roy Harrison
Professor Mathew Heal
Dr Mike Holland
Professor Duncan Lee
Mr John Stedman
Dr Heather Walton
Professor Paul Wilkinson (until September 2022)

Co-opted members

Professor Sheena Cruickshank (Professor of Public Engagement and Biomedical Science, University of Manchester)
Professor Tracy Hussell (Professor of Inflammatory Disease, University of Manchester)

Secretariat

Dr Artemis Doutsi
Dr Naomi Earl
Ms Alison Gowers
Dr James Isaac

Annex F. Differential Toxicity of Sources and Constituents of Particulate Matter sub-group membership

Committee on the Medical Effects of Air Pollutants sub-group on Differential Toxicity of Sources and Constituents of Particulate Matter

Chair

Dr Mark Miller

Members

Professor Martin Clift
Professor Roy Harrison
Professor Frank Kelly

Secretariat

Dr Artemis Doutsi
Dr Naomi Earl
Ms Alison Gowers
Dr Christina Mitsakou

Annex G. Air Quality Information Systems (AQIS) sub-group membership

Committee on the Medical Effects of Air Pollutants sub-group on Air Quality Information Systems

Chair

Professor Martin Clift

Members

Dr Mike Holland

Professor Klea Katsouyanni

Dr Mark Miller

Dr Ian Mudway

Secretariat

Dr Naomi Earl

Ms Alison Gowers

Annex H. Ad-hoc group on economic valuation of morbidity related to air pollution

This ad-hoc group was formed in 2022. Below are the details of members who attended the first meeting that took place on 7 September 2022.

Attendees at the meeting on 7 September 2022

Chair

Dr Mike Holland (policy analyst, EMRC)

Government departments or agencies

Fergus Cumming (UKHSA Chief Economist)
Daniella Murphy (Economic Advisor, Joint Air Quality Unit (JAQU), DEFRA/DfT)
Lesley Owen (health economics, National Institute for Health and Care Excellence)

Academia: economics and other science

John Cairns (Professor of Health Economics, LSHTM)
Yan Feng (Reader in Health Economics, Queen Mary's University)
Alistair Hunt (Lecturer in the Department of Economics, University of Bath)
Laure de Preux (Assistant Professor of Economics, Imperial College London)
Tim Taylor (Senior Lecturer in Environmental and Public Health Economics, University of Exeter)
Diana Varaden (Lecturer in Environmental Social Science and Health, Imperial College London)
Heather Walton (Senior Lecturer in Environmental Health, Imperial College London and QUARK

Chair

Paul Wilkinson (Professor of Environmental Epidemiology, LSHTM (until September 2022))

Clinicians and relevant academia

Paul Jones (Professor of Respiratory Medicine, St George's University)
Jenny Quint (Professor of Respiratory Epidemiology, Imperial College)

Consultancies: independents

David Birchby (economist, Ricardo)
John Henderson (health economist, independent, previously at DHSC)
John Stedman (modeller, Ricardo)

COMEAP/QUARK scientific secretariat

Artemis Doutsi (UKHSA)
Naomi Earl (UKHSA)
Karen Exley (UKHSA)
Alison Gowers (UKHSA)
Christina Mitsakou (UKHSA)