COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

Committee on the Medical Effects of Air Pollutants (COMEAP)

2023 Annual Report

Contents

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

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

Preface

COMEAP considers a wide variety of topics each year to fulfil our remit of hazard identification and characterisation, risk assessment, quantification methods, horizon scanning and awareness raising.

As our 2023 report shows, discussions ranged from quantification of effects of air pollution to evaluating new evidence such as the role of air pollution in lung cancer in non-smokers and the risks from microplastics in the air.

Our published statement on COVID-19 was a result of a careful assessment of the best evidence available on links between long-term exposure to air pollution and infection, hospitalisation and mortality. It has informed a subsequent systematic review led by COMEAP members, and a journal paper has been submitted.

In 2023, we also published an updated summary of our recommendations for quantifying health effects associated with air pollutants. This is a key part of our remit and informs methods used by government and researchers both in the UK and worldwide. We updated our protocol on COMEAP literature reviews and set out our preferred approach to expressing the uncertainty around meta-analytical estimates used for quantification.

COMEAP also discussed an approach to the synthesis and integration of epidemiological and toxicological evidence which had been developed by a Joint Sub-group of the Committees on Toxicity (COT) and Carcinogenicity (COC) of Chemicals in Food, Consumer Products and the Environment. The report of the Joint COT and COC Synthesis and Integration of Epidemiological and Toxicological Evidence subgroup (SETE) builds on work which I initiated, while a Member of COT, on Synthesising Epidemiological Evidence. We trialled the SETE suggested visualisation of evidence synthesis in our COMEAP COVID-19 evidence review.

Substantial committee and secretariat time in 2023 was devoted to developing advice to support the government's review of the UK Air Quality Information System (AQIS), which is led by the

Department of Food, Environment and Rural Affairs (Defra) and the UK Health Security Agency (UKHSA). Our COMEAP statement, and supporting working papers, have informed the recommendations made by the AQIS steering group. The AQIS review forms part of the government's response to the coroner's prevention of future deaths report following the death of Ella Adoo-Kissi-Debrah in 2021. Ella, a nine-year old girl with asthma, was the first person to have air pollution listed as a cause of death. This sad event has resulted in major reassessment of advice provided to the public through AQIS.

We are aiming to achieve greater visibility of COMEAP's work, among various audiences. Two journal papers arising out of COMEAP's work were published: one on the sources and implications of heterogeneity in the results of epidemiological studies, and the other on mechanisms by which air pollutants might adversely affect birth outcomes. I also gave a presentation on COMEAP's work to inform the government's target-setting for particles in outdoor air, at the BOHS Inhaled Particles / NanOEH Conference 2023 held in Manchester. Two posters on other items of COMEAP's work were also presented at this conference.

Finally, I would like to thank the COMEAP members for their commitment to the Committee's work and their many and varied expert contributions. Particular thanks go to Dr Heather Walton who chaired the COMEAP QUantification of Air pollution Risks in the UK (QUARK) subgroup for nearly 9 years. Heather retired from the Committee in December 2023 at the end of her 10-year term. Heather had previously supported the Committee's work for many years as a member of the Scientific Secretariat. I also acknowledge the very valuable support and inputs from additional members and advisors to COMEAP and COMEAP subgroups, and the excellent quality 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.

Note of thanks

Dr Heather Walton (COMEAP Member and COMEAP QUARK Chair) left COMEAP in December 2023 as her 10-year term on the Committee had come to an end. She had also previously contributed to the work of the Committee for many years as a Member of the Scientific Secretariat. Dr Walton was thanked for her valuable contributions to the Committee and, in particular, for the excellent job she had done as Chair of the quantification Sub-group, QUARK (COMEAP meeting December 2023).

Introduction

This report identifies the main activities of the Committee and the advice which the Committee has provided to Government during 2023. The Committee met four times over this period. The meetings were a mixture of full day and half-day meetings and were a combination of in-person, virtual and hybrid events.

Detailed work has also been undertaken in a number of Sub-groups of the Committee. During 2023, there were two virtual half day meetings of the Quantification of Air Pollution Risks in the UK (QUARK) Sub-group (a standing Sub-group), and a number of virtual meetings of an associated ad-hoc group on the economic valuation of morbidity associated with air pollution. There was also a virtual meeting of the COVID-19 Sub-group and six virtual meetings of the Air Quality Information System (AQIS) Sub-group.

The advice provided by the Committee in 2023 has been in a number of forms. As well as published statements, working papers have been provided to inform the discussions of a steering group of a project to review the UK's Air Quality Information System (AQIS). COMEAP's advice is 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 2023

The following section provides information on work that has been published by COMEAP in 2023. Links to the publications are provided for further information.

COMEAP 'Statement on the state of the science linking long-term air pollution exposure with SARS-CoV-2 infection and adverse COVID-19 outcomes'

COMEAP had previously (2020) established a small working group of Members to provide ad-hoc advice to government departments and agencies on issues such as the quality of the available studies, and the appropriateness of methods, used to investigate potential interactions between air quality and COVID-19. In May 2020 COMEAP published its views on the evidence available, at that time, linking air pollution with COVID-19 outcomes.

In this new statement, COMEAP evaluated the 'state of the science' on this topic, based on studies linking long-term exposure to air pollution with SARS-CoV-2 infection and COVID-19 outcomes in human populations (epidemiological studies), and on studies of how air pollution might affect the body's response to the virus (mechanistic studies). COMEAP focused on epidemiological studies of the effects of long-term exposure which used individual-level data;

these studies are less prone to the limitations of time-series studies on short-term exposure and studies on long-term exposure without information enabling control for key confounders at the individual level. Various endpoints were considered. Studies published up to August 2022 were included.

The review found that the evidence was strongest for a role of long-term exposure to $PM_{2.5}$ in increasing the severity of COVID-19 in those with SARS-CoV-2 infection. COMEAP commented that studies linking air pollution and COVID-19 are difficult to conduct and hard to interpret. Careful control for other factors that may influence exposure to the virus and severity of disease is needed.

In addition, COMEAP trialled an approach to provide an assessment, via visual representation, of the strength of the epidemiological and mechanistic evidence for a causal association between long-term exposure to $PM_{2.5}$ and various COVID-19 outcomes. This was based on a framework for synthesising and integrating epidemiological and toxicological evidence described by the Joint COT and COC Synthesis and Integration of Epidemiological and Toxicological Evidence subgroup (SETE). This is a qualitative visualisation to show how the epidemiological and toxicological evidence that had been reviewed contributed to the Committee's conclusions.

Air pollution: link with COVID-19 infection and adverse outcomes - GOV.UK (www.gov.uk)

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

COMEAP first published a summary of the Committee's recommendations for quantifying the health effects of air pollutants in 2020. Since then, a number of COMEAP statements and advice notes including new or updated recommendations for quantification have been published, meaning there was a need to update the summary document. Therefore, the document was updated in order to include the latest recommendations made by COMEAP (up to September 2022).

The summary is intended to be helpful to practitioners and policy makers. As well as recommendations for the relationship between an exposure and a health outcome for individual pollutant-outcome pairs, general principles when carrying out health impact assessments or burden estimates are also discussed. These include issues such as considering the potential over-estimation of effects for health outcomes associated with more than one pollutant, or with both short- and long-term exposure to pollution. There is also mention of the greater uncertainty when estimating effects attributable to large changes in concentrations and when extrapolating to concentrations outside those that have been studied in the scientific literature.

This summary document also includes information on the types of uncertainties relevant to each of the recommendations for quantification of the health effects, which can be used to inform

decisions regarding whether to include a pollutant-outcome pair in core health impact assessments or only in sensitivity analyses.

Air pollutants: quantification of associated health effects - GOV.UK (www.gov.uk)

Updated summary of approach to be taken by COMEAP for evidence reviews and syntheses

COMEAP and its quantification Sub-group QUARK produced a protocol regarding how COMEAP could undertake literature reviews and meta-analysis of available evidence on health effects associated with air pollutants. A short summary of its proposed approach to literature reviews was first published in 2020.

In 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 (SETE) Sub-group. The update also reflected a related discussion by QUARK, of the need for "triangulation" of evidence from different studies and study designs, in order to draw conclusions about the overall coherence of the findings.

This took place in the context of discussing the possible role of "causal inference" methods that have been increasingly used in environmental epidemiology. These are intended to mimic some elements of study design similar to the randomised controlled trials which are used in assessing the efficacy and safety of medicines and other clinical interventions, in order to minimise biases. Some short text was also included in the protocol to explain QUARK's views regarding different ways of expressing the uncertainty around summary effects estimates from meta-analyses of epidemiological studies. QUARK's view is that prediction intervals are appropriate to express the range within which the results of a new study at a new location would be expected to fall. However, for quantification estimates such as health impact analyses, QUARK considers that confidence intervals are more appropriate as they express the uncertainty of the pooled estimates.

Updated summary of approach to be taken by COMEAP for evidence reviews and syntheses (publishing.service.gov.uk).

Journal publications arising from COMEAP's work

Heterogeneity in results in epidemiological studies – Transferability

A journal paper, prepared by a small QUARK working group during 2022, was published in the journal Environmental Pollution in 2023 (Lee and others, 2023). The paper discusses the implications of heterogeneity between the results of epidemiological studies for transferability to

the UK situation. This involved designing and carrying out a simulation study using data from short-term studies.

Health impact assessment for air pollution in the presence of regional variation in effect sizes: The implications of using different meta-analytic approaches - ScienceDirect

Adverse Birth Outcomes

A journal paper stemming from COMEAP's work on adverse birth outcomes was published in November 2023 (see section on "Adverse Birth Outcomes Report" below).

Other topics covered in 2023

Lung cancer and air pollution

The topic of lung cancer and air pollution was previously 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 results suggested that the main role of particulate air pollution in lung cancer is to promote naturally occurring mutations, rather than to induce new mutations.

This topic was discussed again during the COMEAP meeting held in July 2023, following publication of this research in the peer-reviewed literature (Hill and others, 2023). Members were asked to make any further observations on the research and to consider whether it suggested a need for COMEAP to review its existing recommendations. Following discussion, the Committee decided that there was no need, at this stage, to revise its recommendations for the cessation lag used in mortality impact assessments. Members also suggested that views from the Committees on Mutagenicity and Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COM and COC) on aspects of this research would be valuable.

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

COMEAP contribution to AQEG note on hydrogen combustion

During the COMEAP meeting held in July 2023, the Air Quality Expert Group (AQEG) Chair mentioned AQEG's draft advice note on hydrogen combustion, which pointed out that it is a source of NO_2. He suggested that COMEAP's views on the health effects of NO_2 at low concentrations would be a helpful contribution to this advice.

To meet this request, the COMEAP Chair and Secretariat developed a short contribution to the AQEG advice note on hydrogen combustion. This was based on information included in COMEAP's previous publications, and was provided to Members for information. During the October 2023 COMEAP meeting, Members' attention was drawn to this text. They were informed of the suggestion that it would be presented in the AQEG report as a text box, alongside the current mention of the WHO AQG for NO_2. No requests for amendments to the text were made.

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

Indoor Air Quality – damp and mould

In September 2023, Ministry of Housing, Communities and Local Government, Department for Health and Social Care and UK Health Security Agency published guidance for landlords on the health risks of damp and mould in housing[1]. This was developed in response to the Coroner's Prevention of Future Deaths report following the death of Awaab Ishaak. A COMEAP Member contributed comments on an advanced draft during the development of this guidance.

COMEAP Members were provided with information regarding the development of this guidance at its meetings held in March, July and October 2023. Minutes of these meetings are available at: Committee on the Medical Effects of Air Pollutants.

On-going work and 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 considered the evidence linking adverse birth outcomes with maternal exposure to air pollution during pregnancy.

The Secretariat is working on finalising the report, coordinating responses to specific questions, and checking diagrams and references. COMEAP Members received updates on progress during meetings held in 2023.

[1] Damp and mould: understanding and addressing the health risks for rented housing providers - GOV.UK (www.gov.uk)

In November 2023, a journal paper stemming from COMEAP's work on this topic was published in a themed issue on Women's and Reproductive Health and the Environment of BJOG: An International Journal of Obstetrics & Gynaecology.
Ambient air pollution and adverse birth outcomes: A review of underlying mechanisms - Fussell - 2024 - BJOG: An International Journal of Obstetrics & Gynaecology - Wiley Online Library

Cardiovascular Morbidity Report

During 2023, the Secretariat liaised with colleagues at the London School of Hygiene and Tropical Medicine, who had worked with the late Professor Paul Wilkinson on the report on quantifying cardiovascular morbidity, to address outstanding queries on aspects of the report. The Secretariat continues to work to prepare the report for publication. Members received updates on progress during COMEAP meetings held in 2023.

Air Quality Information System (AQIS) review

A review of the UK Air Quality Information System (AQIS) is underway. The need to make the public aware of the health effects of air pollution 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 in the cause of death (Coroner of Inner South London, 2021). This report raised the need to review the current provision of information on air quality and health. The project, which is overseen by the Department for Environment, Food and Rural Affairs (Defra) and the UK Health Security Agency (UKHSA), is being steered by a multidisciplinary AQIS Steering Group. COMEAP has provided advice to the steering group on specific aspects of the AQIS project, within COMEAP's remit.

The COMEAP AQIS Sub-group first met in January 2023. During 2023, the Sub-group produced four working papers which have been used to inform the discussions of the AQIS Steering Group. Three of these working papers relate to the behavioural advice that accompanies the UK Daily Air Quality Index (DAQI) which is used to provide information regarding short-term air pollution episodes. These working papers cover: the susceptibility of different groups to adverse health effects; the lag between short-term exposure and the occurrence of health outcomes; and the effects of exposure to air pollution during physical activity. The other working paper considers a possible approach to providing accessible information on long-term average air pollution levels. COMEAP intends to publish a statement summarising key points and recommendations arising from the evidence reviewed in these working papers.

This topic was discussed at the July, October, and December 2023 COMEAP meetings. Minutes of the Committee's discussion are available at: Committee on the Medical Effects of Air Pollutants.

Microplastic air pollution

During 2023, COMEAP Members continued to contribute to the development of a statement on the health risks of inhaled microplastics, by the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT)[2].

A possible need for a separate statement on this topic from COMEAP was discussed, in the context of planning COMEAP's future work programme, at the COMEAP meeting held in March 2023. At the July 2023 COMEAP meeting it was agreed that COMEAP would aim to publish a short 'state of the science' statement on this topic.

Part of the COMEAP meeting held in October 2023 was dedicated to a workshop on airborne microplastics, including tyre wear. External speakers were invited to present on the current inhalation exposure evidence, real-world analysis of tyre wear emissions, and regulatory approaches to microplastics and tyre wear. An outline of a possible COMEAP statement was discussed. This should focus on aspects where COMEAP could most add value to the reviews that were already available, for example COT's sub-statement on the potential risk from exposure to microplastics via inhalation and a report published by the World Health Organization in 2022, on dietary and inhalation exposure to nano- and microplastic and human health[3]. It was agreed that microplastics and tyre wear would be considered separately, in different statements.

Minutes of the Committee's discussions are available at: Committee on the Medical Effects of Air Pollutants.

Indoor Air Quality

COMEAP intends to respond to the AQEG report on Indoor Air Quality in the UK. Points for inclusion in COMEAP's response, and drafts of possible text, were discussed at the July and December 2023 COMEAP meetings.

In addition, QUARK has been looking at possible approaches that could be used to adapt coefficients, from studies of ambient pollutant concentrations, for application in burden estimates or health impact assessments of exposure indoors, and in other microenvironments. Text summarising QUARK's views on the transferability of the epidemiological literature on outdoor air to evaluating indoor pollution was discussed at the July and December 2023 COMEAP meetings.

During the COMEAP meeting held in December 2023, it was decided that two separate statements would be prepared, rather than combining both of these topics in a single statement as previously intended.

[2] Microplastic Inhalation Statement (food.gov.uk)
[3] https://www.who.int/publications/i/item/9789240054608

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

Shape of the concentration-response function

QUARK continues to discuss the shape of the concentration-response function associating mortality with long-term exposure to $PM_{2.5}$. In 2022, a summary of COMEAP's views 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 $PM_{2.5}$.

During 2023, QUARK continued to monitor relevant developments. At the meeting held in October 2023, QUARK discussed new publications from the Health Effects Institute (HEI)-funded studies. The intention is to develop an updated summary of COMEAP's views on the shape of the concentration-response function associating mortality with long-term exposure to $PM_{2.5}$, to reflect QUARK's discussions of the new analyses.

Multi-pollutant model approaches and measurement error

QUARK has discussed 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. During the 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.

QUARK has continued to discuss this topic, including at the October 2023 QUARK meetings The intention is to develop a statement of the Committee's views on this topic for publication.

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. Proposing methods for quantification of the morbidity health impacts of air pollution is outwith the scope of the group: the group's focus is economic valuation of those impacts. Nonetheless, the observations of the group regarding quantification methods, and proposals for future work, may be valuable.

The first meeting was held in September 2022, which aimed to share information across different disciplines and to bring everyone up to speed with the various aspects involved. A meeting of the economic valuation methods sub-group took place in March 2023 with the aim to discuss economic principles, available data sources and suggested updates in methods. Between May and September 2023, meetings of individual working groups of economists were held in order to discuss the different types of costs – resource, opportunity, utility – separately in each of the three groups. On 20 September 2023 an all economists meeting was held, where all the working groups presented their progress and discussed cross-over issues.

Childhood asthma and air pollution

The COMEAP Strategy Group confirmed childhood asthma as the next topic for consideration by the Committee at its meeting in April 2023. The project seeks to update COMEAP's views on the scientific evidence linking air pollution and asthma, taking into account research undertaken since the publication of its previous advice in 2010 and 1995. The Secretariat started preparing for scoping in June 2023. This includes arranging stakeholder workshops to be held in Spring 2024 to engage experts and patient representatives, to inform decisions regarding the focus and scope of the work.

This was discussed at the COMEAP meeting on 1st December 2023 available at: Committee on the Medical Effects of Air Pollutants.

References

Coroner for Inner South London. (2021). 'Regulation 28: Report to Prevention of Future Deaths' Available: https://www.judiciary.uk/wp-content/uploads/2021/04/Ella-Kissi-Debrah-2021-0113-1.pdf

Lee and others (2023) Health impact assessment for air pollution in the presence of regional variation in effect sizes: The implications of using different meta-analytic approaches, Environmental Pollution, Volume 336, 2023, 122465, ISSN 0269-7491, https://doi.org/10.1016/j.envpol.2023.122465.

Hill and others (2023). Lung adenocarcinoma promotion by air pollutants. *Nature*. 2023 Apr; 616(7955):159-167. doi: 10.1038/s41586-023-05874-3. Epub 2023 Apr 5. PMID: 37020004; PMCID: PMC7614604. Lung adenocarcinoma promotion by air pollutants - PMC (nih.gov)

Annex A. COMEAP membership

Committee on the Medical Effects of Air Pollutants

Chair

Professor Anna Hansell (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)
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)
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)

Secretariat (UK Health Security Agency)

Alison Gowers (Scientific Secretary)
Vanessa Bixley (Administrative)
Dr Artemis Doutsi (Scientific)
Eve Draper (Scientific)
Dr Naomi Earl (Scientific)
Dr Karen Exley (Scientific)
Dr Christina Mitsakou (Scientific)

Annex B. Register of Members' interests

The register of Members' interests (2023) can be found below. This is also available via the COMEAP website.

Member	Personal interests		Non-personal interests	
	Name of company	**Nature of interest**	**Name of company**	**Nature of interest**
Professor A Boobis OBE	Barclays Bank	Shareholder	European Commission (Horizon 2020) (until 05/2019)	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 until 2023)		
	ILSI Europe (no remuneration)	Member of Board of Directors		
	Health and Environmental Sciences Institute (no remuneration)	Member of Board of Trustees (until 2021)		
	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 (until 2020)		
	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 (until 2022)		
	ISO/TC126/Working Group 10: "Intense Smoking Regime" (nominated by UK Department of Health)	Chair/convenor (until 2022)		
	WHO Study Group on Tobacco Product Regulation (TobReg)	Member		

Member	Personal interests		Non-personal interests	
	Name of company	**Nature of interest**	**Name of company**	**Nature of interest**
	Joint FAO/WHO Expert Committee on Food Additives (Residues of Veterinary Drugs) (JECFA)	Member/Chair		
	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 (until 2023)		
	Advisory Board of Plastics Europe Brigid (microplastics) project (non-remunerated)	Member		
	Advisory Group to Personal Care Products Council (PCPC) Sunscreen Consortium – cancer risk assessment (non-remunerated)	Member		
Professor N Carslaw	No shareholdings		Alfred P. Sloan Foundation	2x Research grants
	No personal consultancy		NERC	PI, Co-I on research grants
			Wolfson Foundation	PI on capital grant
Ms R Chambers	Greener UK	Senior fellow working on implementation of Environment Act		
	Feedback Global	Chair		
	Hexagon Housing Association	Non-executive director		
Professor A Hansell (Chair)	University of Leicester	Salary	UKRI (UK Research and Innovation)	Research grants
	Greenpeace	Annual membership and occasional small donation for >35 years	European Commission	Research grants
		.	National Institute of Health Research	Research grants
			British Heart Foundation	Research grants
			European Space Agency	Research grants
			UKHSA and Defra	Research tenders
			Imperial College London, UKHSA	Honorary position
Professor R Harrison	Nextgen Nano Ltd	Shareholder	Natural Environment Research Council	Research Grants
	Renovare Fuels Ltd	Shareholder	European Union	Research Contract

Member	Personal interests		Non-personal interests	
	Name of company	**Nature of interest**	**Name of company**	**Nature of interest**
	Teysha Technologies Ltd	Shareholder		
	Innovation Agri-tech Group	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		
	Lloyds Bank	Shareholder		
	University of Birmingham	Salary		
	No paid work or sponsorship from industry			
Dr M Holland	UK government (Defra, DoH) and related bodies (e.g. Environment Agency, Climate Change Committee)	Consultancy	European Association of Environmental and Resource Economists	Member
	UK national governments (Scotland, Wales)	Consultancy	Imperial College, London	Honorary Research Fellow
	London Borough of Hillingdon	Consultancy		
	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		
	Various consultancies (eftec, CEH, Wood, Ricardo-AEA, IIASA, wca-environment, Eunomia, exponent)	Consultancy		
Dr M R Miller	University of Edinburgh	Salary	British Heart Foundation (BHF)	Research grant
	Lloyds	Shareholder	UKRI, Natural Environmental Research Council (NERC)/Medical Research Council (MRC)	Research grants
	Halifax	Shareholder	NIHR	Research grant
	World Wildlife Fund	Monthly donation	Royal Society	Research grant
			World Heart Federation	Member/Chair of Air Pollution and Climate Change Expert Group
			SPF Clean Air Programme	Member Knowledge Exchange Group

Member	Personal interests		Non-personal interests	
	Name of company	Nature of interest	Name of company	Nature of interest
			Environmental Protection Scotland	Member, Air Quality Expert Group
			Westminster Commission for Road Air Quality	Member
Professor G Shaddick	Royal Holloway, University of London	Salary	EPSRC; European Commission; World Health Organisation; NIHR; Pfizer Ltd; Met Office; Innovate UK, BEIS; NERC	Research Grants/Contracts
	Royal Mail	Shareholder	University of Exeter	Honorary positions
	Shaddick-English Consulting Services	Director		
Mr J Stedman	Ricardo	Salary	Ricardo (research contract Modelling of Ambient Air Quality)	Principal Air Quality Consultant
Professor D Lee	University of Glasgow	Salary	ESRC; MRC; EPRSC; Innovate UK; NERC; Scottish Government; TB Alliance; EA	Research Grants
	External examiner of MSc programmes in Statistics at Lancaster University and Trinity College Dublin	Salary		
Professor M Heal	Cycling advocacy charities Sustrans and Spokes	Regular and occasional small donations	Natural Environment Research Council Defra & UK CEH Defra	Studentship funding Studentship funding Member of the Air Quality Expert Group
Professor K Katsouyanni	Imperial College London	Salary	European Commission	Research Grants
	National and Kapodistrian University of Athens	Emeritus Professor	U.S. Health Effects Institute	Research Grant
	ECOCITY (NGO based in Greece)	Member of the Scientific Committee		
	European Respiratory Society (ERS)	Member of the Committee for Environment and Health		
	WHO	Member of the Global Air Pollution and Health-Technical Advisory Group		
Dr I Mudway	Imperial College London	Salary	NERC	Research grants
	No shareholdings		MRC	Research grant
	No personal consultancies		The Barts Charity	Research grant
	Off the Curriculum	Trustee	USA Health Effect Institute	Research grant
			MRC Centre for Environmental and Health	Research grant

Member	Personal interests		Non-personal interests	
	Name of company	Nature of interest	Name of company	Nature of interest
			NIHR Health Protection Research Unit in Environmental Exposures and Health	Member
			NIHR Health Protection Research Unit in Chemical and Radiation Threats and Hazards	Member
			Gresham College	Visiting Professor
Professor M J D Clift	Swansea University	Academic (Professor) Employer (01.12.2015 – current)		
	University of Manchester	External Examiner (Sept 2021-current) Examiner for MSc Nanomedicine Course		
	Applied Graphene Materials Ltd.	Invited International Expert for Scientific Consultancy (Oct 2019). Provision of expert insight at a one-day workshop on the inhalation health hazard of different graphene nanomaterials.		
	Nooku	Invited consultancy project assessing literature on indoor air quality related to human disease states (Feb 2023 – current). Provision of expert scientific input and literature review of indoor air quality related to human health effects.		
	UK Health and Security Agency	Honorary Contract (Dec 2022 – Dec 2026). Provision of financially supported scientific activities (following review of EOI processes within UK HSA).		
	Titanium Dioxide Industrial Committee (TDIC)	Invited International Expert for Scientific Consultancy (Nov 2023 – current). Provision of expert knowledge of inhalation particle toxicology.		
	UK Animal Alternative Technologies Society	Chair person of Society (Registered Charity) (Dec 2022 – current)		
	British Toxicology Society; Scientific Sub-Committee Member	Member (Nov 2017 – current)		
	Animal Free Research Scientific Committee Member	Member (Feb 2019 – Jan 2024)		
	Editor-in-Chief of Fibres	Member (June 2018 – current)		

Member	Personal interests		Non-personal interests	
	Name of company	**Nature of interest**	**Name of company**	**Nature of interest**
	Associate (i.e. Senior) Editor of Journal of Nanobiotechnology	Member (June 2016 – Jan 2024)		
	Associate (i.e. Senior) Editor of Frontiers in BioEngineering and BioTechnology	Member (August 2020 – Jan 2024)		
	Associated (i.e. Senior) Editor of Particle and Fibre Toxicology	Member (June 2022 – current)		
	Editorial Board member of Mutagenesis	Member (Jan 2017 – current)		
	Editorial Board member of Food and Chemical Toxicology	Member (June 2021 – January 2024)		

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
John Stedman

Co-opted members

Dr Dimitris Evangelopoulos (Imperial College, London)

Secretariat

Dr Christina Mitsakou (QUARK Secretariat lead)
Dr Artemis Doutsi
Dr Naomi Earl
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 (Queen Mary University of London)

Members

Professor Debbie Jarvis (Imperial College London)
Dr Heather Walton

Co-opted members

Professor Peter Brocklehurst (University of Birmingham)
Dr Julia Fussell (Imperial 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 (Secretariat lead until August 2020)
Eleanor Sykes (Secretariat lead until March 2022)
Dr Naomi Earl
Dr Karen Exley
Alison Gowers

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
Dr Ian Mudway
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)
Dr Dimitris Evangelopoulos (Imperial College London)
Professor Tracy Hussell (Professor of Inflammatory Disease, University of Manchester)

Secretariat

Dr James Isaac (UKHSA, Secretariat lead)
Dr Artemis Doutsi
Dr Naomi Earl
Alison Gowers

Annex F. 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

Co-opted members

Dr Paul Pfeffer (Queen Mary University of London)

Secretariat

Eve Draper (Secretariat lead)
Dr Naomi Earl
Alison Gowers

Acknowledgements

The AQIS Sub-group would also like to acknowledge valuable input from COMEAP Member Professor Gavin Shaddick

COMEAP and the AQIS Sub-group would like to thank the following individuals for their valuable input to the work on the topic of physical activity and air pollution:
Dr Gavin Devereux (University of Suffolk)
Scarlett Moloney (Anglia Ruskin University)
Dr Eda Tonga (University of Leicester)

Annex G. 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 have attended meetings and supported the ad-hoc group during 2023.

Chair

Dr Mike Holland

Government departments or agencies

Srobana Ghosh (Health Economist, UK Health Security Agency)
Lois Hanna (Health Economist, UK Health Security Agency)
Dr Chau Man Fung (Economic Analyst, Health and Safety Executive)
Laurence Mounce (Economist, Department for Environment, Food and Rural Affairs - Defra)
Dr Lesley Owen (Health economics, National Institute for Health and Care Excellence - NICE)
Laurent Pipitone (Head of Economic Analysis, Air Quality & Industrial Emissions, Defra)
Sophie Richard (Economist, Defra)

Academia: economics and other science

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

Clinicians and relevant academia

Professor Chris Griffiths (Professor of Primary Care, Queen Mary University of London)
Emeritus Professor Paul Jones (Professor of Respiratory Medicine, St George's University)
Professor Jenny Quint (Professor of Respiratory Epidemiology, Imperial College London)

Consultancies – Independents

David Birchby (Economist, Logika Group)

John Henderson (Health economist, independent, previously at DHSC)
John Stedman (Ricardo)

COMEAP/QUARK Scientific Secretariat

Dr Christina Mitsakou (Secretariat lead)
Alison Gowers
Samuel Thompson