



## Committee on the Medical Effects of Air Pollutants

### Advice on health evidence relevant to setting PM<sub>2.5</sub> targets – update

#### Background

1. In July 2021, we published advice<sup>1</sup> provided to Defra on the health evidence relevant to setting PM<sub>2.5</sub> targets. This was intended to inform Defra's development of air quality targets under the Environment Bill 2020 (now the Environment Act 2021). The advice included that:

- a focus on reducing long-term average concentrations of PM<sub>2.5</sub> is appropriate
- newer evidence indicates that PM<sub>2.5</sub> pollution can have harmful effects on people's health at lower concentrations than had been studied previously
- the available studies have not indicated a threshold of effect below which there is no harm
- reducing concentrations below the World Health Organization's (WHO) Air Quality Guideline (10 µg/m<sup>3</sup>) would benefit public health

2. We noted that one large recent study had found an association between particulate air pollution and mortality in a population exposed to a mean PM<sub>2.5</sub> concentration of 6.3 µg/m<sup>3</sup> and a 5th percentile of 3.0 µg/m<sup>3</sup>.

3. In September 2021, WHO published updated Air Quality Guidelines.<sup>2</sup> The new guideline for annual average concentrations of PM<sub>2.5</sub> is 5 µg/m<sup>3</sup>.

#### Updated WHO Air Quality Guidelines

4. The WHO Air Quality Guidelines are based on the evidence linking concentrations of pollutants in ambient air with adverse effects on health. They are set without reference to achievability.

5. The new WHO guidelines for long-term exposure to pollutants reflect the lowest levels at which the guideline developers could be confident of an adverse effect. This was based on epidemiological studies which had found associations with adverse effects on health in populations in which some individuals were exposed to

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<sup>1</sup> [Fine particulate air pollution \(PM2.5\): setting targets – GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/fine-particulate-air-pollution-pm25-setting-targets)

<sup>2</sup> [WHO global air quality guidelines: particulate matter \(PM2.5 and PM10\), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide](https://www.who.int/air-quality-guidelines)

low concentrations. In practice, the guidelines were based on the average of the 5<sup>th</sup> percentiles of exposure distributions from studies with the lowest levels of exposure. The 5<sup>th</sup> percentiles of the exposure distributions were used, rather than the lower end of the exposure range because there is less confidence in concentration-response functions at concentrations below the 5<sup>th</sup> percentile of an exposure distribution, due to the sparse data.

6. For PM<sub>2.5</sub>, a systematic review and meta-analysis by Chen and Hoek (2020)<sup>3</sup> informed the development of the guideline value. The five lowest 5<sup>th</sup> percentiles of exposures in the available studies of associations with (non-accidental) all-cause mortality were used as the starting point. Depending on the five studies selected<sup>4</sup>, the average of the five lowest 5<sup>th</sup> percentiles was 4.2 to 4.9 µg/m<sup>3</sup>. WHO therefore considered that the available data on the association between long-term average PM<sub>2.5</sub> and non-accidental mortality supported a long-term guideline value of no more than 5 µg/m<sup>3</sup>. They considered that the available studies on cause-specific mortality also supported a guideline value of no more than 5 µg/m<sup>3</sup>.

7. We examined this 2020 review by Chen and Hoek when developing our previous advice to Defra; the study we noted with a 5<sup>th</sup> percentile of exposure of 3.0 µg/m<sup>3</sup> is one of those used in deriving the revised WHO guideline.

### **Additional comments**

8. WHO's revised Air Quality Guideline for PM<sub>2.5</sub> confirms our previously expressed view that PM<sub>2.5</sub> pollution can have harmful effects on people's health at lower concentrations than had been studied previously. It also indicates that reducing concentrations to 5 µg/m<sup>3</sup> would have public health benefits. There is less confidence in the continued health benefits of reductions below 5 µg/m<sup>3</sup> because studies of populations in which a large proportion is exposed to very low concentrations are not currently available. Nonetheless, a large study with a 5<sup>th</sup> percentile of exposure as low as 3.0 µg/m<sup>3</sup> reported an association which continued at these low concentrations, and the available studies have not indicated a threshold for effect at the population level.

9. Therefore, on health grounds, we would strongly support a reduction of PM<sub>2.5</sub> concentrations, ideally to (or below) the WHO guideline value of 5 µg/m<sup>3</sup>. However, we note that WHO recognises that the new guidelines may be challenging to meet immediately and provides interim targets to track progress towards the guideline

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<sup>3</sup> Chen J and Hoek G (2020) Long-term exposure to PM and all-cause and cause-specific mortality: A systematic review and meta-analysis Environment International Article No:105974. [Environment International | Update of the WHO Global Air Quality Guidelines: Systematic Reviews | ScienceDirect.com by Elsevier](#)

<sup>4</sup> The average of the five lowest 5<sup>th</sup> percentiles was 4.2 µg/m<sup>3</sup>. WHO also performed a sensitivity analysis using selected studies. In five studies that reported associations at low concentrations (excluding a study which had found no association and another which had found no evidence of an effect below 8 µg/m<sup>3</sup>) the mean 5<sup>th</sup> percentile was 4.9 µg/m<sup>3</sup>

values; the previous WHO guideline of  $10 \mu\text{g}/\text{m}^3$  is now recommended by WHO as the interim target 4.<sup>5</sup> We have previously acknowledged that the Government needs to balance the health benefits of policies and interventions against their costs, and recognised that cost-benefit assessments may play a role in defining targets.

10. WHO noted that the burden of air pollution-related disease is unevenly distributed and that vulnerable and susceptible populations are often disproportionately affected. It concluded that the available evidence on the effect, on inequalities, of interventions that have been used to reduce air pollution is mixed. More vulnerable groups, such as older people and deprived households, were found to benefit more, equally or less than other groups depending on the intervention and health outcome and the design of the study. We note that Defra plans to implement a Population Exposure Reduction Target (PERT) for  $\text{PM}_{2.5}$  in addition to a concentration-based “Limit Value” type target. We previously advised that reducing exposure of the whole population would be expected to achieve the greatest overall public health benefit. However, achieving compliance with a Limit Value, target, guideline or PERT does not, of itself, reduce health inequalities. Our previous advice therefore recommended that Defra should investigate whether proposed or implemented interventions reduced inequalities in exposure or had undesirable consequences for inequalities (for example, by increasing concentrations of pollutants in areas of socioeconomic deprivation). This advice is unchanged by publication of the revised WHO Air Quality Guidelines.

11. WHO has also provided updated air quality guideline values and interim targets for long-term exposure to  $\text{PM}_{10}$ , nitrogen dioxide ( $\text{NO}_2$ ) and ozone ( $\text{O}_3$ ). We note that the guideline values are based on associations between air pollutant concentrations and health effects reported from single-pollutant models, which only consider the health effects associated with one pollutant at a time, without statistical adjustment for exposures to co-emitted and correlated pollutants. This means that the associations likely reflect the effect of other pollutants to some extent. COMEAP’s previous consideration of this issue<sup>6</sup> suggests that there would be greater benefits from reducing exposure to multiple pollutants than a single pollutant, as the available evidence reflects the effects of a pollutant mixture.

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<sup>5</sup> WHO has recommended four interim targets for annual average concentrations of  $\text{PM}_{2.5}$ , with interim target 4 ( $10 \mu\text{g}/\text{m}^3$ ) being the lowest. Interim target 2 ( $25 \mu\text{g}/\text{m}^3$ ) is the same as the current limit value in England

<sup>6</sup> [Nitrogen dioxide: effects on mortality](#)