World Health Organization Recommendations on Ambient Air Quality

Recommandations de l'Organisation mondiale de la santé en matière de qualité de l'air ambiant

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Air Quality as a Public Health Issue

Public health recognizes air pollution as an important determinant of health. Health effects of ambient air pollution are well documented by studies conducted in various parts of the world. There is significant inequality in the exposure to air pollution and related health risk: air pollution combines with other aspects of the social and physical environment to create a disproportional disease burden in less affluent parts of society.

Health effects of particulate matter (as mass concentration of particles with a diameter less than 10 µm (PM_{10}) and particles with a diameter less than 2.5 µm ($PM_{2.5}$) are especially well documented. There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. Over 80% of population in the European Region of WHO lives in cities with levels of PM_{10} exceeding WHO Air Quality Guidelines. A slightly decreasing trend in PM_{10} levels has been observed in countries in the European Union (EU) over the last decade, but no clear significant improvement of average levels of PM_{10} has been noted. This pollution creates a substantial burden of disease, reducing life expectancy by almost 9 months on average in Europe. Since even at relatively low concentrations the burden of air pollution to health is significant, effective management of air quality aiming to achieve WHO Air Quality Guidelines levels is necessary to reduce health risks to a minimum.

Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and even international levels. The health sector can play a central role in leading a multisectoral approach to prevention of exposure to air pollution. It can engage and support other relevant sectors (transport, housing, energy production and industry) in the development and implementation of long-term policies to reduce the risks of air pollution to health.

WHO Air Quality Guidelines

WHO last revised its Air Quality Guidelines (AQG) in 2005. They address all regions of the world and provide uniform targets for air quality, which would protect the large majority of individuals from the effects of air pollution on health. Specifically for particulate matter, the guideline values are:

- For $PM_{2.5}$, the AQG values are 10 µg/m³ for the annual average and 25 µg/m³ for the 24-hour mean (not to be exceeded for more than 3 days/year);
- For PM_{10}, the AQG values were set at 20 µg/m³ for the annual average and 50 µg/m³ for the 24-hour mean.

In addition to these guideline values, the AQGs provide interim targets for each air pollutant, aimed at promoting a gradual shift to lower concentrations in highly polluted locations. If these targets were to be achieved, significant reductions in risks for acute and chronic health effects from air pollution can be expected. Progress towards the guideline values, however, should be the ultimate objective. As no threshold for PM has been identified below which no damage to health is observed, the recommended values should be regarded as representing acceptable and achievable objectives to minimize health effects in the context of local constraints, capabilities and public health priorities.

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WHO Review of Evidence on Health Aspects of Air Pollution in Support of EU Policies- REVIHAAP

In support of the comprehensive review of air quality legislation of the EU due in 2013, WHO is currently coordinating an international project to provide the European Commission (EC) and its stakeholders with evidence-based advice on health effects of air pollutants. This advice will be grounded on a review of the latest scientific evidence for PM, ground level ozone, nitrogen dioxide, sulphur dioxide, as well as emissions to the air of individual metals species (arsenic, cadmium, nickel, lead, and mercury) and polycyclic aromatic hydrocarbons, as regulated in the EU Directives 2008/50/EC and 2004/107/EC.

The REVIHAAP project consists of a systematic review of the scientific literature in order to provide background to the expert discussion and address a list of 26 key questions posed by the EC regarding the health aspects of air pollutants (see Annex 1). The review is conducted by invited experts from top academic institutions across the world. The questions cover general aspects of importance for air quality management, as well as specific topics of interest for individual air pollutants. Emerging issues on health risks from air pollution related to specific source categories (*e.g.* transport, biomass combustion, metals industry, refineries, power production), specific gaseous pollutants or specific components of PM (e.g. size-range like nano-particles and ultra-fines, rare-earth metals, black carbon (EC/OC)) will be documented. The evidence of health benefits from the reduction of air pollution will also be assessed. Concentration-response functions (CRFs) to be included in cost-benefit analysis will be identified, and developed if necessary. Finally, the impact of the evidence review on the revision of EU policies and the possible need to revise WHO Air Quality Guidelines, last updated in 2005, will be considered.

References

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ANNEX 1

KEY QUESTIONS FOR GUIDANCE OF EU POLICIES

What answers do policy-makers need to improve protection of our health from air pollution?

To effectively advice the revision of EU air quality policies, the WHO-led REVIHAAP project is addressing a list of 26 key questions, formulated by the European Commission and refined by the project Scientific Advisory Board. They cover four areas:

- Particulate matter (PM) - $PM_{2.5}$ and PM_{10} (7 questions).
- Ground-level ozone (4 questions).
- Other air pollutants and their mixtures (10 questions).
- General questions (5 questions).

A. Particulate matter (PM) - $PM_{2.5}$ and PM_{10}

1. What new evidence on health effects has emerged since the review work done for the WHO Air Quality Guidelines published in 2005, particularly with regards to the strength of the evidence on the health impacts associated with exposure to $PM_{2.5}$? Based on this new information, do the scientific conclusions given in 2005 require revision?

2. What new health evidence is available on the role of other fractions/metrics of PM, such as smaller fractions (ultra-fines), black carbon, chemical constituents (metals, organics, in-organics, crustal material and PM of natural origin, primary/secondary) or source types (road traffic including non-tailpipe emissions, industry, waste processing …) or exposure times (*e.g.* individual or repeated short episodes of very high exposure, 1h, 24h, yearly)?

3. EU legislation currently has a single limit value for exposure to $PM_{2.5}$ which is based on an annual averaging period. Based on the currently available health evidence, is there a need for additional limit values (or target values) for the protection of health from exposures over shorter periods of time?

4. What health evidence is available to support an independent limit value for PM_{10} (in parallel to (i) an annual average limit for $PM_{2.5}$ and (ii) multiple limits to protect from short term and long term exposures to $PM_{2.5}$)?

5. EU legislation has a concentration limit value and an exposure reduction target for $PM_{2.5}$. To decide whether it would be more effective to protect human health through exposure reduction targets rather than limit or target values it is important to understand (amongst other things, such as exposure, cost effectiveness, technical feasibility) the shape of the concentration-response functions. What is the latest evidence on thresholds and linearity for $PM_{2.5}$?

6. Based on currently available health evidence, what PM metrics, health outcomes and concentration-response functions can be used for health impact assessment?

7. Are there critical data gaps to be filled to help answer the above questions more fully in future?

B. Ground-level ozone

The current target value for ozone in Directive 2008/50/EC is 120 µg/m^3 as the daily maximum 8-hour mean. This is less stringent than the guideline recommended by the WHO in its global update from 2005 (air quality guideline of 100 µg/m^3).

1. What new evidence on health effects has emerged since the review work done for the WHO Air Quality Guidelines published in 2005, particularly with regards to the strength of the evidence on the health impacts associated with short-term and long-term exposure to ozone?

2. What new health evidence has been published in relation to the evidence or likeliness of a threshold below which impacts are not expected?

3. Based on currently available health evidence, what ozone metrics, health outcomes and concentration-response functions can be used for health impact assessment?

4. Is there evidence that other photochemical-oxidants (individually or in mixtures) are of public health concern *e.g.* does the impact of outdoor ozone on reaction products indoors explain the outdoor ozone associations, and links to the secondary organic aerosol?

C. Other air pollutants and their mixtures

1. There is evidence of increased health effects linked to proximity to roads. What evidence is available that specific air pollutants or mixtures are responsible for such increases, taking into account co-exposures such as noise?

2. Is there any new evidence on the health effects of nitrogen dioxide (NO_2) that impact upon the current limit values? Are long-term or short-term limit values justified on the grounds that NO_2 affects human health directly, or is it linked to other co-emitted pollutants for which NO_2 is an indicator substance?

3. Based on existing health evidence, what would be the most relevant exposure period for a short-term limit value for NO_2?

4. Based on currently available health evidence, what NO_2 metrics, health outcomes and concentration-response functions can be used for health impact assessment?

5. Is there any new evidence on the health effects of air emissions of arsenic, cadmium, mercury, lead and nickel (and their compounds), that would impact upon current target values?

6. Is there any new evidence on health effects due to air emissions of polycyclic aromatic hydrocarbons (PAHs) that would impact upon current target values?

7. Is there any new evidence on the health effects of short term (less than 1 day) exposures to sulphur dioxide (SO_2) that would lead to changes of the WHO air quality guidelines based on 10 minute and daily averaging periods or the EU's air quality limit values based on hourly and daily averaging periods?

8. Are there important interactions amongst air pollutants in the induction of adverse health effects that should be considered in developing air quality policy?

9. Are there critical data gaps to be filled to help answer the above questions more fully in future?

10. What is the contribution of exposure to ambient air pollution to the total exposure of air pollutants covered by the regulations, considering exposures from indoor environments, commuting and work places?

D. General questions

1. What new information from epidemiological, toxicological and other relevant research on health impacts of air pollution has become available that may require a revision of the EU air quality policy and/or WHO air quality guidelines notably for particulate matter, ozone, nitrogen dioxide and sulphur dioxide?

2. What evidence is available directly assessing health benefits from reducing air pollution?

3. Is there evidence of new emerging issues on risks to health from air pollution, either related to specific source categories (*e.g.* transport, biomass combustion, metals industry, refineries, power production), specific gaseous pollutants or specific components of particulate matter (*e.g.* size-range like nano-particles and ultra-fines, rare-earth metals, black carbon (EC/OC))?

4. The 6th Environment Action Programme aims to "achieve levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment" (Article 7 (1) of Decision No. 1600/2002/EC). Is there evidence of a threshold in the concentration-response curves for $PM_{2.5}$, ozone and NO_2?

5. What concentration-response functions for key pollutants should be included in cost-benefit analysis supporting revision of EU air quality policy?