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Executive Body for the Convention on Long-range Transboundary Air Pollution

Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe

Working Group on Effects

Fourth joint session
Geneva, 10-14 September 2018
Item 4 of the provisional agenda
Progress in activities in 2018 and further development of effects-oriented activities

Effects of air pollution on health*

Report of the Joint Task Force on the Health Aspects of Air Pollution on its twentieth meeting

Summary

The present report is being submitted for the consideration of the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe and the Working Group on Effects in accordance with the request of the Executive Body for the Convention on Long-range Transboundary Air Pollution in the 2018-2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1, items 1.1.1.7, 1.1.1.17-1.1.1.19 and 1.1.3.1-1.1.3.3) and in accordance with the activities set out in the informal document submitted to the Executive Body for the Convention at its thirty-seventh session entitled “Draft revised mandates for scientific task forces and centres under the Convention”.

* The present document is being issued without formal editing.

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The report presents the results of the discussions on the health impacts of ambient air pollution and other workplan items at the Task Force's twenty first meeting (Bonn, Germany, 16-17 May 2018).

Contents

I. Introduction

1. The present report summarizes the results and discussions on the health impacts of ambient air pollution presented at the twenty-first meeting of the Joint Task Force on the Health Aspects of Air Pollution (Task Force on Health) under the World Health Organization (WHO) European Centre for Environment and Health and the United Nations Economic Commission for Europe (ECE) Executive Body for the Convention on Long-Range Transboundary Air Pollution. The report also provides a summary of workplan items discussed at the meeting, in accordance with the 2018-2019 workplan for the implementation of the Convention (ECE/EB.AIR/140/Add.1) adopted by the Executive Body at its thirty-seventh session in December 2017.

2. The twenty-first meeting of the Task Force on Health was held in Bonn, Germany, on 16 and 17 May 2018. Altogether, 52 experts from 34 Parties to the Convention attended the meeting, in addition to the Chair of the Working Group on Effects and one representative of the Convention secretariat. The European Union, a Party to the Convention, was represented by the European Commission and the European Environment Agency. The meeting was chaired by Ms. Dorota Jarosinska (WHO European Centre for Environment and Health) and co-chaired by Mr. Alexandr Gankine (Belarus). Mr. Román Pérez-Velasco (WHO European Centre for Environment and Health) acted as rapporteur. Fourteen temporary advisers participated in the meeting, from the following organizations: the International Institute for Applied Systems Analysis (Austria); the Regional Environmental Centre for Central Asia (Kazakhstan); the Health Effects Institute (United States of America); Health Canada; the Lazio Regional Health Service (Italy); King's College London (United Kingdom); the Flemish Institute for Technological Research (Belgium); Public Health France; Transus Consultants (Hong Kong, China); the Spanish National Research Council; the Institute of Public Health of Serbia "Dr Milan Jovanovic Batut"; the Health and Environment Alliance (Belgium); and the German Environment Agency. An observer from Spadaro Environmental Research Consultants also participated in the meeting. The German and Swiss Governments both provided financial support for the meeting.

II. National and international policies and processes on air quality and health

A. Updates on partner organizations' activities

3. A representative of the Convention secretariat gave an update on recent developments under the Convention. On the science side, the speaker provided an overview of the Third Joint Session of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) and the Working Group on Effects. An improvement in the reporting of national emissions was noted, as well as better spatial resolution through a new gridding system, an increased number of black carbon inventories, and more complete datasets from the Eastern Europe, Caucasus and Central Asia region. New methodological approaches were highlighted, such as the treatment of condensable and semi-volatile organic compounds in emission inventories, modelling of the linkages between urban and regional/hemispheric scales of air pollution, as well as updates on the work of the Task Force on Hemispheric Transport of Air Pollution. Furthermore, Parties were reminded of the need for cooperation beyond the

region to reduce the high background levels of air pollution, as recommended in the 2016 scientific assessment report[1] of the Convention. On the policy side, several initiatives were outlined, including the establishment of the Policy Review Group to provide recommendations in response to the assessment report and to update the Long-Term Strategy for the Convention, the Working Group on Strategy and Reviews' special session on solid fuel residential heating, the response to the United Nations Environment Assembly's resolution on air pollution, and the Batumi Action for Cleaner Air. In relation to capacity building, efforts have focused on improving legislative analysis and emission inventories at country level. Outreach initiatives have included information exchange with Asian partners, sessions on air pollution globally at the Saltsjöbaden workshop (Gothenburg, Sweden, 19-21 March 2018), cooperation with the Transport, Health and Environment Pan-European Programme, and the First Global Conference on Air Pollution and Health.

4. The Chair of the Working Group on Effects provided an overview of the group's activities, its structure and the flow of information within the Convention. The different effects of air pollution (e.g., vegetation, water, health) were integrated with data on emissions, depositions, concentrations and costs of air quality interventions through the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model. The different model scenarios were then shared with the Working Group on Strategies and Review, which selected the most appropriate scenarios according to cost-effectiveness results. The Convention's Executive Body and its Bureaus had recently discussed the results of the 2016-2017 workplan of the Task Force. The workplan included the development of quantification methods for the health effects of air pollution, the assessment of the evidence on health impacts of ozone (O_3) and particulate matter (PM), and the evaluation of risk communication of air pollution exposure. Likewise, the activities in the 2018-2019 workplan had been reviewed. It was noted that the activities were linked to concrete objectives/deliverables, reflected additional issues not included in the mandates, and echoed the Policy Review Group's recommendations (see para. 30). The Task Force was also informed that the mandates of the EMEP Task Forces and Centres, including of the Task Force on Health, were under review and due for approval in 2018. To conclude, an overview of the Task Force's sources of funding, and a call to increase voluntary contributions from Parties was made.

5. A representative of the European Commission provided an update on current activities in the European Union, beginning with an overview on air quality in the region. Europe's air quality had slowly been improving, but fine particulate matter ($PM_{2.5}$) and especially nitrogen dioxide (NO_2) continued to cause serious impact on citizens' health. The latest annual estimates pointed to approximately 400000 premature deaths due to PM and 75000 due to NO_2, and at least 24 and 330-940 billion euro in direct and indirect costs, respectively. Although air pollution was a widespread problem, authorities could adopt a wealth of interventions in order to address the issue. Furthermore, few success stories existed, including the application of restrictions for vehicle access in cities, retro-fitting city bus fleets, and promoting more efficient boilers. On the policy side, the European Union aimed to reduce emissions at source through the National Emissions Ceilings Directive (NECD) and source-specific emissions standards, as well as pollutant concentrations in ambient air through the Air Quality Directives. Due in late 2019, the fitness check of the European Union Directives 2008/50/EC and 2004/107/EC intended to retrospectively

[1] See Rob Maas and Peringe Grennfelt, eds., *Towards Cleaner Air: Scientific Assessment Report 2016* (Oslo, 2016) and United States Environmental Protection Agency and Environment and Climate Change Canada, *Towards Cleaner Air: Scientific Assessment Report 2016-North America* (2016, online report).

assess what happened with their implementation, what caused any change and how much change might reasonably be credited to European Union action. The ultimate purpose of the exercise was to identify learning points to guide future action. Finally, the speaker made some concluding reflections. While there was an increasing public and political awareness on the problem of air pollution, substantial implementation and compliance gaps remained across the European Union. For an effective reduction of air pollution, close cooperation between different societal actors and across governance levels was crucial, with cities having an important role to play.

B. Update on World Health Organization's regional activities

6. A representative of the WHO European Centre for Environment and Health provided an update of the Centre's ongoing activities around four areas: update of WHO Global Air Quality Guidelines (AQGs); development of methods and tools (AirQ+, health benefits from carbon reductions, health and environmental benefits from reduced transport related emissions); capacity building in air quality and health; and support to countries. In relation to the latter, the Centre recently facilitated a regional consultation on the update of the WHO Global Air Quality Database, yielding a high response rate as well as valuable information on national issues of concern related to air quality. To address these issues, the speaker referred to the *Compendium of Possible Actions to Advance the Implementation of the Ostrava Declaration* resulting from the Sixth Ministerial Conference on Environment and Health.[2] The Ostrava Declaration promotes the development of national portfolios for action to reflect national needs and capacities, while preserving and strengthening coherence among existing policy frameworks. Possible actions to improve air quality included, among others, the implementation of the Convention (and its relevant protocols) and the ECE Batumi Action for Cleaner Air. To support national actions, WHO/EURO had developed a new information resource on environment and health.[3]

III. Country experiences on air quality and health – towards the implementation of the Ostrava Declaration on Environment and Health

7. A representative of the Dutch Ministry of Infrastructure and Water Management gave an overview of the National Air Quality Cooperation Programme. Although important achievements have been made over the last decades, especially for PM_{10} exposure, issues such as NO_2 exposure in busy streets remained a problem. In 2009, the Dutch Government launched an initiative involving ministries, provinces, municipalities and city regions in order to comply with the European Union air quality standards, improve public health, and create conditions for spatial projects to be executed. It was noted that air pollution problems could not be solved by only acting at the local and regional scale, because there was still a major contribution from cross-border pollution. Although meeting NO_2 standards in the very near future was foreseen, the National Health Council recommended prioritizing the reduction of PM and NO_2 from road traffic (especially diesel vehicles) and tackling ammonia emissions from livestock farming. The Government Coalition Agreement also put down a new programme that went beyond the national air quality standards and towards

[2] See World Health Organization Regional Office for Europe (Copenhagen, 2017). Available from: http://www.euro.who.int/__data/assets/pdf_file/0008/341945/Annex1_13June.pdf.

[3] https://gateway.euro.who.int/en/.

WHO guideline values. Although $PM_{2.5}$ levels in busy streets were below the European Union limit values, they were still above the WHO values. Recommendations to meet WHO guideline values included the following actions at the European Union, national and city levels: implementation of the National Emission Ceiling Directive and real life Euro-6 performance, emission standards for wood burning, low emission manure application, early scrapping/retrofitting of old vehicles, ships and installations, low emission zones, speed limits, and so on. A new national air quality action plan was under development using a multi-stakeholder, multi-level governance approach, in alignment with the climate change agenda. The scope of measures would be oriented by the share of sectoral contributions to exposure and burden of disease, but international cooperation would also be prioritized. Stakeholders had suggested local measures including planting trees, installing vacuum cleaners, painting walls with titanium dioxide (TiO_2) limiting fireworks and eastern fires, subsidizing electric vehicles, stove replacement and so on, which will be considered based on effectiveness and cost. Lastly, the speaker noted that the Ministry was seeking international cooperation for exchange of best practices and development of a consistent set of health indicators.

8. A representative of Public Health France presented on environmental and public health tracking activities at both the French and European levels. The Task Force was given an overview of Public Health France's role, especially on epidemiological surveillance of ambient air pollution. Environmental Public Health Tracking was the ongoing collection, integration, analysis and interpretation of data about environmental hazards, exposure to environmental hazards and adverse health effects. It also included the dissemination of information and implementation of strategies to improve and protect public health. The European Union Environment and Epidemiology Network was a relevant activity that monitored drivers of (re-) emerging infectious disease, provided access to climatic/environmental geospatial data for epidemiologic analysis, and speeded detection of emerging public health threats through prediction tools and forecasting models. Although Europe had plentiful means for environmental health surveillance, these resources largely resided in silos at the country level. In the case of France, there were surveillance activities on polluted sites and soils, air pollution, carbon monoxide, lead or pesticides, but these were not integrated with activities in neighbouring countries. The recent International Network on Public Health and Environment Tracking (INPHET)[4] aimed to raise awareness of ongoing surveillance of environmental threats and their health impact in Europe and beyond. The ultimate goal was to enhance the understanding of environmental health and provide direct access to data tailored to the needs of citizens, public institutions and other sectors. INPHET assessed the availability, quality, timeliness and utility of existing exposure and health effect data, synthetized the information and communicated it in an actionable form to policymakers and other stakeholders. A dedicated task force within the network intended to produce guidance on basic requirements for urban air pollution health surveillance systems, and case studies of how air pollution exposure and outcome data had been used to advance policies. As INPHET required ongoing collaboration across governance levels, a call was made for Parties to join in.

9. A representative of the German Environment Agency reported the results of the quantification of environmental disease burden due to NO_2 exposure in Germany, a research project conducted by the Helmholtz Zentrum München and IVU Umwelt GmbH. Although the annual average NO_2 concentration was decreasing and remained below European Union limit values, assessing its health impact was still needed. For this purpose, systematic review methods were employed, including searching bibliographic databases

[4] See www.epiprev.it/INPHET/home.

and the grey literature, the evaluation of the quality of epidemiologic studies using a predefined set of criteria, the evaluation of the overall body of evidence per health endpoint, and the assessment of its transferability to the German setting. Of note, strong evidence was only found for cardiovascular mortality. Burden of disease methods were used to combine the data, resulting in premature deaths and disability-adjusted life years attributable to NO_2 exposure. Only health endpoints with moderate and strong evidence were used. 10 micrograms per cubic meter (μg/m^3) was chosen as the counterfactual exposure value, because of the large uncertainties below this level in epidemiologic studies. Scenario analyses for other values (0, 5 and 20 μg/m^3) were also conducted to assess uncertainty. NO_2 exposure was assessed using a chemical transport model and measurement data combined with population data on a 7 km x 8 km grid. The speaker noted that only the rural and urban background concentrations were assessed. Although the burden of NO_2 associated to cardiovascular mortality and other endpoints was considerable, the uncertainty around the estimates had to be taken into account. For example, changing the NO_2 counterfactual value from 0 to 20 μg/m^3 had an impact on years of life lost related to cardiovascular mortality that ranged from duplicating the burden (at 0 μg/m^3) to a much lower value (at 20 μg/m^3). Similarly, excluding the potential combined contribution of PM and NO_2 decreased the burden by half. Finally, the speaker reported a new method to incorporate the add-on of traffic to NO_2 exposure, allowing modelling exposure at the street level in Berlin, Brandenburg and Munich. This approach resulted in burden of disease increases of around 50 per cent, due to the intense traffic and high population density in Berlin and Munich.

IV. Communication and public health messages on air pollution

10. A representative of the European Environment Agency briefed participants on the six months' experience of using the European ambient air quality index (AAQI). Starting in 2014, the AAQI development project was carried out through a multi-stakeholder approach, including feedback from European Union member States, the Agency and European Topic Centres. The Agency took over an advanced index prototype in late 2016 and further developed it until November 2017, when it was presented at the European Clean Air Forum. The AAQI contained individual sub-indices for five pollutants (PM_{10}, $PM_{2.5}$, NO_2, O_3 and sulphur dioxide (SO_2)). The indices were based on up-to-date pollutant concentration data measured at station level, complemented with Copernicus Atmosphere Monitoring Service (CAMS) modelled data for filling gaps. The 'worst case' of the pollutant sub-indices was taken as the overall index. Breaking points were based on European Union legislation and WHO AQGs. Since the AAQI's release, four additional European Union member States (Bulgaria, Cyprus, Estonia and Italy) had successfully started reporting data and were now included in the index. Although two European Union countries (Greece and Romania) were not reporting data yet, other Agency's members (Switzerland and Norway) and cooperating countries (Serbia and the Former Yugoslav Republic of Macedonia) were reporting. Some countries had embedded the index in their national websites, while other authorities had started or planned to use the same methodology for their national indices. In terms of public impact, the AAQI webpage received over 240000 visitors and 5500000 hits at launch, and around 2100 visitors and 3200 hits per day until 7 May 2018. Other examples included visitors' peaks after the index was featured in influential news websites or the embedding of the index in the websites of popular companies. Stakeholders had also provided valuable suggestions for improvement, such as using hourly values instead of 24-h running means for PM, the possible underestimation of the index in the absence of $PM_{2.5}$ measurements, or the addition of a filter to choose different station types. For the future, there were plans to include the

suggested improvements, monitor the index performance to changes in air pollution, and add health messages and advices.

11. An expert from Transus Consultants presented a recent global review on air quality (AQI) indices. Commissioned by WHO Headquarters, the objective of the project was to provide a global assessment of index systems in use through desktop research and discussion with air quality experts and managers. Systems from countries from all WHO Regions and the European Union were reviewed. The systems were used for reporting the (current) state of air quality in the respective settings, as well as for communicating information to the public on short-term health impacts, early warnings to vulnerable populations, recommendations to reduce personal exposures, or air quality forecasts. National air quality standards were typically used for benchmarking, but WHO AQGs were sometimes referred to. Most indices were built around SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10}, but carbon monoxide or visibility were also considered. Data collection was generally performed via fixed monitoring stations subject to quality control/assurance, managed by government or non-government bodies. Averaging times ranged from 1 to 24 hours. Reference points were typically 100 and 50 $\mu g/m^3$, in line with short- and long-term air quality standards respectively. A computed index of the single 'worst' pollutant tended to determine the overall AQI value. For reporting, numerical or band systems were employed, but some of the indices had health impact descriptors attached. The speaker identified several shortcomings of current AQI systems: issues with time lag and responsiveness; different banding systems/breakpoints and colour codes; inconsistent use of descriptors and health advisories; lack of consideration of the combined health impact of multiple pollutants; inability to reflect non-threshold concentration–response relationships; and linkage with standards that might be influenced by non-health factors. Recent developments included the growing use of health risk-based indices, the development of regional indices, and the emergence of regional initiatives such as the Thematic Working Group on Air Quality in Asia Pacific. To conclude, the speaker shared the following ideas for next steps in the project: surveying recent trends and developments of AQIs; discussing the evidence basis for the provision of health advisories; studying the extent of AQI use by user group and its effectiveness; and developing international best practice guidelines for AQI development.

12. An expert from the Lazio Regional Health Service presented a global survey of strategic action plans, commissioned by WHO Headquarters, and provided insights on related public health messages. An action plan was a public health response to air pollution episodes, typically short-term, that included a definition of alert levels, a recommendation to reduce emissions, indications to minimize population exposure, and suggestions for behavioural change in the general population and vulnerable subgroups. The review found inconsistency of approaches used across jurisdictions, in terms of AQI computation, emergency measures to reduce emissions, risk communication, and issuance of health advisories based on AQI values. In terms of efficacy, a recently published study had analysed it using an air quality model at the European Union level. Efficacy was generally higher for NO_2 than for PM_{10} reduction, and when plans lasted longer (3 vs. 1 day).[5] A 2012 survey on European Union best practices for short-term action plans provided details of existing plans, exceedances of alert and limit values, risk assessment and forecasting methods, short-term measures, communication and implementation strategies, and impact assessment.[6] The following emission reduction measures were identified: speed limitations,

[5] Philippe Thunis and others, "Analyzing the efficiency of short-term air quality plans in European cities, using the CHIMERE air quality model", *Air Quality, Atmosphere and Health*, vol. 10, No. 2 (Sept 2017), pp. 235-248.

[6] See AEA Technology plc and Umweltbundesamt. *Best practices for short term action plans.* (Didcot,

diesel driving restrictions, free public transport, cleaning of streets, and reduction of domestic heating emissions. However, the impact of the measures was never assessed. Nonetheless, examples of robust plans could be found. For example, French plans had a clear link to relevant legislation and provided clear guidance on the responsibilities of each authority, actions to be taken, criteria used to initiate and terminate operations, and a description of the geographic extent and purpose of the measures. The speaker advanced the planned launch of a survey at city level, in order to better assess actions plans in use, evaluate the use of AQI systems, assess current practices to reduce emissions during episodes, and review current health messages. The presentation was concluded with an overview of issues around public health messages. Risk communication should provide messages tailored to the general population and vulnerable groups, as well as guidance for healthcare providers. Little evidence was available and many questions remained open, but an example could be recent recommendations issued for chronic obstructive pulmonary disease patients to stay indoors, clean indoor air, or on use facial masks and respirators. To bridge this gap, medical societies in Europe and the United States were working on evidence-based guidelines to reduce exposure levels and health risk from air pollution.

13. A representative of the Health and Environment Alliance presented activities carried out by the non-governmental organization (NGO) around communication on air quality and health. Communication consisted of informing stakeholders to raise awareness and increase their support for clean air measures. The NGO used a hands-on approach to design messages that were culturally-sensitive, targeted, based on hooks and evidence, and embedded in the overall organizational narrative. The range of communication tools that were employed was wide, encompassing reports, postcards, posters, visuals and testimonies of health professionals. An important initiative was the European Union Urban Air Quality Partnership, bringing cities, member States and other stakeholders together with a common goal to place the ‘healthy city’ concept higher on the European Union agenda and achieve healthy urban environments. The partnership’s action plan contained a package of actions for awareness-raising and knowledge-sharing. Possible actions were improving communication strategies by focusing on benefits, developing a communication toolbox, designing models of awareness-raising campaigns, promoting citizen science, and scaling up successful activities to the European level. To feed the communication toolbox, a survey of local authorities was ongoing. Preliminary results indicated a large variation in level of detail and range of engagement in communication. Challenges identified were the difficulty in changing behaviour, funding constraints, and the need for national legal frameworks to support local action. Another major activity is the ‘Unmask My City’ campaign, a global initiative led by health professionals calling for cities to meet WHO AQGs by 2030. Working together with WHO and NGOs, the initiative used community-based monitoring to raise awareness and call for better official monitoring. Twelve cities around the world were already collaborating since May 2017 (e.g. Belgrade, Istanbul, London, Warsaw and Tuzla). To conclude, the speaker noted that more and more projects that involved citizens in communication were emerging, including the development of ‘citizen science’ websites and the use of social media for awareness-raising.

V. Review of the progress in research on the health impacts of air pollution

14. An expert from the Health Effects Institute gave a brief introduction of the organization and presented the new directions in research on air pollution and health around

2012).

the world. A high priority area was the evaluation of the adverse health effects of traffic-related air pollution. Some commissioned studies, in review or published, intended to enhance exposure assessment and assess the vertical gradient of air pollution. Other ongoing studies aimed to assess confounding and effect-modifiers (e.g., traffic noise, socioeconomic status) and non-tailpipe emissions of motor vehicles. Additional work included the update of a previous review of the traffic and health literature using more systematic methods and meta-analysis, with the aim to better inform future risk and health impact assessment. Another area of interest was the evaluation of the health impacts of air quality interventions ('accountability research'). Starting in 2003 with the 'chain of accountability' framework, recent research focused on assessing large-scale, multi-year regulatory programmes. Future plans included the development of new analytic methods, assessing interventions to reduce exposure at the community and individual levels, and learning from other regions in the world. Recent interest in estimating the effects of exposure to low levels of air pollution and how the concentration–response function (CRF) looked like at those levels had triggered the funding of three studies in Europe, Canada and the United States. In order to better assess low levels, large population cohorts, fine spatial scale exposure assessment and novel statistical methods were used. For example, the European analysis would use the ten ESCAPE studies that included lifestyle data and complemented them with seven large administrative cohorts. Early results from the United States study were already published, including the finding of large $PM_{2.5}$ effects in concentrations as low as <12 μg/m^3. To conclude, the speaker summarized the Institute's Global Health Programme. Highlights included the recent 'State of Global Air 2018' report and its associated website,[7] and new research on the higher range of the exposure distribution by pooling data from 23 cohorts from nine different countries in Asia.

15. As a result of the discussions at the previous Task Force meeting, a comparative evaluation of burden of disease methods by using data from Serbia was conducted by two experts from the Institute of Public Health of Serbia and the Health Effects Institute. With this purpose, $PM_{2.5}$ levels, patterns and health impacts after using local air quality monitoring (AirQ+ approach) vs. 2016 Global Burden of Disease (GBD) data were compared. While the former approach included data from 41 monitoring stations, the latter used a combination of satellite-based and monitoring data from a limited number of monitoring sites. The ultimate goal of the assessment was to understand where the differences in $PM_{2.5}$ exposure were occurring and assess whether combining satellite data with additional national ground-level data could improve the agreement between the two methods. A series of maps and detailed results were shared with participants, including the location of ground-level monitoring stations, their characteristics and latest measurements, and recent GBD satellite data. For comparability with GBD data, PM_{10} data from monitoring stations were converted into $PM_{2.5}$. By conducting simulations, a range of conclusions could be reached. The lack of measuring continuity in $PM_{2.5}$ concentrations, due to the small number of stations, hindered risk assessment using the AirQ+ approach. Conversely, GBD estimates of $PM_{2.5}$ offered more continuous measures over space and time but might underestimate concentrations in urban centres and industrial areas. A potential solution involved an increase in the number of monitoring stations that reported data to WHO. Overall, more collaboration was needed to support the regular registration of health and air pollution data, run further comparisons of health impacts of air pollution with other cities and countries, and conduct studies on the health and economic impacts of air pollution. To conclude, the speakers noted that they planned to run complete AirQ+ analyses with both sets of monitoring data and compare the impacts of other input data on the health impact analyses (e.g., CRFs, mortality rates).

[7] See https://www.stateofglobalair.org/.

16. A representative of WHO Headquarters gave an update on activities in air pollution and health. Through the global databases on ambient air quality in cities and household energy use, WHO gathered and updated data for monitoring the progress in the air pollution exposure and health impact indicators of the Sustainable Development Goals (7.1.2 and 11.6.2; and 3.9.1, respectively). Further, the Fourth version of the WHO Global Urban Ambient Air Pollution Database[8] was recently released, providing annual mean concentrations for $PM_{2.5}$ and PM_{10} for more than 4300 human settlements in about 100 countries. Although most data came from high-income countries, a greater number of low- and middle-income countries have started to report. These data were used to raise awareness and obtain modelled exposure data, especially for those countries that lacked the capacity for data collection. For burden of disease estimation, the same methods as the Institute for Health Metrics and Evaluation (IHME) were used. In particular, ambient $PM_{2.5}$ exposure and polluting fuel use were modelled. CRFs were the integrated exposure–response functions (IER) for five cause-specific diseases, the counterfactual was set at around 4 $\mu g/m^3$, and the baseline health data came from WHO global health estimates. Updated estimates of annual attributable mortality were 4.2, 3.8 and 7 million for ambient, household and overall air pollution, respectively (2016). Of these, approximately 500000 deaths occurred in the WHO European Region yearly, as a result of ambient air pollution. Of note, air pollution had been recognized as a major risk factor for non-communicable diseases, at the same level as tobacco, alcohol or physical inactivity. To be finalized soon, the Clean Household Energy Solutions Toolkit[9] aims to help countries implement household fuel use guidelines and streamline the very slow progress on SDG 7.1.2 for clean cooking. To engage the health sector to realize climate and health benefits, the Urban Health Initiative had launched the first two of several pilot projects, with the ultimate goal of generating replicable tools and guidance material. Ultimately, the speaker provided a brief update on the BreatheLife Campaign and the WHO Global Platform on Air Quality and Health. The latter initiative aimed to review progress in air pollution research and emerging issues, identify gaps and opportunities, and respond to questions by countries and scientists. Ongoing work included harmonization of approaches to integrate exposure data in models, further development of CRFs, evidence reviews (desert dust, non-exhaust dust, biomass burning, low-cost air quality monitoring, AQIs, strategic action plans, personal-level interventions) and communication strategies.

17. An expert from Health Canada presented the results of the application of a new risk estimator for health impact assessment of air pollution, with special emphasis on the European region. The IER function, used by both IHME and WHO, was the first model that covered the global exposure range in both ambient and household air pollution. However, the model required strong assumptions to convert total inhaled particle dose for ambient air, second hand smoke, household air and active smoking to equivalent 24 hour ambient concentrations. Another key assumption was that any given concentration risk of death was the same among all types of $PM_{2.5}$ exposures. To address these issues, a new risk function had been built using complete data from 41 cohort studies of ambient $PM_{2.5}$ ─ the Global Exposure Mortality Model (GEMM). Several comparative analyses using the GEMM, IER and the European Health Risks of Air Pollution in Europe (HRAPIE) functions were shown, including for exposures, numbers of deaths, mortality rates, and health co-benefits from air quality. GEMM predictions suggested that the CRF may be different (larger) from other sources. In particular, the all-cause GEMM predicted larger excess deaths compared to the sum of cause-specific GEMMs and the IER. In conclusion, a clear need for additional

[8] http://www.who.int/phe/health_topics/outdoorair/databases/cities/en/.
[9] http://www.who.int/airpollution/household/chest/en/.

studies at high exposures was identified, particularly for specific causes of death, as they appeared to be much more unstable compared to all-cause of death risks.

18. An expert from the International Institute for Applied Systems Analysis presented the progress towards the achievement of the European Union's air quality and emission objectives. Based on the GAINS model, the Institute had recently re-analysed scenarios for baseline emission projections including the latest regulations (excluding the NECD), additional efforts to meet the NECD emission reduction requirements and the achievement of the WHO AQG and European Union ecosystem targets. Large emission inventory changes for 2005 and 2010 (between the 2014 and 2017 submissions) were found for some member States. For ammonia and $PM_{2.5}$, the NECD implied further action in almost all member States. New source-oriented legislation was recently introduced, such as the Eco-Design Directive on product-related emission standards for small combustion devices for solid fuels, the Medium Size Combustion Plan Directive, the Non-Road Mobile Machinery Directive and the Final Agreement on Euro 6 Emission Regulations. These rules had led to new projections, such as updated economic outcomes and the Climate and Energy Policy scenario (30 per cent energy efficiency improvements, 12 per cent lower consumption of fossil fuels and 40 per cent less greenhouse gas emissions). In term of air pollution emission projections for 2030, the new policy package would deliver the targets for the pollutants in about half of the member States. This roughly translated into greater reductions for SO_2, nitrogen oxides, $PM_{2.5}$ and volatile organic compounds, with the only exception of ammonia, for which further actions would be needed. Annual costs for additional emission reductions ranged between € 960 and 540 million/year (or € 1.9-1.05/person/year), depending on energy and climate policy decisions. Using the HRAPIE methodology, loss in statistical life expectancy attributable to $PM_{2.5}$ ranged from 9 to 4.1 months in 2005 and 2030, respectively. However, in the Benelux region, Czechia, Northern Italy and Poland, people would still lose more than 5-6 months of life. The number of premature deaths attributable to $PM_{2.5}$ ranged from 418000 cases in 2005 to 194000 cases in 2030. Lastly, recent legislation would bring the WHO guidelines for $PM_{2.5}$ within reach for most areas in 2030. Further efforts would be required at ‘hot spots’ (e.g., Northern Italy, Southern Poland), especially for agriculture and residential combustion.

19. A representative of the WHO European Centre for Environment and Health presented the process and progress in updating the WHO Global AQGs. Participants were reminded that the guidelines were developed according to the procedures described in the *WHO Handbook for Guideline Development*,[10] to ensure objectivity, transparency and relevance. Several formal groups had been established, with different roles and responsibilities, including the WHO Steering Group, methodologists, the Guideline Development Group (GDG), the External Review Group and the Systematic Review Team. The process consisted of three stages: planning, development and publishing. From 2016-2017, the work consisted of planning and scoping the guidelines, including an expert consultation to prioritize topics for the guidelines in Sept 2015, the securing of resources, and the first official GDG in September 2016. From 2017 to present, several milestones had been reached. Of note, the guideline planning proposal was approved by the Guideline Review Committee. Other activities were the commissioning of systematic reviews, the follow-up of reviews by other authors, the drafting of the guideline table of contents, and the adaptation of methodologies to the air quality and health field. Finally, in March 2018, the second meeting of the GDG took place. During the meeting, the GDG assessed progress in the project and provided recommendations. For these guidelines, the Systematic Review

[10] World Health Organization, 2nd ed. (Geneva, 2014). Available from http://apps.who.int/medicinedocs/en/d/Js22083en/.¨

Team was conducting five systematic reviews of the adverse health effects from exposure to six classical air pollutants. Most reviewers had already the studies for inclusion and were carrying out or had finalized data extraction. Some reviewers had already conducted some preliminary analyses. Three additional external reviews on desert dust, ultrafine particles and PM components would also be evaluated and used to develop guidelines, if feasible. Once the overall quality of the body of evidence was assessed, six steps to come from evidence to guideline exposure levels would be followed. The speaker concluded by advancing the next steps in the project: finalization of the adapted tools, ongoing work on reviews, discussion on how indoor air quality would fit in the guidelines, elaboration of methods for setting interim targets, and drafting of the guideline document.

20. An expert from the Spanish Institute of Environmental Assessment and Water Research reported on a review of evidence on the health effects of biomass burning dust, commissioned by WHO Headquarters. Biomass burning mainly came from agricultural activities, preventive bush fires, forest fires, and energy production. Bush and forest fires caused short but intense air pollution episodes, while energy production emitted more continuous pollution, especially during winter and autumn. Agriculture activities led to both peak concentrations in short periods and elevated winter-autumn emissions. The contribution of biomass burning to the annual mean of $PM_{2.5}$ was as high as 21 per cent in some Mediterranean cities, equivalent to traffic-related pollution. In order to review the evidence, the authors systematically searched for relevant papers up to October 2017, using a combination of exposure and health outcome terms. In addition, the references of 14 previously published reviews were scanned. In total, 72 papers ─ only examining short-term effects ─ were found eligible. For mortality, 15 papers were included, with 11 papers showing a positive and significant association for some mortality-related outcomes. Just a few studies met the requirements for meta-analysis. For example, 8 datasets had enough observations for meta-analysis of all-cause mortality, while 6 datasets could be employed for synthetizing cardiovascular mortality. All-cause mortality seemed to increase with statistical significance during forest fire days and was associated with PM_{10} increases during the episodes. Taking into account limitations in exposure characterization, no significant association with mortality was found. Of note, it was uncertain if the increased mortality associated with fires was exclusively due to smoke rather than to the combination of PM sources and meteorology. For all-cause and cause-specific morbidity, 55 studies were identified. Most studies suggested that PM from wildland fires caused short-term respiratory effects, but results were contradictory for cardiovascular effects. The speaker concluded by giving several recommendations. Best practice guidelines for source apportionment analysis and evaluation of health outcomes should be developed. To further build the evidence base, harmonized multi-city studies should be promoted. Lastly, more studies in Africa and Asia should be conducted, given the high contribution of biomass burning to ambient air pollution in these regions.

21. An update on activities of the Committee on the Medical Effects of Air Pollutants was given by a member of the Committee secretariat from Public Health England. As a result of the United Kingdom's difficulty in complying with annual mean NO_2 limit values, the Government asked the Committee to examine the causality of the link between NO_2 and health effects in epidemiologic studies. Firstly, the Committee went through existing reviews and found strengthening evidence for associations. Secondly, the Committee assessed whether there was a causal link between long-term exposure to NO_2 and all-cause mortality and how to quantify that effect. The Committee had made interim recommendations in 2015 but carried out a systematic review and meta-analysis to inform its final views. Efforts were made to prevent bias by including each cohort just once. To make the results appropriate for use in cost-benefit assessments for policy analysis, studies in specific age-groups or in more susceptible populations were excluded. Although a statistically significant association was found, the Committee cautioned that the extent of

the causal effect of NO_2 was difficult to assess, as NO_2 concentrations are correlated with $PM_{2.5}$ and other components of the air pollution mixture. A key point of the ensuing discussions was how to take this uncertainty into account quantitatively, when predicting the benefits that would be expected from interventions. Challenges around interpreting two-pollutant models were identified, including a lack of testing for interaction, overlapping confidence intervals, a possible transfer of effect in the presence of exposure misclassification, and high correlation between pollutants. As a pragmatic recommendation, studies with a lower correlation could be used to make an informal estimate of a representative reduction of the NO_2 coefficient on adjustment for PM. Expert judgement was used to suggest the extent to which this might represent a causal effect of NO_2. For health impact assessment of reduction in all traffic-related pollutants, using an unadjusted NO_2 coefficient was recommended. For interventions targeting NO_x emissions, the recommendation was to use 25-55 per cent of the summary unadjusted coefficient ('central range'). Calculating the mortality burden attributable to NO_2 was not recommended, but exploratory calculations for the air pollution mixture were supported by some Committee members. Lastly, it was mentioned that the Committee was reviewing the strength of evidence for epidemiological associations and causality between air pollution and cognitive decline and dementia. This work revolved around two hypotheses of interest: effects could either be direct, due to translocation of ultrafine particles, or secondary to other health effects of air pollution, such as those on the cardiovascular system.

22. An expert from the Flemish Institute for Technological Research (VITO) updated the Task Force on the improved NO_2 exposure assessment methods in Flanders, Belgium. Assessing NO_2 exposure was challenging because of the limited representativeness of measurement stations, limited availability of input data to capture spatial variability in models, and the large amount of resources needed for modelling. As a result, VITO was making coordinated efforts to improve upon NO_2 exposure assessment, by combining measurements and model results to accurately represent urban 'hot spots' and produce exposure metrics for health impact consistent with scenario analysis. As presented at the past Task Force meeting, a recent project had investigated the appropriate scale for NO_2 assessment at the European Union level. A scale of about 100 m was recommended but had limitations to capture the true urban 'hot spots' of NO_2 concentration. To illustrate the strong spatial variability of NO_2, the results of a 'citizen science' experiment in Antwerp, where 2000 citizens monitored air quality using passive during a month, were shared with the participants. In relation to modelling, Flemish researchers had developed a model chain to perform health impact calculations and policy scenarios, while reducing uncertainties. In particular, land use regression and dispersion modelling were combined to develop the chain model. To resolve the resulting underestimation of street canyons, the researchers added street canyon parameterization using the Operational Street Pollution (OSPM0 model to get closer to the true NO_2 spatial variability in Antwerp. Exceedances in smaller towns and at the regional level could also be shown. Lastly, the speaker announced other initiatives worth mentioning. A new 'citizen science' experiment was being repeated in Antwerp using a much larger number of locations. This exercise would help validate and improve the recently built high-resolution model. An attempt to couple exposure assessment results with a medical database in Flanders was also ongoing.

23. A representative of the Swedish Environmental Protection Agency provided an update on the proposed scope of work of the Task Force's Working Group on Polycyclic Aromatic Hydrocarbons (PAHs) for the biennium 2018-2019. Given the relevance of PAHs within the Convention, a working group was suggested by Switzerland at the past Task Force meeting. The working group was established with the following objectives: keeping the importance of PAHs on the agenda, discussing new evidence on health endpoints other than cancer, and describing the different approaches to the assessment of carcinogenic potency. Many PAHs were known or possible carcinogens. Despite their structural

similarities, PAHs varied greatly in their carcinogenic potency. Reported health endpoints other than cancer included cardiovascular effects, respiratory and asthma symptoms, immunotoxicity, and reproduction and birth outcomes. Current risk assessment approaches used benzo[a]pyrene as a surrogate marker for mixture exposure, assessed the relative potency factors using benzo[a]pyrene as a reference, or evaluated the whole mixture potency. It was noted that other mechanisms than mutagenicity were also of importance to cancer development (e.g., inflammation). There were some drawbacks to current approaches to risk assessment, including the exclusion of outcomes other than cancer, underestimation of cancer risk using benzo[a]pyrene as a marker, and variability in source composition. The speaker noted several means to improve the risk assessment of PAHs in the future. A common mode of action to underpin the relative potency procedure was needed. In addition, other mechanisms of importance to cancer development and other endpoints had to be brought into the discussion. Lastly, a set of key indicators for policy use and a stepwise procedure to include more outcomes were worthy of consideration. The Working Group would suggest possible steps to be taken for improving risk assessment of PAHs, having in mind simplicity and policy relevance. An additional Party to the Convention, Canada, volunteered to contribute to the working group.

VI. Capacity building on air quality and health: the use of the WHO AirQ+ software and sub-regional activities

24. A representative of WHO presented the recent upgrade of the AirQ+ software. AirQ+ was a user-friendly tool to estimate the magnitude of the most important and best recognized effects of air pollution in a given population. The tool was designed for public health or environmental specialists with minimum knowledge of atmospheric modelling, statistical methods, epidemiology or geographic information system. However, AirQ+ could also be used for policy, educational and communication purposes. Two-year responses to an online survey on AirQ+ showed that more than half of the users were from academia, and over 90 per cent were from the fields of environment or health. The outreach of the tool was now global with respondents from 62 countries and 153 cities. The main purpose of using the software reported was research, followed by health impact assessment. The software was mainly used to calculate health impacts at the local level in areas of 1 million or more inhabitants, especially those attributable to $PM_{2.5}$ and PM_{10}. Dissemination of the tool had occurred mainly through the Internet, but also as a result of the ongoing presentation and capacity building activities. Some examples of the software features and recent developments were given to the audience. For calculations in European Union countries, relative risks for selected pollutant health endpoint pairs were based on HRAPIE. In countries with very high levels of air pollution, IERs for cause-specific mortality burden estimates were recommended. The speaker highlighted the incorporation of databases on conversion factors between $PM_{2.5}$ and PM_{10} at the national level and on worldwide solid fuel use statistics. Users just had to input basic data on air pollution (e.g., average levels), exposed population (e.g., number of adults aged 30 or above) and health (e.g., baseline rates of outcomes), but could also change the default relative risks or load their own data for not included pollutants. Next steps in the project were further dissemination the tool, translation into French, addition of new modules and supporting documentation, and allowing dialogue with other tools developed by WHO.

25. A representative of the National Academy of Medical Science of Ukraine introduced the audience to the Russian language version of AirQ+. The Academy was charged with checking the accuracy of the Russian translation and providing suggestions for improvement. The task of checking the translation was time-consuming, because of the need for harmonizing all the definitions and indicators. In reviewing the glossary, a

common recommendation was to add the original English term to avoid confusion. An example was the definition of 'pollutant', where the translation was 'an object that pollutes the air'. This problem was also identified in the supporting documentation. For example, in the document giving examples of calculations, original terms were added to ease understanding. Other issues identified included some duplication of text. Finally, the speaker presented other activities related to AirQ+ in Ukraine, such as the conduct of health impact assessments (e.g., coal thermal power stations, Smart City projects in Kiev) or capacity building workshops.

26. A representative of the WHO Centre for Environment and Health provided an update on the organization's capacity building efforts on air quality and health. In 2016, an AirQ+ basic training workshop was delivered, including topics of how to download and install the software, how to enter your data and select analysis, and some case studies. Incorporating experts' feedback, a training curriculum was then developed, in order to raise awareness of the adverse health effects of air pollution, strengthen the capacity of health risk assessment, and promote the use of AirQ+ among member States of the WHO European Region. The curriculum was designed as a five-day long training, but a shorter 3-day version was also planned. The delivery format consisted of lectures, small group discussions and hands-on exercises, but there was also an expectation that participants did some preparatory work before the training to maximize impact. As for AirQ+, the target audience were environmental and public health experts. The speaker guided the Task Force participants through the modules of the curriculum. The training started with an introduction, followed by a module on how the knowledge around air pollution and health had been built, another module on how to assess and quantify the impact of air pollution on population health (e.g., principles of health risk assessment, mapping of tools), the application of AirQ+, and a concluding module focused on policy and communication. In the near term, WHO planned to finalize the content of the modules and the preparatory work expected from participants, conduct a pilot run of the training in Sarajevo (Bosnia and Herzegovina, autumn 2018), explore potential partnerships (e.g., ECE, United Nations Environment Programme) and mobilize further resources.

27. A representative of the Regional Environmental Centre for Central Asia (CAREC) provided an overview on the organization's activities on air quality and health in Central Asia. CAREC's main goal was to identify the correlation between human health and environmental factors, as well as to assist in reducing the burden of environmental hazards on population health. The Centre was building a new capability on project implementation in line with the Ostrava Declaration and Action Plan. Activities on air quality included the Sustainable Low Emissions Transport Project, joint regional events in partnership with the Convention and UNDP on transport health and environment, and the launch of the Environment for Central Asia process. More and more regional governments were increasing commitments to monitor and reduce air pollution, as well as stepping up action from the health and other sectors. Existing CAREC platforms, including the annual Central Asian Environmental Forum, were important for regional coordination, sectoral cooperation and political support for the implementation of international conventions, and for enhancing awareness and exchanging lessons learned and best practices. In relation to transport, the Centre contributed to the search of key pathways by which transport affected health and assessing the health co-benefits (and risks) of climate mitigation strategies in the transport sector. Tools for assessing, planning and financing low-emission transport systems were also reviewed by the Centre. CAREC and OECD would soon host a regional workshop to discuss the results of the fuel efficiency assessment of the transport sector in Kazakhstan and the impact of government measures to formulate recommendations for further development of sector regulation policies. The workshop would also provide training on the economic evaluation of environmental public transport policy. Within the framework of the Transport, Health and Environment Pan European Programme, the Centre would also

organize a workshop to strengthen regional capacities to integrate the programme's priority goals and tools into national policies.

VII. Towards the First WHO Global Conference on Air Pollution and Health

28. Representatives of WHO Headquarters presented the First WHO Global Conference on Air Pollution and Health. Responding to the large burden of disease attributable to air pollution, a World Health Assembly resolution (2015) and road map (2016) set forth a strategy for reducing air pollution health risks. In collaboration with United Nations Environment Programme, the World Meteorological Organization, the United Nations Framework Convention on Climate Change, the Climate and Clean Air Coalition and ECE, WHO would organize a global conference on air pollution and health to review progress and agree on further action.[11] The conference would be held in Geneva, including 400 worldwide participants, from 30 October to 1 November 2018. The conference aimed to advance science on critical health-related issues, create opportunities for scaling up action in member States, discuss and agree on ambitious targets (e.g., reaching WHO AQGs by 2030), and raise political commitment and resources from health and other sectors for prevention of diseases attributable to air pollution. Participants would include Ministers of Health, Ministers of Environment and other national government representatives; representatives of intergovernmental agencies, health professionals, other sectors (e.g. transport, energy), as well as from research, academia and civil society. The conference intended to advance collaborations between WHO and sister United Nations agencies. A draft overview of the agenda was shared with Task Force participants, as well as sources of information to follow up on the conference developments.

VIII. Implementation of the workplan of the Task Force on Health for 2018-2019

29. A representative from the WHO Centre for Environment and Health gave an overview of the development of the 2018-2019 workplan and its current implementation. Based on the Policy Review Group's recommendations, a workplan was proposed at the past Task Force meeting. After receiving experts' input, the document was approved at the end of 2017. Most of the included activities were in line with the Policy Review Group's recommendations and long-term strategy, with some exceptions (e.g., airborne effects of heavy metals) and some pending activities due to a lack of resources. For each workplan item, the speaker reviewed the progress in the planned deliverables, while highlighting the resources that were available and those that were needed:

(a) Update of the evidence on the health impact of O_3, PM, NO_2, SO_2 and carbon monoxide (Update of WHO Global AQGs ongoing; additional funding needed);

(b) Report of emerging issues and methods for health risk/impact assessment of air pollution and cost benefit analysis (pending; funding needed);

(c) Update of the tools for quantification of health burden of air pollution (the Russian language version of AirQ+ completed, new functionalities under development; additional funds needed);

[11] See http://www.who.int/airpollution/events/conference/en/.

(d) Proposal of a road map for assessing the health risks of PAHs in view of their relative carcinogenic potencies; evaluation of the representativeness of benzo[a]pyrene as an indicator for the PAH group; and evaluation of the equivalence factors that could be used in risk assessment of PAHs (working group on PAHs established in January 2018; supported by Finland, Norway, Sweden, Switzerland and the United Kingdom);

(e) Development and implementation of a capacity-building curriculum on health impact assessment of air pollution at the regional and sub-regional levels (draft curriculum completed, pilot implementation in Sarajevo planned; additional funds needed);

(f) Regional input to the review of methods used for estimating burden of disease attributable to air pollution, coordinated by WHO Headquarters; and

(g) Regional input to the review of communication strategies for health messages related to air pollution, coordinated by WHO Headquarters.

30. While the Task Force meeting participants commended the current workplan activities, the following additional proposals for the future were put forward and agreed:

(a) Organization of a specific session to review previous year's research on the health effects of air pollution in the upcoming Task Force meeting;

(b) Establishment of a working group to assess the new developments around the assessment of the health impacts of NO_2; and

(c) Establishment of a working group on methods of assessing the health impacts of air pollution to liaise with WHO Headquarters and other groups under the Working Group on Effects to discuss streamlining of methodological approaches.