METEOROLOGICAL AND AIR QUALITY (MAQ) SERVICES FOR COVID-19 RISK REDUCTION AND MANAGEMENT / RECOMMENDATIONS FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES

* Recommendations from the WMO COVID-19 Research Task Team, based on an assessment of knowledge as of 9 May 2022.

BACKGROUND

During the COVID-19 pandemic, many National Meteorological and Hydrological Services (NMHS) sought to provide useful and actionable information to help understand and manage the pandemic and related decision-support. Little was known about the influence of environmental factors, and many NMHS were trying to help. WMO immediately created a COVID-19 Task Team to help navigate, inform, and facilitate the appropriate use of meteorological, climate and air quality information for COVID-19.

This document is an overview of knowledge, reflections and lessons learned, and is designed to provide recommendations to NMHS regarding the provision of services for COVID-19. Furthermore, the insights herein may improve global responses to potential future public health emergencies, including future pandemics.

WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

SCIENTIFIC KNOWLEDGE

- Scientific progress has been made towards identifying the influence of meteorological and air quality (MAQ) on SARS-CoV-2 transmission and COVID-19 severity, although there remains much uncertainty.
- Initial efforts were hampered by the lack of global infrastructure, tools and open, free and publicly available data (e.g. health, environmental, MAQ) for real-time sharing, at relevant temporal and spatial scales.
- Geographic disparity in resources and data accessibility highlighted the inequality of information available to tackle the pandemic.
- Observed variability in SARS-CoV-2 transmission and COVID-19 severity is dominated by factors other than MAQ, including vaccine coverage, new variants, government interventions and personal protection measures and behaviours. Disentangling the relative roles of these factors from effects of MAQ, in controlling the COVID-19 transmission dynamics, is not trivial and remains a challenge.
- MAQ information can be used effectively to design and execute COVID-19-related actions and interventions, e.g. for the logistics of vaccine handling, implementing adequate ventilation of, or air filtration in, indoor spaces, establishment of field hospitals, and management of compound environmental hazards (for example, evacuation or sheltering guidance, accounting for COVID-19 risks), to name
a few.
- The influence of MAQ drivers on SARS-CoV-2 transmission and COVID-19 severity remains an active research topic in collaboration between MAQ experts.

BOX 1: SEASONALITY

State of understanding:

- The transmission of some respiratory viruses, including influenza and other human coronaviruses, vary seasonally with outbreaks generally occurring during winter months in temperate zones.
- The interaction between meteorological factors, such as temperature and humidity, seasonal patterns of human behaviour, and changing levels of population immunity influences the timing and intensity of disease outbreaks.
- The influence of meteorological drivers on SARS-CoV-2 transmission across the globe is confounded by other dominant factors, including vaccine coverage, new variants, government interventions and personal protection measures.
- Nevertheless, laboratory studies and some epidemiological analyses have pointed to meteorological sensitivities of SARS-CoV-2 and COVID-19 that are generally consistent with sensitivities of other seasonal respiratory viral illnesses – e.g. reduced virus survival under conditions of high temperature, high absolute humidity, and/or high UV radiation. This emerging evidence supports the expectation that SARS-CoV-2 transmission may be favoured under wintertime conditions in temperate regions, though the dominant mechanisms and degree of potential seasonal influence remain uncertain, and the specific nature of some sensitivities – e.g. linear versus threshold versus optimal range – is under investigation.
- More data over a longer period of time will help better shape the seasonal nature of COVID-19.
- One cannot assume reduction in risk during warm seasons, as other factors can dominate the seasonal influence on overall risk profiles.

Application to decision-making

- Seasonal patterns in COVID-19 need to be considered in the context of broader risk profiles.
- Summer in the respective hemispheres cannot simply be assumed to be a lower risk period, considering the potential for new variants to emerge at any time, the likelihood that seasonal influence is mediated by human behaviour, and the fact that high positivity rates in any season present a major risk of continued transmission.
- The use of climate information in setting COVID-19 risk mitigation policies should take place in the context of comprehensive risk analysis that considers the status of local and global positivity rates, the presence of novel variants, local vaccination rates, and other non-meteorological factors relevant to transmission dynamics.

More information is available via the September 2021 Task Team roundtable on COVID-19 seasonality.

THE ROLE OF NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES

NMHSs can provide useful information in a number of ways to support the health sector during a pandemic, or localized outbreaks and public health emergencies with recognizes MAQ associations.

Forecasts and Models

When impacts of MAQ on SARS-CoV-2 transmission are better understood, NMHSs may be able to provide meteorological/climate/air quality data and forecasts of potential relevance to COVID-19 risk management, including integration into SARS-CoV-2 transmission models. Data and forecasts should be of a quality and accessibility that complies with the WMO Data Policy. WMO designated Global Production Centres and Regional Climate Centres are well positioned to support more effective ways of working given their role in supporting applications via the climate services information systems.

Data

Accurate, timely, open data coupled to robust analysis, such as impacts of MAQ on disease transmission, should be freely available for public health research and applications especially during global or national crises. Quality Assurance/Quality Control to ensure accuracy and legitimacy of forecast products, data and other information, levels of certainty is important.

Co-Production with Health Sector and Policy-Makers

As evidence of impacts of MAQ on SARS-CoV-2 transmission emerges, NMHS should collaborate with health experts/institutions in the co-production of COVID-19 related risk assessments and forecasts that consider MAQ information. NMHSs can contribute expertise, through data sharing and enabling tools, and with infrastructure (Computational resources, etc.). Public health sector and policymakers should be involved throughout, from conception through implementation. Failing to do so risks developing tools, services and systems that are unusable by intended end users, unfit for their intended purpose, or, in some cases, misleading from the perspective of health relevance. Operational, scientific and policy aspects must be consistent and complement each other. Operational, scientific and policy aspects must be consistent and complement each other.

Issuing Authority

COVID-19 risk assessments, forecasts or related products that consider MAQ information should be issued by, or jointly with, the health authorities. In addition to MAQ, they should be developed considering the role of all the other relevant social, environmental, behavioural factors and public health interventions that determine virus transmission.

Science Based

New services and products that incorporate MAQ considerations for COVID-19 risk management should be based on well-established science. It is important to verify that specific studies being considered comply with relevant guidelines of data quality, analysis scale, consideration of confounders, and interpretability (e.g. those described in the First Report of the WMO COVID-19 Task Team: Review on Meteorological and Air Quality Factors Affecting the COVID-19 Pandemic (WMO-No. 1262)) in order to establish their trustworthiness.

Response

NMHS should engage with health authorities to ensure that the MAQ information is effectively interpreted and used for designing and executing COVID-19-related actions and interventions, e.g. logistics of vaccine handling, hospital preparedness, environmental exposure recommendations.

Research

Research on the influence of MAQ drivers on SARS-CoV-2 transmission and COVID-19 severity remains an active endeavour and should be promoted and pursued. Collaboration between MAQ experts, including NMHS and health experts is necessary for this purpose.

Continuity of Services

Ensure that tailored services which may be developed for a specific purpose are adequately documented, remain valid, updated and continue to be user-relevant over time.

COMMUNICATION AND ENGAGEMENT

- Communication of MAQ-informed findings on COVID-19 should be done by the domain experts or recognized authorities in meteorology and public health, preferably jointly between the different experts and/or authorities, and ensuring the reinforcement of each other's messages when done separately.
- Clear communication of uncertainty in MAQ analysis and their association with COVID-19 risk is essential.
- Plain communication, avoiding unnecessary jargon, is required regardless of format (e.g. written, verbal and/or visual).
- Timeliness should be balanced with reliability, ensuring transparency.
- Working across disciplines and agencies is essential to ensure inclusivity and accessibility to all.
- Since the beginning of the pandemic, there has been demand for decision-relevant information from many interest groups. To satisfy this demand and to advance the development of MAQ-informed COVID-19 risk analysis, experimental forecast products and prototypes have been developed and sometimes disseminated. Extreme caution is recommended in the presentation of these products. An experimental and uncertain forecast may be worth sharing with expert partners, but wider distribution of unverified forecasts risks misinforming the public and undermining confidence in scientific approaches to COVID-19 risk assessment.
- Ensure adequate space exists for two-way engagement and communication between users and producers. This will allow for constructive and honest feedback from users and enhance the quality of the developed service.

BOX 2: AIR QUALITY

State of understanding:

- The correlation between long-term air pollution exposure and a range of health impairments makes it difficult to control for confounders when studying the influence of elevated air pollution on SARS-CoV-2 transmission or COVID-19 severity.
- Nevertheless, a number of epidemiological studies have suggested that long-term exposure to air pollutants, including particulate matter (PM), ozone (O3), and nitrogen dioxide (NO2), is associated with more severe COVID-19 symptoms and higher likelihood of death. Evidence regarding the influence of short-term air pollution exposure to COVID-19 risk is still emerging.
- There is also some experimental evidence that exposure to PM may increase risk of severe COVID-19 symptoms. The public health importance of the effects identified in these experiments is still to be determined.
- Some studies suggest that air pollution may enhance the spread of COVID-19, though evidence of the epidemiological significance of this effect is uncertain. The mechanisms of this influence are still being investigated – direct influence on virus survival and transport is plausible, but short-term and long-term impacts of air pollution on host physiology may also play a role.

Application to decision-making

- Communities and workers should be aware of their exposure to air pollution. In the case of outdoor air pollutants, meteorological services can work to communicate patterns of air pollution at the highest spatial and temporal resolution possible, to make the data meaningful to those burdened by high pollution conditions.
- Understanding of how acute air pollution exposures influence COVID-19 transmission and severity is not fully clear. Nevertheless, given the known influence of acute exposure on respiratory and cardiovascular conditions, it would be valuable for NMHSs to enhance production and communication of high-resolution air pollution monitoring and forecast products. COVID-19 risk serves as one of many motivations for getting this information to vulnerable individuals and communities.

THE PATH FORWARD

- The global response to the pandemic has been underpinned by an unprecedented and unrestricted access to data sets previously unavailable on a routine basis. Such access must continue to ensure that current and future interventions and cross-cutting services can depend on these vital data to help address challenges.
- The scramble for data and information exchange at the outset of the pandemic emphasizes the need to establish long-term collaboration between the climate services and public health communities, including academics, practitioners, policymakers and funders, within the principles of co-design and co-production.
- Effective and rapid collaboration in the face of an emerging pandemic also depends on clear institutional arrangements and governance. These ensure that the corresponding roles and ownership are clear when it comes to the collection and curation of data, generation of authorized information products, and communication with decision-makers and the public. Pre-designated focal points and Memorandums of Understanding with health authorities can facilitate the readiness of NMHSs to support public health research and responses in times of emergencies.
- Clear documentation and regular updating of datasets, methods, and frameworks for risk assessment and communication are critical to pandemic readiness. The co-development of integrated climate and disease surveillance systems or observatories can preposition NMHSs to support public health research and responses in times of emergencies.
- As in any assessment and prediction problem, MAQ-informed evaluation of COVID-19 or other emerging infectious diseases represents a balance of timeliness versus certainty. The fact that caution is essential when communicating research findings with the public should not paralyse climate service providers from working with public health experts to generate the best possible information even as understanding of risk factors evolves. Managing expectations and responsibly applying emerging understanding to decision-relevant risk assessment and forecast is a fundamental challenge for the climate services community, and the experience of COVID-19 highlights the need to build on past experience and to address this challenge in appropriate context as new threats emerge.

BOX 3: COMPOUND HAZARDS

- The COVID-19 pandemic has been associated with multiple major compound hazard events, in which pandemic risks were overlain by one or more climate hazards to produce risk conditions that are elevated relative to either risk factor alone. Examples include cyclones and hurricanes that necessitated large-scale evacuations, floods that displaced people into temporary housing, and extreme heat events that forced some to find shared climate-controlled environments.
- Meteorological services have a leading role to play in preparedness for and response to such compound hazard events. Traditional meteorological forecast services are critical for understanding and communicating risk related to the climate hazard, and effective integration of these traditional services with health risk information can inform management of interacting climate and COVID-19 risks.
- Anticipatory action is a powerful tool for reducing the impacts of compound hazards, and meteorological services can provide the evidence basis and communication required for those actions.
- Meteorological service contributions to pandemic-related compound hazards can be enhanced through investments to integrate disparate datasets on health, infrastructure, social vulnerabilities and climate, so that planning and response activities can most effectively reach those in greatest need of help.

More information is available via the June 2021 Task Team roundtable on compound hazards and COVID-19 and an associated meeting report published about the event First Report of the WMO COVID-19 Task Team: Review on Meteorological and Air Quality Factors Affecting the COVID-19 Pandemic (WMO-No. 1262).

FURTHER RESOURCES

- WMO Health Activity Area
- About the COVID-19 Research Task Team

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