Workshop report

Advanced Analytics to Inform Decision Making During Public Health Emergencies

WHO Hub for Pandemic and Epidemic Intelligence

9 May - 10 May 2023, Berlin Germany

World Health Organization | HUB Pandemic and Epidemic Intelligence

UKRI MRC Centre for Global Infectious Disease Analysis

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Executive summary

The COVID-19 pandemic has led to significant understanding of evidence-informed decision making during public health emergencies. Imperial College London and the World Health Organization (WHO) Hub for Pandemic and Epidemic Intelligence (WHO Hub) jointly organized a workshop to generate an understanding of the context and ways in which advanced analytics were used for decision making during the COVID-19 pandemic and to identify opportunities to strengthen the data-to-decisions pathways. Held on 9 – 10 May 2023 at the WHO Hub in Berlin, Germany, the workshop brought together mathematical modellers specialized in infectious disease modelling and scientists based at academic institutions, public health agencies, or Ministries of Health, and public health decision makers.

The workshop was conducted in four interactive group activities. The dialogue among participants led to the identification of potential opportunities for support and actions to strengthen the use of outputs from advanced analytics for decision making. These opportunities could be actions to strengthen processes and structures, improve workflows, find consensus on ways of working together, establish a knowledge foundation for support, and jointly drive evidence-based decision-making priorities for epidemic and pandemic preparedness. Workshop participants highlighted further need to capture additional perspectives held by actors from diverse geographical areas, contexts, and roles who were not present at the workshop, and political decision makers to enrich the understanding of the different priorities for advanced analytics for decision making in different regional and local contexts. The workshop highlighted the benefit in bringing together experts from around the globe to share experience and lessons learned to identify priority activities to tackling challenges and improve the way advanced analysis is perceived and used for policy and response decision making.

Overall, this workshop has contributed to a longstanding global dialogue on processes and systems to facilitate knowledge translation from data to decisions. Workshop participants collectively identified the need to develop a global network of advance analytics experts, with regional hub coordination to ensure inclusion and capacity building at local level. A network of modelers would be an interconnected community that would contribute to pandemic and epidemic rapid response while collectively improve how data are analyzed, actionable insights shared to inform decisions during public health emergencies and how models are evaluated and improved jointly.

Photo: Workshop participants in Berlin, Germany

Introduction

The COVID-19 pandemic has led to significant understanding of evidence-informed decision making during public health emergencies. To generate an understanding of the context and ways in which advanced analytics were used for decision making during the COVID-19 pandemic and to identify opportunities to strengthen the data-to-decisions pathways, Imperial College London and the World Health Organization (WHO) Hub for Pandemic and Epidemic Intelligence (WHO Hub) jointly organized a workshop (Annex 1). Held on 9 – 10 May 2023 at the WHO Hub in Berlin, Germany, the workshop brought together 28 evidence producers (57%) and public health decision makers (43%), from 16 countries (46% female; 54% male) (Figure 1) (Annex 2).

Producers of advanced analytic outputs for policy and response decision making were represented during the workshop by mathematical modellers specialized in infectious disease modelling and scientists based at academic institutions, public health agencies, or Ministries of Health. Participants were invited to attend the workshop in view of their engagement in the data-to-decisions process during the COVID-19 pandemic, as developing advanced analytics, translating advanced analytics for decision making or making response decisions. By engaging both evidence producers and decision makers and promoting dialogue and knowledge sharing between participants, the workshop fostered collaborative discussions and generated possible solutions to common challenges. The participants' collective expertise and experiences offered a rich set of perspectives, facilitating in-depth discussions about outputs from advanced analytics for policy and response decision making during epidemics and pandemics.

The objectives of the workshop were threefold:

1. To identify processes and structures for evidence-based decision making in public health emergencies, with a particular focus on understanding the impact of outputs from advanced analytics in this process.
2. To identify the enablers of and inhibitors to using outputs from advanced analytics in public health emergencies to inform policy and response decisions.
3. To jointly explore potential frameworks and solutions to address the challenges in effectively using outputs from advanced analytics for policy and decision making during public health emergencies.

The workshop was conducted in interactive group activities tailored to the objectives of each session (Annex 3). This allowed for small-group discussions and deliberations among evidence producers and decision makers.

This report serves as a record of the workshop, capturing the key discussions, insights, and solution ideas put forth by participants. The insights gained from this workshop will contribute to the development of robust and effective strategies for the use of outputs from advanced analytics to prepare for and respond to future pandemics and epidemics. Further, the lessons learned may inform future initiatives that bring together diverse actors to formulate actionable insights that will strengthen global pandemic preparedness and response efforts.

Session 1

Data-to-decisions pathways experienced during the COIVD-19 pandemic

Task: Participants were asked to discuss and visualise the data-to-decision pathways experienced during the COVID-19 pandemic, including the stakeholders engaged and their responsibilities.

The processes and structures in place for the use of outputs from advanced analytics for decision making during the COVID-19 pandemic differed significantly across settings and contexts. However, similarities emerged across the data-to-decision making processes and structures described by workshop participants. These similarities included the multitude of actors, variety of relevant data and analytics, and the repurposing or establishment of networks (formal and informal). The diverse array of key actors can be broadly categorized into evidence producers, evidence consumers, and evidence translators.

Evidence producers, those producing advanced analytic outputs for response and decision making, varied by country. The production of advanced analytic outputs was either government-based (centralised or decentralised), academic-based, based at private companies or a combination of these. For example, some countries relied on the work of government-based data analysts only, while others engaged multiple academic mathematical modelling groups. Some countries lacking advanced analytical capacity engaged academic mathematical modelling groups outside their country and region. Some countries mandated or commissioned mathematical modelling consortia to support decision makers. In some instances, these consortia were multidisciplinary, including public health experts, clinical experts, and government representatives, and were overseen at sub-national or national levels. Other groups produced analytic outputs voluntarily, i.e., without being mandated or commissioned to produce advanced analytic outputs. In some countries this was very structured and coordinated, but this was not the case everywhere.

Decision makers, i.e., actors who consumed outputs from advanced analytics, included political decision makers at federal and state levels, public health officials, public health workers, clinicians, and the public. Among other influences, outputs from advanced analytics informed their decisions to introduce, promote, or adhere to interventions, such as lockdowns and the introduction and roll out of vaccines. In most countries, the main player for deciding on interventions was within the ministries of health. Further, the workshop participants acknowledged the public as consumers of evidence on which individuals took decisions in response to the pandemic.

Evidence translators, such as key individuals at the interface between advanced analytics and decisions, national and subnational committees set up to translate information into policy and response options, consulting firms, non-governmental organizations (NGOs) and international organizations, including WHO, acted as knowledge brokers to support national responses. Depending on their role, they developed, received, and translated outputs from advanced analytics into actionable recommendations and facilitated information sharing between evidence producers and consumers.

Collaboration and the integration of different perspectives on the development and use of outputs from advanced analytics were realized through networks of various scales and scopes. Consortia that convened modelling groups are an example of formal network structures that were useful to synthesize scientific outputs for policy decision making.

Other networks were established more organically or in an ad hoc way during the pandemic. Additionally, informal networks that included local clinicians and healthcare workers facilitated the integration of local contextual knowledge into the development and use of advanced analytic outputs. Similarly, such informal networks among scientists enabled the discussion and verification of approaches, assumptions, and findings. At the global level, the informal mathematical modelling network convened by WHO from mid-January 2020 played an incredibly valuable role through early information sharing, adding credibility to modellers' advice to decision makers in their own countries.

Analytics that were communicated between actors varied in complexity, ranging from data (e.g., epidemiological metrics and data) over descriptive statistics to advanced analytics (e.g., nowcasts, forecasts, severity estimates). Workshop participants recalled various policy questions for which advanced analytics were sought (e.g., 'Should we restrict movement to reduce impact?', 'Will the healthcare system be overwhelmed?').

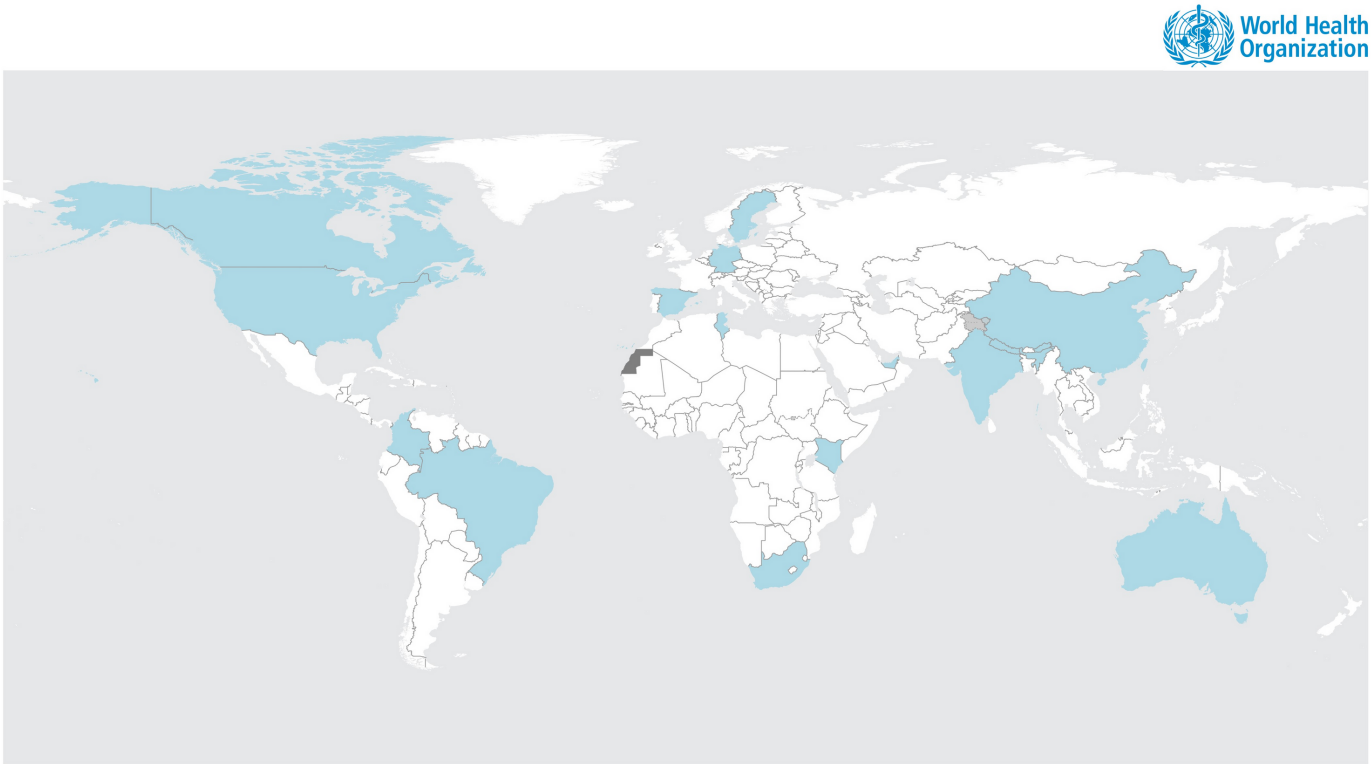

Figure 1. Workshop participants
The designations employed and the presentation of the material in this publication do not imply the expressions of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: WHO Health Emergencies Programme

Session 2

Inhibiting and enabling factors occurring across the data-to-decisions pathways

Task: Participants were asked to discuss and explain the inhibitors and enablers they experienced across data-to-decisions pathways.

Enablers and inhibitors are summarized across six themes: governance, sustainability, trust, network, data, and communications.

GOVERNANCE

Inhibitors

- Pandemic plans to control data governance and sharing to public that were based on previous events, e.g., H1N1 pandemic in 2009, failed.
- Lack of time to digest all information, specifically, data.
- Delay of mathematical modellers receiving data; thus, parameter ranges were informed by outdated data.
- Backlog on death data in many countries.
- Lack of code verification, which data was used, and the appropriateness of methods.
- Long time frame for reporting advanced analysis results in some countries.

Enablers

- Open-source:
  - Access to parameter databases.
  - GitHub repositories.
  - Literature reviews.
- Time to access data improved during the pandemic.

SUSTAINABILITY

Inhibitors

- Lack of funding for producing advanced analytics led to shortages in mathematical modelling human resources, and consequently to lack of time to analyse data.
- Reactive emergency funding was not sufficient to develop the underpinning capacity needed to respond to a crisis.

Enablers

- Sufficient and independent funding; reallocation of time from other grants as well as additional funding.

TRUST

Inhibitors

Lack of independent communication

- Lack of independence to communicate outputs from advanced analytics to the public openly; experts were not given a platform to communicate to the public; centralised, controlled communication resulted in loss of academic freedom and perceived credibility.
- Science produced to support a pre-existing argument.
- Polarisation on (advanced) analytics.

Enablers

Transparency

- Honest and transparent data-driven public communication, which led to trust and less resistance to interventions.
- Transparent modelling/science communication (e.g., GitHub).
- Society's demand for data and general data savviness indirectly enforced more transparent public health responses.

NETWORK

Inhibitors

Mathematical modellers

- Limited funding for and capacity to do the modelling in some countries.
- Exhaustion, burnout.
- Many modelling outputs led to conflicting results of different models and difficulties in choosing or merging results.
- Task shifting not embedded in organizational cultures.
- Misalignment of impact-oriented research with academic key performance indicators.
- Resource-intensity and timeline to train new capacities.

Decision makers

- Limited technical understanding of modelling outputs and appropriate uses of outputs from advanced analytics (including understanding when it is not useful or necessary).
- Lack of feedback loop from decision makers to modelling groups.

Technological

- Surveillance system was not set for fast and timely analysis.
- Systems were not developed for the amount of data collected during the pandemic.

Capacity surge and sustainability

- Outsourcing the production of advanced analytics and recruiting surge capacity was expensive in the absence of existing relationships.
- Bias towards mathematical modelling groups that had the technical knowledge and capacity to write papers for publication.

Enablers

Institutional

- Willingness to invest in fast learning.
- Quick promotion of more junior staff/analysts/modellers meant fresh perspectives.

Population

- Societal enlightenment about epidemiology, e.g., outputs from advanced analytics, epidemiological data, R(t), etc.
- Networks and consortia at national and international level (formal and informal, soft), embedded in existing networks enabled discussions, verification, knowledge sharing As it was not an academic exercise, arguments about authorship, leadership, funding, and money were deprioritized.
- Direct communication with policymakers at regular task force meetings leading to decreased risk of misusing or misinterpreting outputs from advanced analytics.
- New ways to regulate access to data.
- Willingness to invest in fast learning.
- Quick promotion of more junior staff/analysts/modellers meant fresh perspectives.

Photo: Anne Cori, Catherine Elliott, Maria Amélia de Sousa Mascena Veras and Toomas Timpka in a group discussion

DATA

Inhibitors

Surveillance

- Quality of data (completeness, timeliness) Lack of longitudinal data to understand disease progression.
- Unavailability and lack of representativeness and quality.
- Changing surveillance and reporting systems.
- Lack of integration of modellers' perspective in surveillance systems.
- Difficulty in integrating new sources.

Architecture

- Data architecture (difficulty of data linkage).
- Documentation of inconsistency of data over time.
- Data governance, i.e., unauthorized or uncontrolled use of data.
- Restricted access to protect patient or healthcare providers.
- Individual agreements prohibited data sharing.

Supplementary

- Insufficient data on healthcare resources.
- Uncertainty about denominators.
- Incomplete qualitative understanding of how populations interacted.
- Limited incorporation of social and behavioural sciences into advanced analyses.

Enablers

Access

- Suspension or easing of some regulations by the information regulator and enacting of emergency regulatory provisions enabled rapid and seamless data transfer between collaborators (while overuse can undermine public trust).
- Prior infrastructure and pandemic preparedness plans.
- Investment in surveillance system and short seroprevalence studies.
- Open-source data culture.

Innovation

- Integration of new data.

Photos: Workshop participants in Berlin, Germany

COMMUNICATION

Inhibitors

General

- Absence of knowledge brokers who could clearly articulate evidence needs over time, the appropriate scope of advanced analyses, and facilitation of the dialogue between decision makers and evidence producers.
- Time for mathematical modellers to understand decision makers and vice versa.
- Lack of science behind advanced analytics communicated to evidence receivers, i.e., defining recommendations with evidence.

Decision makers

- Unrealistic expectations of advanced analytics capacities.
- Lack of critical thinking and scepticism towards analytics and uncertainties.
- Bias towards communication with no uncertainty.
- Confusion over conflicting/diverging modelling results and recommendations.
- Volume and scope of advanced analyses required to determine optimal time to implement interventions with minimal impact on the economy and population health.
- People became 'data addicted', which came at the opportunity cost of modellers performing less valuable analyses.

Mathematical modellers

- Limited integration of micro- and macroeconomic perspectives with dynamic models.

Others

- Non-experts had a platform and voice.
- Advanced analytics that are not scientifically rigorous and peer-reviewed, and that should not inform policy.
- Absence of press conferences where media/public could ask questions.
- Journalists and media also translated science in their own interest.
  Misinformation in society and polarized echo chambers in social media.
- Doctors were challenged to communicate the benefit of interventions to patients from an individual perspective rather than from a population-wide perspective.

Enablers

- Existing relationships and skills (supply and demand side) developed through preparedness/endemic work allowed for rapid realization of collaborations between mathematical modellers and decision makers.
- Journalists produced great visualizations for media, which helped communicate to the public.
- Actors learned how to translate science and adapt the language used for different audiences.

Photos: Gesine Meyer-Rath and Amy Fairchild presenting

Session 3

Exploration of solution ideas in response to inhibitors

Task: Participants were invited to conceptualize solution ideas in response to inhibitors that were identified in the previous session.

The solutions presented in the following subsections are interrelated and complement each other. They present opportunities for pandemic and epidemic preparedness efforts. These are not recommendations or endorsements; the following is a collection of brainstormed solution ideas.

GOVERNANCE

Participants identified the need for a dynamic, transparent, equitable, and accountable system. The establishment of national and global guidelines was proposed. Broadly, the guidelines are envisioned to provide:

Guidance

- Develop and share best-practice frameworks and guidance with Member States, academic institutes and other organizations producing products for advanced analytics reporting during public health emergencies that supports the decision-making process, including methods, data management, documentation of methodology to produce outputs with advanced analytics (e.g., via public hosting services such as GitHub), and the use and reporting of decisions within a set timeframe.
- Define the roles and responsibilities of actors such as data providers, analytical teams, modelers, the scientific community, science communicators, and decision makers, and develop recommendations for minimum advanced analytic capacities at the country level.
- Develop guidance or best practices for reporting outputs from advanced analytics to better support the formulation of policy and decision options for decision makers.

Accountability and transparency

- Distribute responsibility and accountability between evidence producers, evidence translators, and evidence consumers.
- Analyse differences in constitutional preconditions of legal mechanisms and conduct a closer analysis of their effectiveness and impact on the pandemic.
- Make it mandatory to communicate limitations and uncertainties of results to different audiences.
- Establish a feedback loop among actors in the data-to-decisions process to build trust.
- Outline the independence of the production of outputs from advanced analytics, clarifying the rights, ethics, and responsibilities of actors and the role of outputs from advanced analytics during a public health emergency of international concern. Participants identified the challenges evidence producers faced during the pandemic to independently share and communicate outputs from advanced analytics and note the benefit of clarifying the role of actors and outputs from advanced analytics. Such clarifications could protect evidence producers, intermediaries and decision makers when faced with diverging and colliding viewpoints, politicization of topics and retrospective evaluation of response. This could influence how evidence consumers perceive and act on outputs from advanced analytics. Defining responsibilities may also influence the types of analyses produced, the timing of analysis and the access to results and methodologies with a balance of transparency also in the formulation of decisions.

SUSTAINABILITY OF PATHWAYS

The COVID-19 pandemic saw an injection of resources for establishing processes and repurposing capacities for the use of outputs from advanced analytics to inform decision making. It also highlighted gaps in processes and structures for rapid information sharing and coordination. Participants suggest that the sustainability of advanced analytics to decision-making pathways could be achieved through a more interconnected global network of networks, revised incentives, building capacity, and securing resources.

Interconnected network

- Participants envision a future interconnectedness between county networks, regional networks, and global networks, using a communities-of-practice approach. Modelling units/groups would support ministries of health or public health agencies to build internal country capacity during and outside of public health emergencies. Country modellers would be connected with regional hubs that support collaboration and communication.

Incentives

- Individuals, groups, and organizations involved in advanced analytics to inform decision making during public health emergencies are missing the incentive that would recognize their work.
- Traditional academic incentives, in part driven by funder priorities, are not conducive to working with a collaborative approach. There is a need to revise the incentives for network participation, sharing data, outputs, methods, models, building capacities, and supporting other jurisdictions, as well as inputting into and collaborating in a global network.
- Through participation in the network, members would benefit from having access to data and publications and working closely with decision makers to contribute to improved health outcomes.
- Central coordination via regional hubs and working with modelling groups or individual modellers in each country within a region, which provide access to resources and analytics, may result in the sustainability of pathways.
- Building capacities locally to perform analyses, communicate and interpret findings, and contextualize them.

Capacity

- Growing and sustaining workforce and expertise during the preparedness phase, including through contributions to endemic infectious disease control policy.
- Supporting local champions to identify where and how capacities should be strengthened.
- Embedding short courses and workshops on advanced analytics for epidemic and pandemic preparedness and response, as well as visualization and communication of results for policy and response decision making.
- Developing secondment and internship programs in government departments to build and sustain relationships with modelers and to sensitize decision makers to the advanced analytics process and benefits, especially during non-pandemic times.

Resources

- Investment is required to sustain pathways, including the allocation of domestic resources or the identification of funding sources for the initiation and maintenance of these efforts (e.g., pooled, coordinated mechanisms).
- Domestic investment is crucial to build on and strengthen the gains made during COVID-19.
- Tapping into global resource mechanisms, such as a pandemic fund, would help sustain the pathways from data to decisions and build in-country capacity.
- Working with global funders to prioritize funding initiatives focused on strengthening the processes and structures in place for advanced analytics to inform decision making and sustain capacity and infrastructure.

TRUST

Trust was discussed in relation to strengthening transparency, accountability, connection, community, and networks. Participants identified several relationships that require consistent solutions over time to build trust. These relationships include: 1) within the scientific community, 2) between the scientific community and decision makers, 3) between the scientific community and the public, and 4) between decision makers and the public.

The discussion on trust primarily focused on communication between different actors. Evidence producers need to be responsive to the government, listen to evidence consumers, and be aware of each other's perspectives. According to workshop participants, trust can be achieved through:

Between the scientific community and decision makers

- Define roles and responsibilities between actors in the advanced analytics to decision making process.
- Establish protocols for data sharing, communication, and feedback loops in the data-to-decisions process.
- Establish protocols for key data collection during epidemics and pandemics (i.e., serosurveys, cohorts) that can provide for key input parameters for modelling around the world.
- Differentiate between two channels: evidence reporting during an emergency and evidence translated for policy and response decision making.
- Seek feedback on the usefulness of knowledge products and advocate for transparency in decision making processes.
- Establish a transparent process for funding research during emergencies.
- Communicate uncertainties around analytics clearly and transparently to manage. expectations and highlight appropriate usage and caution.
- Educate evidence consumers about uncertainties and the dynamic nature of pandemics and epidemics, where new outputs from analytics can undermine or change decisions over time.
- Engage with decision makers to understand policy-relevant outcome measures to model politically relevant signals in data.

Within the scientific community

- Create a community of practice that shares work, ideas, results, and methods, fostering cross-collaboration and exchanging lessons learned.
- Adopt a regional hub approach to the concept of communities of practice.
- Build country capacity for generating outputs with advanced analytics.
- Encourage complementary collaborations and discourage excessive competition, as academic indicators of success may contradict the collaborative mindset necessary for sharing and building together.
- Maintain a culture of reporting and preprints, moving towards open access to promote equity. Create incentives that reward early sharing.

Between the scientific community and the public

- Engage with the public.
- Train and empower journalists in scientific briefings to provide feedback on the information they need.
- Centralize collated resources for accessibility.
- Tailor messaging to cultural contexts and be aware of contradictions.
- Identify sustainable and considerate messaging approaches.

Between decision makers and the public

- Increase social listening and amplify voices.
- Conduct stakeholder engagement to gather perspectives.
- Adopt a proactive approach to addressing infodemics.
- Evaluate where models add value to communication efforts.
- Survey decision makers to gather feedback.
- Educate evidence consumers about uncertainties and the dynamic nature of pandemics and epidemics.

NETWORK

A lack of communication pathways and pre-established connections between modelling groups/ modelers and decision makers was perceived as a key inhibitor. Where governments or those organizations acting as knowledge translators had pre-established consortia and pathways for use of outputs from advanced analytics to inform response and policy decision making, they were equipped to scale rapidly to coordinate and access information to inform decisions. Across all the themes, participants repeated the need for a coordinated network, a global network of networks bringing together modelers and various actors, such as ministries of health, public health agencies, academia, particularly, smaller institutions, and the private sector. Such a network could provide leadership and coordination for advanced analytics for endemic and pandemic preparedness and response in the context of public health emergencies. The following suggestions were made:

Structure and coordination

- Establishing a network of networks: a supportive, globally representative secretariat to facilitate relationship-building and parallel collaboration between modelling groups across regions and globally.
- A network could support global and regional coordination for capacity building, generating actionable knowledge, exerting influence through a unified voice, and achieving measurable impacts on policy and practice.

Capacity building

- Enhancing data collectors' understanding of how data is analysed by updating core competencies of field epidemiology programmes with more advanced analytical components/modules to improve the quality of data that feed into modelling.
- Providing mentoring, PhD supervision, and capacity development.
- Engaging knowledge translators, also referred to as "sticky networkers", to develop an understanding of the knowledge translator role and build capacity of network members to assume this effective knowledge broker role to connect networks and translate science.

Value

- Providing value to network members through activities, such as sense-checking, discussions, validation, skills and knowledge resources, and a platform to meet actors with complementary skills.
- Generating actionable knowledge together.

Governance

- Developing strong governance structure at a global level to coordinate and support regional networks.
- Need for resources, investment, and financing to allow a strong and cohesive network to form.

Photo: Presentation on discussion group outputs

DATA

Identified inhibitors at the point of data collection to analysis include the type of data collected (or not collected/available), data quality, the ability to link data, data volume, and governance. Participants proposed the following solution ideas that encompass systems, tools, norms and standards, communication, and incentives to improve data collection, analysis, and sharing for advanced analysis during emergencies:

Tools, norms and standards

- Develop guidelines to enhance interoperability between different systems, ensuring seamless data exchange and integration.
- Create a comprehensive catalogue of data required at various stages of the life cycle of public health events for advanced analytics, based on decision-making needs and questions.
- Establish minimum data sets for advanced analytics queries, outlining the essential data elements necessary for effective analysis.
- Compile a comprehensive catalogue of data types and databases collected throughout an epidemic or pandemic, facilitating easy access and use of relevant data.
- Follow best practices for data protection by implementing anonymization and appropriate aggregation techniques to safeguard sensitive information.
- Establish standard protocols that provide clarity and guidance on the minimum scope of data, representativeness of locations, data types for follow-up, appropriate frequency of data collection, and key evidence that should be developed in real-time.

Communication and incentives

- Empower and provide incentives to local healthcare workers to improve data quality.
- Establish continuous communication and feedback mechanisms to harmonize data.

Systems

- Implement digitized surveillance systems that enable data to be linked, integrated, and easily accessible. These systems should be ethically defensible and provide outputs that can be shared with communities, authorities, and international agencies.
- Architect databases in a way that structures data for easy linkage and interoperability with other data sources.
- Plan for scalable and flexible systems that can accommodate different disease epidemics/pandemics and handle increasing data volumes.
- Create an accessible and ethically defensible system that ensures controlled access while promoting the sharing of results from local communities to international agencies. This can be achieved through a secure and efficient platform.
- Consider the need for a fully digitized data architecture that incorporates various data streams, including seamless linkage with data from other diseases, to enable real-time capabilities.

Photo: Joseph Wu presenting

COMMUNICATION

In the data-to-decisions process, various actors, audiences, communication channels, and modes of communication were identified, and they varied greatly across different countries during the COVID-19 pandemic. Actors and audiences had different expectations regarding how they receive, use, and act on information. Solutions, results, and recommendations were based on the best available evidence within limited timeframes and communicating uncertainty and limitations to non-scientific audiences was discussed as an inhibitor, including the challenges of transparency, accountability, and tackling misinformation.

Sharing best practices

- Map the actors involved in the data-to-decisions process and develop case studies that highlight different types of communication channels and modes used.
- Create case studies as learning opportunities from other countries that showcase how outputs from advanced analytics, including mathematical models, have informed decisions and addressed the questions of decision makers during the COVID-19 pandemic.
- Identify examples of success and share best practices and lessons learned in communicating data to inform decisions at different levels.

Capacity building

- Enhance communication capacity among the scientific community to effectively adapt scientific information for different audiences.
- Establish science communication programs, such as at the Master's level or through short courses, to train scientists on effective communication strategies.
- Develop a communications protocol for scientists or knowledge brokers who engage with journalists and use social media to communicate science during public health emergencies.

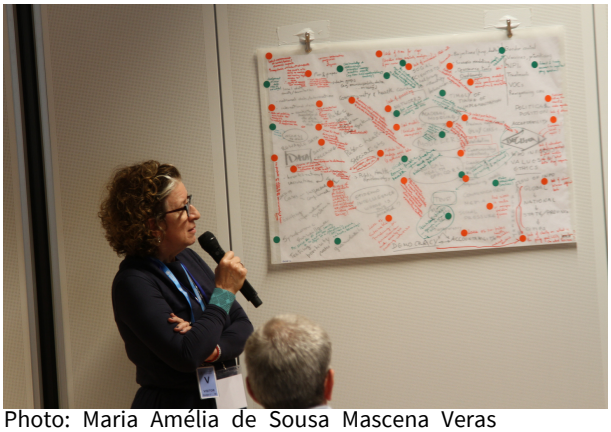

Photo: Maria Amélia de Sousa Mascena Veras presenting

Photo: Amy Fairchild and Gesine Meyer-Rath in group discussions

Session 4

Identification of potential opportunities for support and actions to strengthen the use of outputs from advanced analytics for decision making

Task: Participants were asked to indicate where opportunities for support exist, what actions could be taken now to strengthen the use of advanced analytics outputs for decision making and how global partners and the WHO could be useful.

These opportunities could be actions to strengthen processes and structures, improve workflows, find consensus on ways of working together, establish a knowledge foundation for support, and jointly drive evidence-based decision-making priorities for epidemic and pandemic preparedness. WHO could be a possible convener or supporter of such efforts. Building on their ideas for potential solutions, workshop participants suggested the following next steps:

1

Evaluation of the impact of outputs from advanced analytics on decision making during public health emergencies

Evaluation through a retrospective research study of the use and impact of outputs from advanced analytics to inform decision making during the COVID-19 pandemic.

2

Development of country case studies on the processes and structures in place to use outputs from advanced analytics for decision making during public health emergencies

Evaluation of systems and processes in place for the use of outputs from advanced analytics to inform response and policy decision making from country perspectives. They could be a resource of best practices and lessons learned.

3

Engagement of political decision makers

Engagement to enhance the understanding of decision making processes, influences, and how to better translate and communicate outputs from advanced analytics to inform response and policy decisions.

4

Development of a country-level assessment tool

Refinement of the workshop methods into practical tools to support Member States in assessing outputs from advanced analytics to decision-making processes. It could also identify opportunities and incorporate the experience and views of those disciplines not included in this workshop at a country level that would strengthen and optimize evidence-based decision making for public health emergencies.

5

Global mapping exercise of modelling capacities

Mapping of existing advanced analytics capacities at national and regional levels. Coordinated approach with the WHO Hub for Pandemic and Epidemic Intelligence, WHO regional offices and regional modelling networks, Member States and WHO country office.

6

Establish a network of networks

For example, a network including this meeting's participants, focusing on advanced analytics informing response and policy decision making or already established networks and regional initiatives to bring members from different geographical, cultural, and contextual backgrounds together. Aims of these networks could be to prioritize, guide, and take action on key areas of work, either areas identified during the workshop or new areas.

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7

Development of agreements and key documents to support the use of outputs from advanced analytics to inform decision making

The following agreements and guidelines may enable pre-positioning on agreed processes and structures, optimising the data-to-decisions process, defining roles, and scaling up during emergencies:

- Protocols to establish data and analysis sharing agreements
- A code of professional ethics
- Guidelines on how to collaborate in data-to-decision making processes

8

Curation of a series of publications

Publicationsin high-impact journals, e.g., a Lancet commission, with a series of documents on issues discussed, summaries of best practices, and reflections on successes and lessons learned.

Conclusion

Discussions among a subset of key evidence producers and decision makers who were engaged in the COVID-19 pandemic led to the identification of key solution ideas and opportunities to understand and optimize the development and use of advanced analytics outputs for public health emergencies decision making. Workshop participants highlighted further need to capture additional perspectives held by actors from diverse geographical areas, contexts, and roles who were not present at the workshop, e.g., country-based epidemiologists, surveillance officers, data-to-policy translators, and political decision makers to enrich the understanding of the different priorities for advanced analytics for decision making in different regional and local contexts. The workshop highlighted the benefit in bringing together experts from around the globe to share experience and lessons learned to identify priority activities to tackling challenges and improve the way advanced analysis is perceived and used for policy and response decision making. Overall, this workshop has contributed to a longstanding global dialogue on processes and systems to facilitate knowledge translation from data to decisions. Workshop participants collectively identified the need to develop a global network of advanced analytics experts, with regional hub coordination to ensure inclusion and capacity building at local level. A network of modelers would be an interconnected community that would contribute to pandemic and epidemic rapid response while collectively improve how data are analyzed, actionable insights shared to inform decisions during public health emergencies and how models are evaluated and improved jointly.

Annex 1: Organizers

Name	Organization	Country
Anne Cori	Imperial College London	United Kingdom
Dina Saulo	WHO Hub for Pandemic and Epidemic Intelligence	Germany
John Fass	WHO Hub for Pandemic and Epidemic Intelligence	Germany
Julia Fitzner	WHO Hub for Pandemic and Epidemic Intelligence	Germany
Patricia Ndumbi	WHO Hub for Pandemic and Epidemic Intelligence	Geneva
Paula Christen	Imperial College London	United Kingdom
Rebecca Lais	WHO Hub for Pandemic and Epidemic Intelligence	Germany
Sabine van Elsland	Imperial College London	United Kingdom

Annex 2: Participant list

Name	Organization	Country
Alexander Ullrich	Robert Koch Institute	Germany
Amy Fairchild	Government Office for Science	United Kingdom
Anders Tegnell	Swedish Public Health Agency	Sweden
Anne Cori	Imperial College London	United Kingdom
Calvin Chiew	Ministry of Health, Singapore	Singapore
Catherine Elliott	Canadian Public Health Agency	Canada
Chathura Edirisuriya	WHO Country Office, Nepal	Nepal
Fernando Simon	Ministry of Health, Spain	Spain
Gesine Meyer-Rath	South African Modelling Consortium	South Africa
Harry Moultrie	National Institute for Communicable Diseases, South Africa	South Africa
Jodie McVernon	The Peter Doherty Institute for Infection and Immunity	Australia
Johanna Hanefeld	Robert Koch Institute	Germany
Joseph Wu	The University of Hong Kong	Hong Kong, China
Julia Fitzner	WHO Hub for Pandemic and Epidemic Intelligence	Germany
Julio Croda	Oswaldo Cruz Foundation and Federal University of Mato Grosso do Sul	Brazil
Kathy Leung	The University of Hong Kong	Hong Kong, China
Maria Amélia de Sousa Veras	FCMSCSP and Observatório COVID-19 BR	Brazil
Moritz Kraemer	Oxford University	United Kingdom
Neil Ferguson	Imperial College London	United Kingdom
Oliver Morgan	WHO Hub for Pandemic and Epidemic Intelligence	Germany
Prabasaj Paul	US CDC	United States of America
Sheetal Silal	Modelling and Simulation Hub, Africa (MASHA), University of Cape Town	South Africa
Silvano Barbosa	WHO Country Office, Brazil	Brazil
Slimane Ben Miled	Pasteur Institute of Tunis	Tunisia
Teresia Njoki Kimani	Centre for Epidemiological Modelling and Analysis, University of Nairobi	Kenya
Toomas Timpka	Region Östergötland and Linköping University	Sweden
Yuka Jinnai	WHO Regional Office for the South-East Asia	India
Zulma Cucunubá	Pontificia Universidad Javeriana	Colombia

Annex 3: Agenda

DAY 1		
Arrivals	Registration Coffee / tea / breakfast	8.30-9.00
Welcome	Housekeeping Purpose of the workshop	9.00-9.10
Introductions	Welcome Oliver Morgan - WHO Hub for Pandemic & Epidemic Intelligence Neil Ferguson - Imperial College London Introduction of John Fass (facilitator) Participant introductions	9.10-9.30
Session 1	Task 1: Introduction Presentation 1	9.30-10.00
	Task 1: Representation of data to decision process	10.00-10.30
	BREAK	10.30-10.50
	Task 1: Continued representation of data to decision process	10.50-11.30
	Task 2: Group sharing and discussion of data to decision process	11.30-12.30
	LUNCH	12.30-13.30
Session 2	Task 3: Introduction Presentation 2	13.30-14.00
	Task 3: Identifying inhibiting and enabling factors across the data to decision process	14.00-15.00
	BREAK	15.00-15.20
	Task 4: Group sharing and discussion of identified inhibiting and enabling factors	15.20-16.00
Wrap up	Outcomes of day Reflections on workshop activity Wrap up	16.00-16.30
	WORKSHOP DINNER Rutz Zollhaus Chausseestrasse 8 10115 Berlin	18.30

DAY 2		
Arrival	Coffee / tea / breakfast	8.30-9.00
Recap	Recap of Day 1 Running order & purpose of the workshop day Task 5: Introduction	9.00-9.30
Session 3	Task 5: Ways to get around or remove defined inhibiting factors	9.30-10.30
	BREAK	10.30-11.00
	Task 6: Group sharing and discussion of ways to get around or remove defined barriers	11.00-12.30
	LUNCH	12.30-13.30
Session 4	Task 7: Introduction Task 7: Identifying opportunities for support	13.30-14.30
	BREAK	14.30-15.00
	Task 8: Discussing the global dimension & next steps	15.00-16.00
Wrap up	Workshop Feedback Closing Neil Ferguson - Imperial College London Chikwe Ihekweazu - WHO Hub for Pandemic and Epidemic Intelligence	16.00-16.30

END OF WORKSHOP

World Health Organization | HUB
Pandemic and Epidemic Intelligence

UKRI MRC Centre for Global Infectious Disease Analysis

Imperial College London