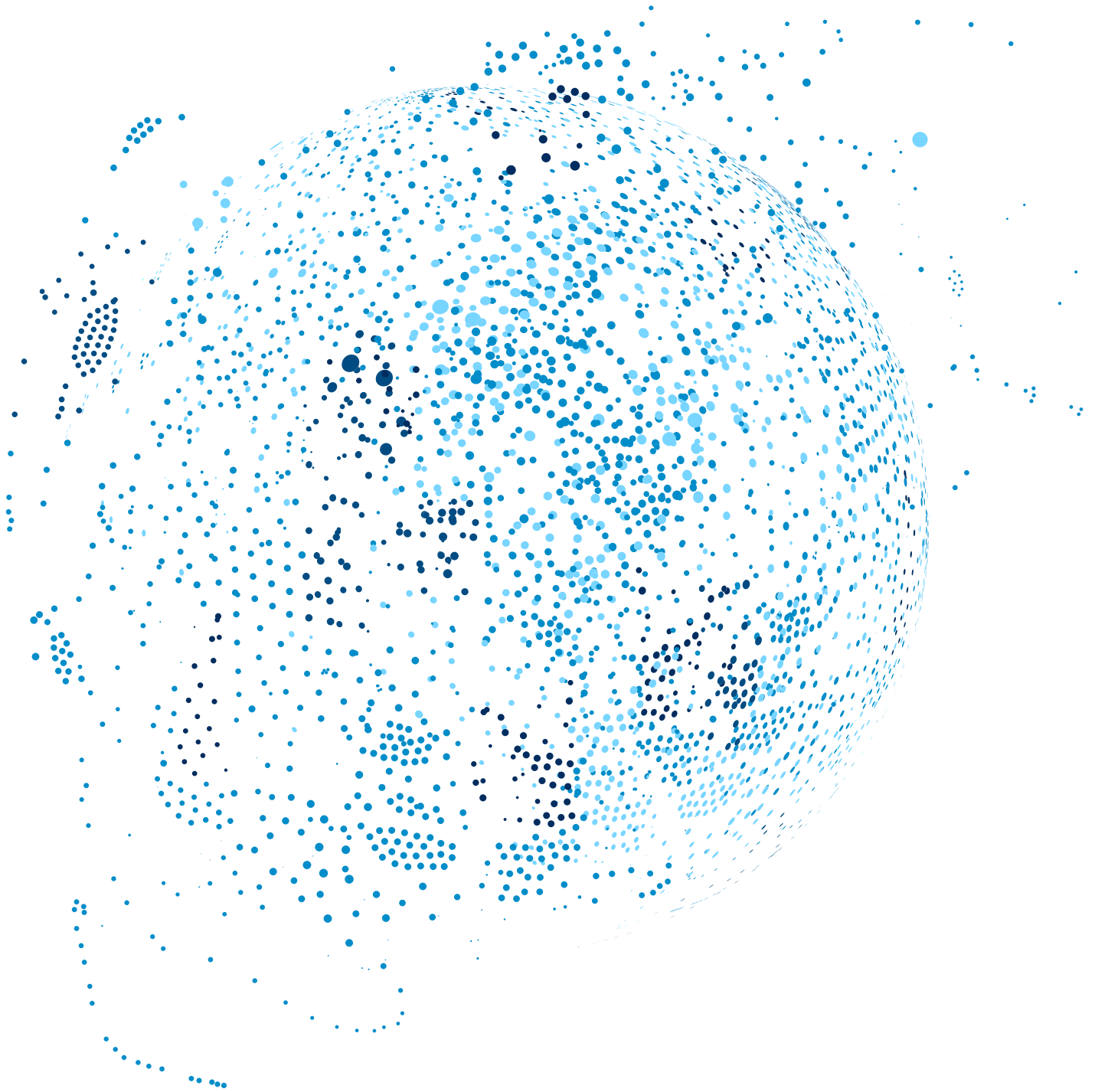


# WHO HUB FOR PANDEMIC AND EPIDEMIC INTELLIGENCE

Better Data. Better Analytics. Better Decisions



World Health Organization  
Health Emergencies Programme



World Health Organization | **HUB**  
Pandemic and Epidemic  
Intelligence

# A NEW UNDERSTANDING OF PANDEMIC AND EPIDEMIC RISKS

The coronavirus disease (COVID-19) pandemic has changed the way we see the world. It has highlighted how interconnected and interdependent our lives are across countries and communities. Our shared global experience of the pandemic has helped us develop a deeper understanding of public health: one that includes all of us through our governments, our businesses and our societies, in all communities around the world.

This shared understanding enables us to build a new way to protect our communities from pandemic and epidemic risks. We can use information from diverse sources to create a more holistic approach to understanding public health risks, in real time. However, we must also learn to work in a new way; a way that recognizes that only through collaboration and trust can we truly understand risks everywhere, wherever and whenever they occur.

The systems that we currently have to identify and understand risks of pandemic and epidemic potential have evolved rapidly over the past decade. WHO already conducts global surveillance for public health risks in every country of the world, every single day of the year. About 4500 signals of public health risks are identified every month. There are also national and regional public health organizations that conduct surveillance within their own jurisdictions. However, there are limitations.

Existing disease surveillance systems are mostly limited to health data. Those data are increasingly fragmented, making it difficult to connect them using existing systems and approaches. Surveillance data provide limited insight into the context from which the data are derived, which limits our understanding and ability to take effective action. Stakeholders have varying capacities to analyse such data, which may be a further barrier for their use by policy- and decision-makers. Data and insights from data are frequently not shared.

We need a new approach (see Box). An approach that harnesses the opportunity of a new technological reality to share data for the common good, that enables a broader engagement across professional disciplines and with other stakeholders; it must build trust and support a new political understanding and commitment to work together to manage pandemic and epidemic risks. We need the capability to analyse and interpret data so that they become useful information, and we need to understand the context of that information to turn it into the intelligence that policy- and decision-makers need for action. Moreover, we must do this equitably, bringing these capabilities to all countries and communities of the world in a collaborative way so that we all benefit. The WHO Hub for Pandemic and Epidemic Intelligence (the WHO Hub) will be the catalyst for creating this new approach.



## Conclusions from recent reviews of the COVID-19 pandemic

...we need more meaningful cooperation during and in-between health emergencies; more transparency, more regular detailed exchange of real-time data and experiences at all levels, more reliability of interaction...

**Review Committee on the Functioning of the International Health Regulations (2005) during the COVID-19 Response, Executive Board, January 2021**

...surveillance and alert systems at national, regional and global levels must be redesigned... to function at near-instantaneous speed. This will require the consistent application of digital tools, including the incorporation of machine learning, together with fast-paced verification and audit functions. It will also require a commitment to open data principles as the foundation of a system that can adapt and correct itself.

**COVID-19: make it the last pandemic, Report of the Independent Panel for Pandemic Preparedness and Response, May 2021**

Globally networked surveillance and research: to prevent and detect emerging infectious diseases... We must urgently build a global genomic and epidemiological surveillance program, combining pre-existing and new nodes of expertise at the global, regional, and country levels, with the WHO at the center.

**A global deal for our pandemic age, Report of the G20 High Level Independent Panel on Financing the Global Commons for Pandemic Preparedness and Response, June 2021**

# FROM SURVEILLANCE TO PANDEMIC AND EPIDEMIC INTELLIGENCE

Pandemic and epidemic intelligence is a core function of public health to generate actionable insights for decision-making to protect and improve the health of populations. It involves continuously identifying, generating, connecting, synthesizing, analysing, assessing and interpreting a wide range of public health data along with relevant contextual information, such as geography, social factors, environment, animal health and population health, both current and historical. Current tools for pandemic and epidemic intelligence, such as the Epidemic Intelligence from Open Sources (EIOS) Initiative<sup>1</sup> gather information from a diverse range of open (publicly available) sources and use machine learning to aid analysts to interpret the information.

Traditional disease surveillance collects data about patients, cases or laboratory diagnosis of specific diseases and compares trends over time to identify increases or decreases in disease incidence. When information about disease incidence is combined with information about the context from which the information was sourced, we move to pandemic and epidemic intelligence, gaining a more complete understanding of risk, and creating an opportunity for better, more informed policies and decisions.

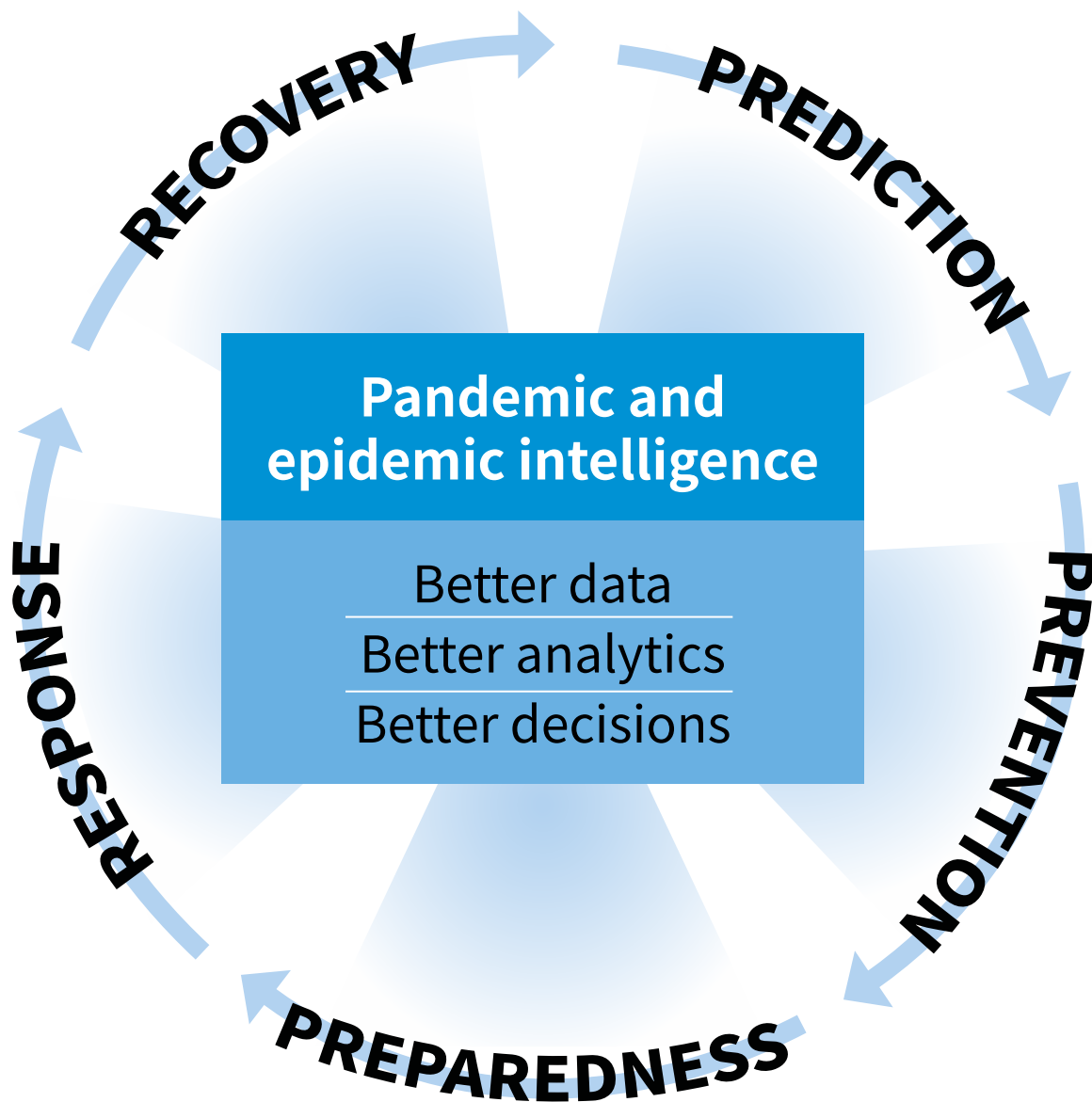


The focus of the WHO Hub is to strengthen pandemic and epidemic intelligence through better data, better analytics and better decisions across all aspects of managing public health emergencies (Fig. 1).

Strengthening of pandemic and epidemic intelligence is underpinned by many other global efforts such as those to establish an international treaty for pandemic preparedness and response,<sup>2</sup> the High-Level Panel on Digital Cooperation convened by the United

Nations Secretary-General,<sup>3</sup> the joint *The Lancet and Financial Times* Commission “Governing health futures 2030: growing up in a digital world” (report due to be published towards the end of 2021), WHO’s global strategy on digital health<sup>4</sup> and many other initiatives advancing health data governance,<sup>5</sup> the championing of open science,<sup>6</sup> and advocacy for the FAIR principles (Findability, Accessibility, Interoperability and Reusability)<sup>7</sup> for scientific data stewardship. As all work of WHO, it is based on the values of human rights and equity.

Figure 1. Pandemic and Epidemic Intelligence for Managing Health Emergencies



# COLLABORATIVE INTELLIGENCE FOR PANDEMICS AND EPIDEMICS

Collaborative intelligence is a term that captures the essence of WHO's new approach. To improve the assessment and management of public health risks, collaborative intelligence is needed across four areas (Fig. 2):

- first, the synthesis of many different types of contextual information about the circumstances in which pandemics and epidemics occur;
- secondly, interaction across many stakeholders in political, public policy, scientific and civil society organizations, who are required to use pandemic and epidemic intelligence outputs to manage and respond when there are public health emergencies;
- thirdly, a global trust architecture for pandemic and epidemic intelligence that promotes greater sharing of data, information and insights between communities and countries for the public good; and
- fourthly, knowledge sharing through distributed adaptive information networks that facilitate effective hybrid human-artificial decision-making.

Multidisciplinary collaboration for pandemic and epidemic intelligence requires a much more active engagement across many professional disciplines and sectors. Pandemic and epidemic intelligence teams need multidisciplinary approaches to understand many factors, a few of which are outlined here: environmental factors such as rainfall or vegetation coverage; social factors such as health-seeking behaviour, health and risk literacy, cultural beliefs about disease causation and prevention; economic factors such as travel patterns and trade routes; and human and animal interactions in agriculture and nature, as well as consumption, production and sale of wildlife.

Decision-makers who use pandemic and epidemic intelligence outputs span multiple stakeholders in political, public policy, civil society, and science organizations who impact

the way we make decisions as individuals and societies to manage public health risks. Creating a collaborative intelligence component to decision-making includes: approaches for using both qualitative and quantitative information; developing multidisciplinary and multistakeholder platforms to explore issues relevant to public policy decision-making for public health; developing greater public health literacy among policy-makers to make optimal use of pandemic and epidemic intelligence outputs for decision-making; establishing global communities of practice for policy-makers outside of public health but who are called on to make public health decisions during times of crisis; and engaging with citizen science and community decision-makers.



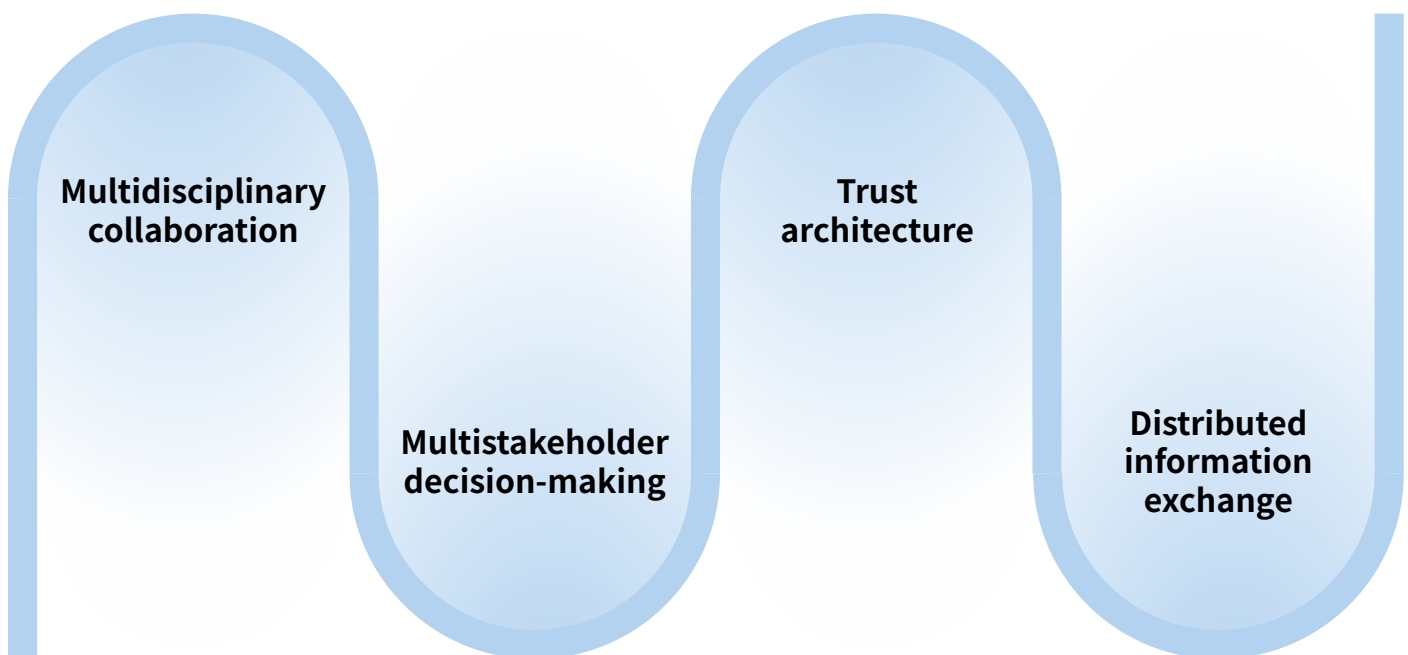
Recognizing the importance of including a larger number of stakeholders for pandemic and epidemic intelligence, a strengthened global trust architecture is needed to promote greater sharing and collaboration. Given the growing interconnectedness between all of us, the benefits of effective pandemic and epidemic intelligence can only be achieved by sharing of information between all countries, sectors, disciplines and communities around the world. A collaborative intelligence trust architecture will

enable insights that combine both open (publicly available) and closed (not publicly available) data from both private and public sources. Developing a trust architecture for pandemic and epidemic intelligence is a considerable undertaking that touches on many aspects: governance, legal frameworks and data-sharing agreements; data solidarity, fairness and benefits sharing; transparency about how pandemic and epidemic intelligence outputs are used; openness of technology solutions and artificial intelligence applications; security of data; combating misinformation and addressing infodemics; privacy by design principles; and public participation and people's data literacy.

Distributed information exchange in a collaborative way is necessary for effective

pandemic and epidemic intelligence. A distributed approach is a non-hierarchical self-organizing way to work across a diverse range of information and insights, which may be conflicting or divergent, to achieve better pandemic and epidemic intelligence. Scientific advances are generating new approaches to information exchange – such as artificial swarm intelligence, federated learning, natural language processing, knowledge representation and reasoning, network science, complexity science, and crowdsourcing – which provide opportunities to create collaborative intelligent learning systems for public health that embrace diversity of effort, respond to complexity and uncertainty, and can adapt to new and unanticipated public health risks.

**Figure 2. Collaborative intelligence for pandemic and epidemic intelligence**



# LEARNING TOGETHER FOR STRONGER PANDEMIC AND EPIDEMIC INTELLIGENCE

Developing new capacities for epidemic and pandemic intelligence will require that we learn together as a global community. Working closely with the WHO Academy, the WHO Hub will develop knowledge-exchange programmes that model its inclusive and multidisciplinary approach to collaborative intelligence and are specifically tailored to bridge the gap between knowledge generation and pandemic and epidemic intelligence decision-making.

The WHO Hub will facilitate the development of a learning agenda for pandemic and epidemic intelligence that will explore different ways for collaborative learning. This will need to include multidirectional learning across multiple stakeholders from the local-to-global and global-to-local levels. Collaborative learning approaches may include simulations, serious gaming and other forms of skills development.

The learning agenda of the WHO Hub will engage academic partners globally to develop flexible learning pathways that are suitable for

the multidisciplinary nature of professionals needed to work in pandemic and epidemic intelligence. Flexible learning modalities will also be important, such as self-directed online learning, training courses and workshops, and formal accredited postgraduate qualifications.

## VISION

*Keep the world safe*

## MISSION

*To build a system of collaborative intelligence enabling better decisions to avert and manage pandemic and epidemic risks*



# WORKING PRINCIPLES



**Ethical Design:** Pandemic and epidemic intelligence systems will adopt approaches that achieve data privacy, confidentiality, security and ethical use of aggregated and disaggregated data, including clinical data, crowdsourcing, and data available through the internet of things (such as wearables, air-quality sensors). The WHO Hub will also promote the integrity of custodianship of data at source, benefits sharing from data insights and participation based on common good approaches.



**Equity:** The WHO Hub will work for the benefit of all populations and address unfair and avoidable differences in access to pandemic and epidemic intelligence tools, insights, and participation, irrespective of social, economic, demographic or geographic factors.



**Exploration and innovation:** The WHO Hub will foster exploration and innovation using agile approaches. This will be critical for the WHO Hub to adapt to both the complexity and the uncertainty of epidemic and pandemic risks as well as the dynamic nature of digital and data science fields.



**Multiplicity:** The WHO Hub recognizes that pandemic and epidemic intelligence cannot be achieved by any one initiative alone but requires a multiplicity of initiatives.



**Openness:** The WHO Hub will promote the use of open-source technology solutions as well as the widest possible access to insights generated from pandemic and epidemic intelligence activities. This includes the promotion of platforms and tools that are available to members of the public and that maximize citizen-scientist opportunities.



**Interdependence:** The interdependence of human health and animal and environmental health is fundamental. The WHO Hub will connect across fields and disciplines that work on One Health and Planetary Health.





# EVOLVING PANDEMIC AND EPIDEMIC INTELLIGENCE

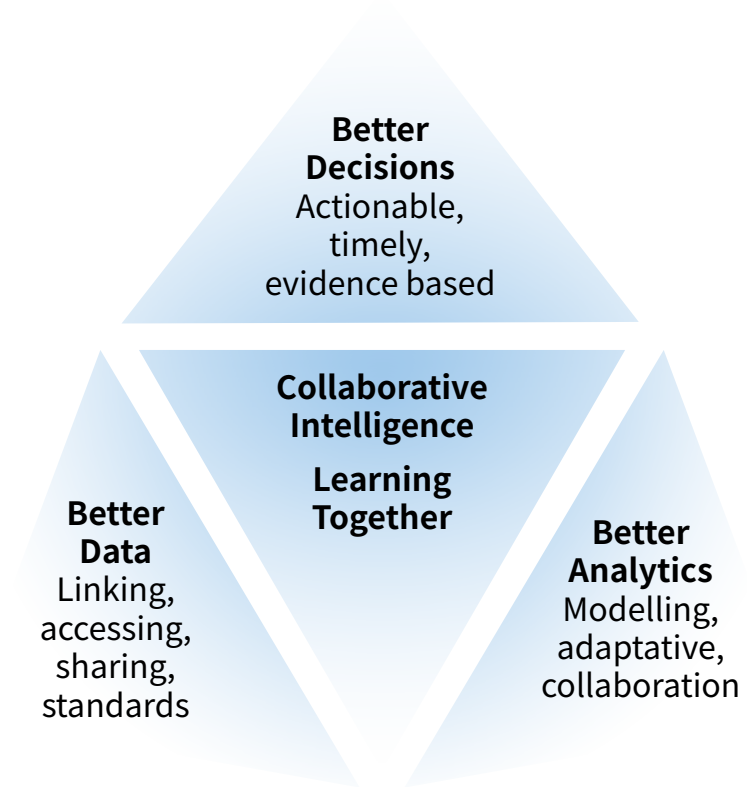
The work of the WHO Hub will evolve as global needs for pandemic and epidemic intelligence change over time. By design, the WHO Hub will use an evolutionary approach to implementation whereby through the work of the WHO Hub, new priorities and projects will be defined incrementally, allowing for exploration and discovery of new aspects of pandemic and epidemic intelligence that may not be possible to define through traditional project management cycles. All aspects of pandemic and epidemic intelligence will be matured through an evolutionary approach of iterative exploration and discovery, including technical, collaborative, governance, ethical and other dimensions.

The work of the WHO Hub will be organized around the focus areas of better data, better analytics and better decisions supported by the approaches of collaborative intelligence

and learning together (Fig. 3). Prime-mover initiatives within the three focus areas will accelerate existing efforts while enabling the exploration and discovery of new dimensions of pandemic and epidemic intelligence.



**Figure 3. Implementing the work of the WHO Hub for Pandemic and Epidemic Intelligence**



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## BETTER DATA

With the constantly expanding and overwhelming velocity, variety and volume of information available, sophisticated methods are required to help sift through it, isolate relevant and useful content, and synthesize and integrate it. At the same time, the data held by different organizations and Member States are difficult to share, bring with them constraints of confidentiality and the need to preserve privacy, and access to the data is limited by lack of time and resources. Fundamental barriers are the absence of standards and streamlined processes, and the diversity of languages and applications used to collect them. When shared, data are often delayed, partial, static, subject to restrictions and/or in need of time-consuming clean-up, translation and transformation. Collectively, these challenges highlight the urgent need for strengthened global data architecture and governance to facilitate rapid and efficient data and information sharing from countries, as well as from other organizations spanning the public, private and academic sectors. The goal of creating an evolving and growing data and application ecosystem for pandemic and epidemic intelligence requires agreed standards for metadata and interoperability.

The EPI-BRAIN initiative will steer the technology and dynamic data components of the ecosystem required to understand how these factors link together and interact. This will be driven by the development, evolution, maintenance and expansion of a semantic network of distributed data through the development of fit-for-purpose taxonomies, ontologies and related standards; establishment of a sustainable pandemic and epidemic intelligence global data architecture; and creation of semantically linked data for analytics and insights. The artificial intelligence, knowledge representation and reasoning, natural language processing and computational social science tools used to support this architecture require considerable investment in data normalization.

## BETTER ANALYTICS

Effective evidence-driven public health action requires robust analyses using comprehensive and contextualized data. However, the current landscape is incoherent: tools are often developed in isolation and/or on an ad hoc basis, analyses are hampered by various data issues as identified above and communities of practice are often fragmented and/or narrowly focused rather than collaboratively

feeding into and building on each other's results and insights. Incentives are often not aligned and reflect immediate or narrow purposes.

The Insights Initiative will be created to build and nurture frameworks to promote and guide the collaborative and iterative exploitation of data for actionable insights and actively nurture an evolving network of connected analytical solutions. By fostering the collaborative creation of customizable connected solutions for complex analyses, the WHO Hub will enable Member States and organizations to inform policy and action using the new pandemic and epidemic intelligence global data architecture. Insights for pandemic and epidemic intelligence will be based on: effective use of semantically linked data; collaborative development of analytic tools; and translation of analyses into usable insights. To ensure that the insights make their way into robust and trusted decisions based on diverse perspectives, the WHO Hub will harness methods and tools from the decision sciences including expert elicitation, wisdom of the crowd and forecasting approaches. To ensure that insights lead to demand-driven and tailored decisions that meet contextual needs, the WHO Hub will follow a boosting approach that enlists resources from the cognitive strengths and environment of decision-makers to boost existing competences and develop new ones.

## BETTER DECISIONS

The goal of stronger pandemic and epidemic intelligence is to improve public health decision-making. Decision-making in response to pandemic and epidemic risks involves many stakeholders with different capacities. There are also structural challenges to better decision-making such as gaps in communication, infrastructure and workforce competencies. In turn, these impact adoption of solutions and tools and ultimately the longer-term development of the pandemic and epidemic intelligence ecosystem.

The Implementation Accelerator will be established to work with communities of practice at local, regional and global levels to scale up and accelerate the adoption of new pandemic and epidemic intelligence solutions. The communities of practice will also inform and prioritize future needs and gaps that need to be addressed. The Implementation Accelerator will identify how pandemic and epidemic intelligence approaches can contribute to achieve already defined public health goals, such as performance for outbreak response, managing emerging disease risks and disease control programmes.

# CONNECTING THE WORLD TO KEEP IT SAFE

WHO is the United Nations agency that connects nations, partners and people to promote health, serve the vulnerable and keep the world safe.<sup>8</sup> It has 194 Member States. The WHO Hub is part of the WHO Health Emergencies Programme and builds on the existing public health intelligence work of WHO with all countries and communities in the world.<sup>9</sup> The WHO Hub's global reach will be unique through WHO's 150 country offices, six regional offices and Geneva headquarters. The WHO Hub will work with all countries around the world and will treat pandemic, epidemic and public health risks with equal urgency and diligence in each country.

Over time, as the distributed network facilitated by the WHO Hub matures and funding diversifies, additional nodes will be established to extend its global reach. They will strengthen WHO's trust architecture to foster globally comprehensive collaborative intelligence that will increase equity in pandemic and epidemic risk management.

The German Government's visionary and determined support for global health sets a strong foundation for the WHO Hub both politically<sup>10</sup> and financially. Together, the German Federal Chancellery and Federal Ministry of Health have mobilized 100 million euros to fund the WHO Hub for the first three years. The WHO Hub will be based in Berlin, which is a vibrant research, science and education ecosystem. The interdisciplinary Berlin-Potsdam innovation hub is home to leading science and education institutions including various sites of the Helmholtz Association of German Research Centers,<sup>11</sup> the Max Planck Society for the Advancement of Science,<sup>12</sup> the Leibniz Association<sup>13</sup> and the Fraunhofer Society.<sup>14</sup> Its ecosystem includes the Potsdam Institute for Climate Impact Research,<sup>15</sup> the Hasso Plattner Institute,<sup>16</sup> the German Research Center for Artificial Intelligence,<sup>17</sup> the Zuse Institute Berlin for applied mathematics and data-intensive high-performance computing,<sup>18</sup> and the Alexander von Humboldt Institute for Internet and So-



ciety,<sup>19</sup> as well as leading universities, such as the Freie Universität Berlin,<sup>20</sup> Humboldt-Universität,<sup>21</sup> Technische Universität Berlin,<sup>22</sup> the University of Potsdam<sup>23</sup> and the Hertie School of Governance.<sup>24</sup> Berlin also has a civil society spanning a range of topics from data protection and digital rights to foreign policy that includes think tanks such as the Stiftung Neue Verantwortung [New Responsibility Foundation]<sup>25</sup> and the German Institute for International and Security Affairs,<sup>26</sup> as well as smaller initiatives such as AlgorithmWatch<sup>27</sup> and netzpolitik.org.

The WHO Hub's two foundational partners in Berlin – the Robert Koch Institute (RKI, German national public health institute) and Charité – Universitätsmedizin Berlin<sup>28,29</sup> – are both globally well networked and connect the WHO Hub with numerous key initiatives. RKI's strong portfolio of international work is reflected in its Centre for International Health Protection, in being the WHO Collaborating Centre for Emerging Infections and Biological Threats, and a founding member of the

EIOS initiative, a member the International Association of Public Health Institutes (IANPHI), as well as being the only Collaborating Centre for the Global Outbreak Alert and Response Network (GOARN). RKI has a very strong collaboration with the Africa Centres for Disease Control<sup>30</sup> and Prevention and works closely with the European Centre for Disease Prevention and Control.

As Europe's largest medical and life sciences university hospital, Charité will support the WHO Hub's learning agenda by developing postgraduate learning opportunities through Charité Global Health.<sup>31</sup> Charité also hosts the World Health Summit, which is one of the leading strategic forums for global health,<sup>32</sup> and it initiated the M8 Alliance of Academic Health Centers, Universities and National Academies, which is a growing network currently including 30 members in 20 countries, including the InterAcademy Partnership (IAP),<sup>33,34</sup> which represents the national academies of medicine and science in 130 countries.



# A NEW COLLABORATIVE ENVIRONMENT

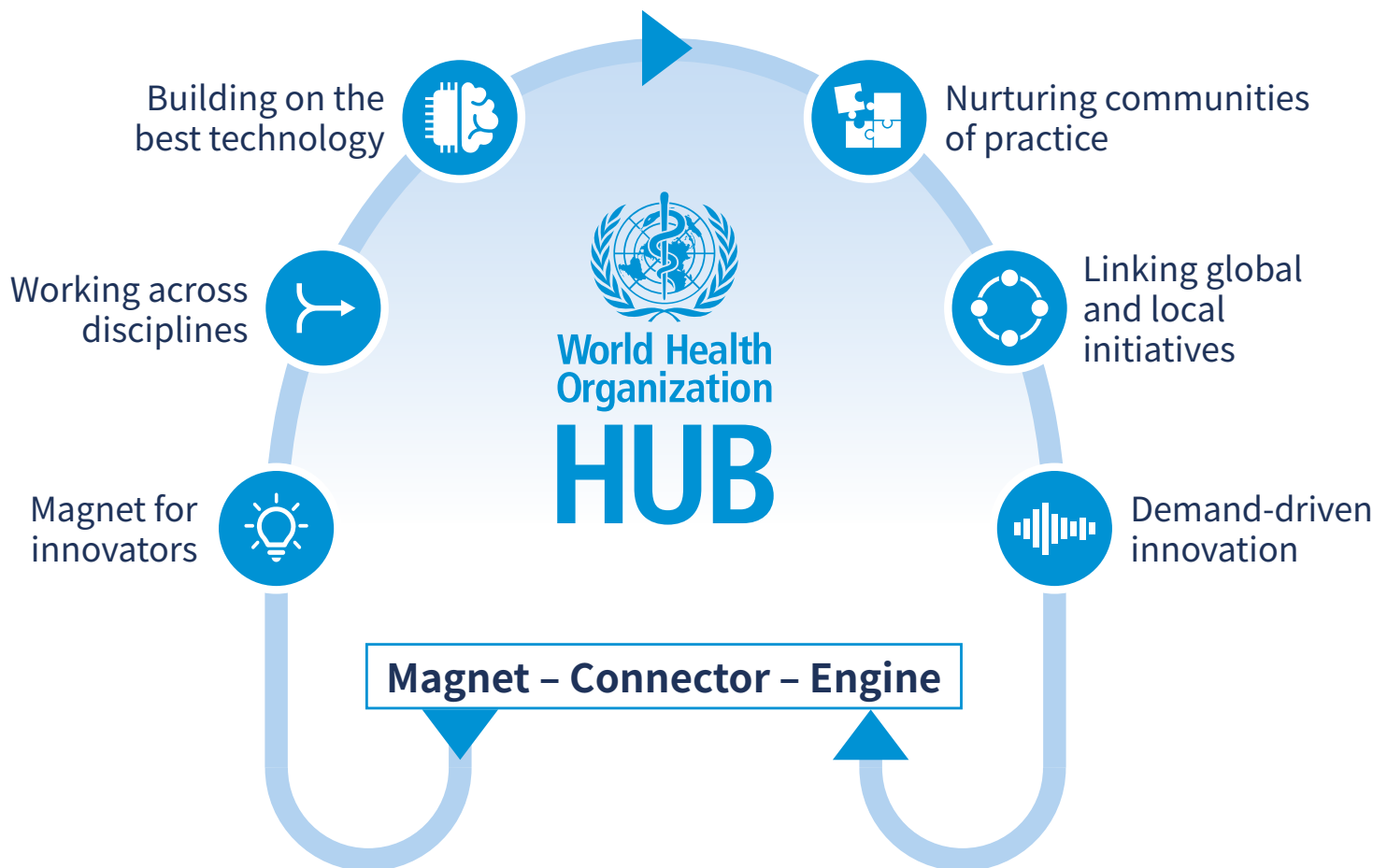
The WHO Hub will create a new collaborative environment that brings together the innovators from across disciplines as well as leveraging the best available technologies (Fig. 4). The WHO Hub will anchor its work in the needs of stakeholders, ensuring that its work is demand driven while also linking global and local initiatives together. The WHO Hub will additionally be an environment where communities of practice related to pandemic and epidemic intelligence can grow and mature.

The creation of a new collaborative environment will include virtual and in-person inte-

ractions. The WHO Global Health Campus in Berlin will provide a physical space for people to work together on projects and initiatives. In the future, sites in other locations across the world will foster even greater opportunities for collaboration.

The WHO Hub will also create a different working dynamic through which WHO can increase interaction with and between partners. This will include different working relationships between WHO, Member States and partners such as GOARN, IANPHI and the World Health Summit.

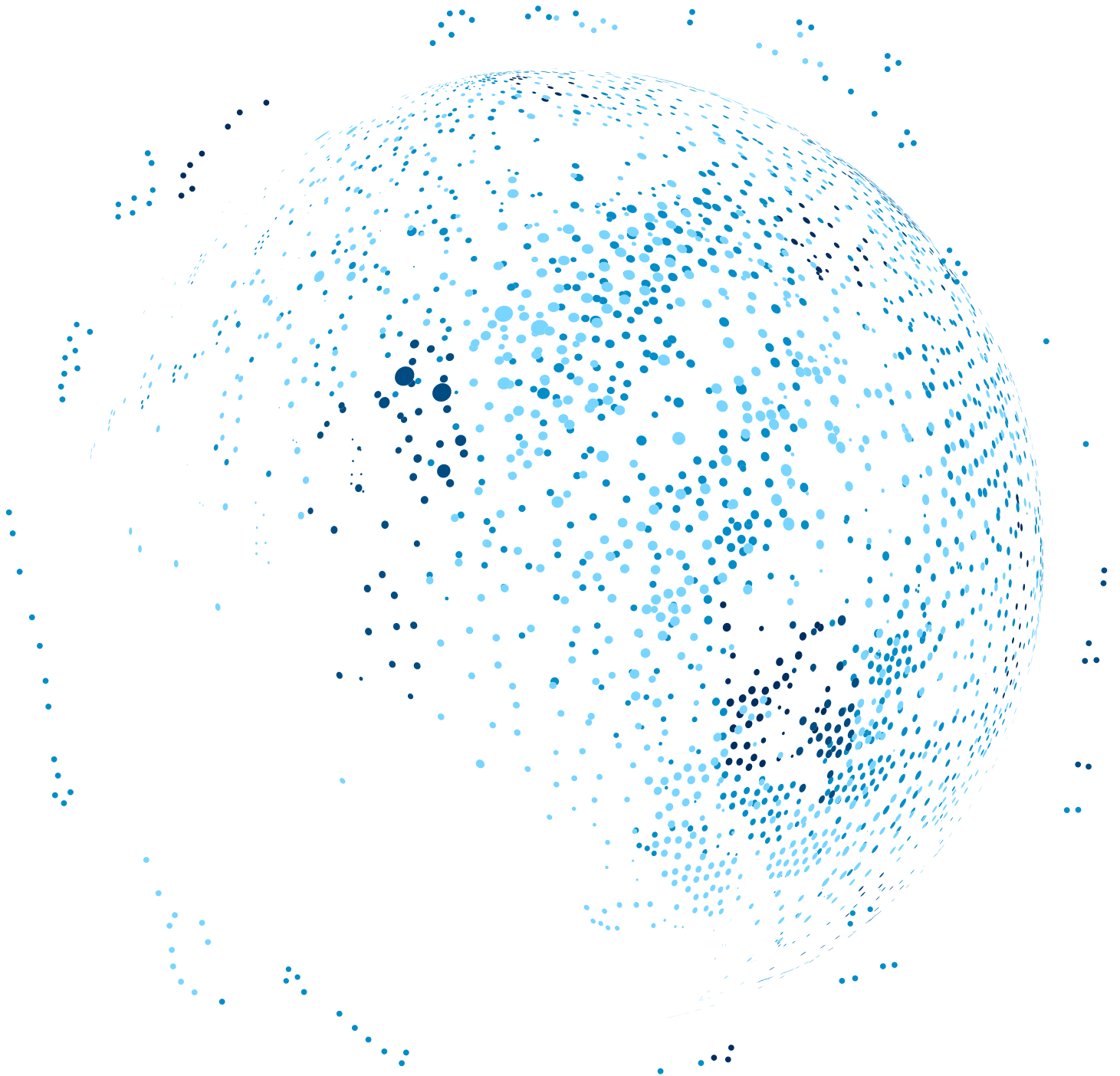
**Figure 4. The collaborative environment for pandemic and epidemic intelligence**



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# ENDNOTES

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This is a living document and will be further developed as the WHO Hub evolves.

