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*FasterCures*

# A Global Early Warning System for Pandemics

Mobilizing Surveillance for  
Emerging Pathogens

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## About the Milken Institute

The Milken Institute is a nonprofit, nonpartisan think tank. For the past three decades, the Milken Institute has served as a catalyst for practical, scalable solutions to global challenges by connecting human, financial, and educational resources to those who need them. Guided by a conviction that the best ideas, under-resourced, cannot succeed, we conduct research and analysis and convene top experts, innovators, and influencers from different backgrounds and competing viewpoints. We leverage this expertise and insight to construct programs and policy initiatives. These activities are designed to help people build meaningful lives in which they can experience health and well-being, pursue effective education and gainful employment, and access the resources required to create ever-expanding opportunities for themselves and their broader communities.

## About FasterCures

FasterCures, a center of the Milken Institute, is working to build a system that is effective, efficient, and driven by a clear vision: patient needs above all else. We believe that transformative and lifesaving science should be fully realized and deliver better treatments to the people who need them.



# CONTENTS

<b>1</b>	<b>Executive Summary</b>
<b>2</b>	<b>Introduction</b>
<b>3</b>	<b>Need for an Early Warning System</b>
3	Current Institutional Capacity
6	Constraints of the Existing Systems
<b>7</b>	<b>Guiding Principles for an Early Warning System</b>
<b>8</b>	<b>Considerations for a Successful Early Warning System</b>
<b>9</b>	<b>Initial Steps to Outline the Scope of an Early Warning System</b>
<b>11</b>	<b>A Model toward a Shared Vision for an Early Warning System</b>
11	Governance and Relationship Structure
12	Global Coordination
15	Examples of Key Data-Related Questions
15	Financial Outlook
<b>16</b>	<b>Immediate Actions toward an Early Warning System</b>
<b>18</b>	<b>Conclusion</b>
<b>19</b>	<b>Appendix</b>
<b>20</b>	<b>Endnotes</b>
<b>22</b>	<b>Acknowledgments</b>
<b>23</b>	<b>About the Authors</b>



# EXECUTIVE SUMMARY

In 2020, COVID-19 caught the world by surprise—this should not have been the case. The pandemic revealed significant gaps in early warning capabilities to detect and respond to emerging pathogens before they cause global harm. Given the current situation, how can we leverage existing systems and emerging technologies to better characterize the various risk factors that could signal the next pandemic?

The current global infrastructure suffers from deep fragmentation, lack of coordination and collaboration, a need for sophisticated knowledge management, and virtually no sustained governmental and organizational commitment. This report seeks to catalyze momentum and lay the framework for mobilizing a more rapid and nimble early warning system with robust global coordination.

We outline principles to help guide decision-making, highlight key considerations for success, and offer initial steps and immediate actions for realizing such a coordinated global system.



# INTRODUCTION

*The vision for an early warning system outlined in this report encourages coordination between global players to identify and share information.*

The COVID-19 pandemic has brought into stark relief the gaps in our world's ability to quickly identify, track, and combat the rise and movement of pathogenic threats, including new viruses of epidemic and pandemic potential as well as antimicrobial resistance that threatens modern medicine. As we near 160 million cases and over 3 million deaths worldwide from COVID-19 in May 2021,<sup>1</sup> life as we know it has changed drastically, and global economies have been disrupted to a degree not seen before in many of our lifetimes.

As we continue to fight the COVID-19 pandemic and seek the best way to “re-open” communities, the need for a global, coordinated, and active early warning system is more acute than ever. The growth in urbanization, globalization, and ecological factors increases the potential for future outbreaks, epidemics, and pandemics. But the challenges are many. While the technology exists to identify pathogenic threats in their pre-emergent phase, the current system suffers from fragmentation, a lack of coordination and collaboration, a need for sophisticated knowledge management, and virtually no sustained governmental and

organizational commitment. The vision for an early warning system outlined in this report encourages coordination between global players to identify and share information. It will act as a trusted source for initiating response efforts as threats are detected.

By building a forward-looking, global system, future threats to health and well-being can be identified quickly and acted upon in a coordinated way. Utilizing the Milken Institute's extensive network of international experts in health, finance, and technology, FasterCures, a center of the Milken Institute, assembled an esteemed Advisory Group that convened a series of stakeholder workshops. The workshops aimed to create a consensus vision of an ideal early warning system, discuss the obstacles to creating and maintaining such a system, and identify solutions and actions that can bring together existing systems to work as a seamless global whole. Those discussions inform this report. Given the diversity of stakeholder perspectives, components of this report may not reflect all viewpoints but will ideally generate dialogue toward a unified approach for mobilizing an early warning system.



# NEED FOR AN EARLY WARNING SYSTEM

*The COVID-19 pandemic has shed light on the significant gaps in global early warning capabilities to coordinate and disseminate information on emerging threats in a timely manner.*

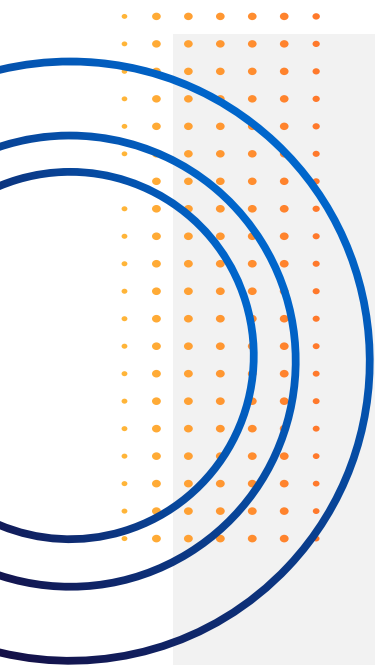
Although current systems are adept at event-based surveillance, the COVID-19 pandemic has shed light on the significant gaps in global early warning capabilities to coordinate and disseminate information on emerging threats in a timely manner. Researchers now estimate that the SARS-CoV-2 virus was likely circulating undetected for some time before the first outbreak was reported in Wuhan, China.<sup>2</sup> Since the virus was identified and its genetic sequence was shared around the world, it has continued to evolve to find more efficient methods of transmission through human-to-human contact. Some countries have actively invested in surveillance activities to track emerging mutations and variants of concern, yielding valuable scientific information, while many have not. This persistent fragmentation, despite the implications for public health decision-making, highlights the variable investment in surveillance and information flow worldwide.<sup>3</sup>

## Current Institutional Capacity

Three multilateral agencies within the United Nations (UN)—the World Health Organization (WHO), the Food and Agriculture Organization

(FAO), and the World Organisation for Animal Health (OIE)—exemplify strong institutional capacity for global surveillance.

The WHO plays a critical role in detecting and responding to public health risks and emergencies through indicator-based and event-based surveillance. The WHO conducts indicator-based surveillance for specific diseases, such as seasonal, pandemic, and zoonotic influenza monitoring, through its Global Influenza Surveillance and Response System (GISRS).<sup>4</sup> GISRS consists of WHO Collaborating Centres and Essential Regulatory Laboratories across the globe. Also, the WHO undertakes event-based activities, including during humanitarian crises and natural disasters. For example, the Early Warning Alert and Response System (EWARS)<sup>5</sup> was designed to strengthen disease surveillance in emergency settings with real-time data reporting to Ministries of Health and the WHO. The WHO is also responsible for supporting its Member States in developing implementation plans and core competencies for surveillance and response activities,<sup>6</sup> as mandated by the International Health Regulations (IHR 2005),<sup>7</sup> a legal framework for reporting public health events.



## Global Influenza Surveillance and Response System<sup>8</sup>

*An example of a global system focused on active longitudinal surveillance*

“Global influenza surveillance has been conducted through WHO’s Global Influenza Surveillance and Response System (GISRS) since 1952. GISRS is a system fostering global confidence and trust for over half a century, through effective collaboration and sharing of viruses, data and benefits based on Member States’ commitment to a global public health model. The mission of GISRS is to protect people from the threat of influenza by continuously functioning as a:

- global mechanism of surveillance, preparedness and response for seasonal, pandemic and zoonotic influenza;
- global platform for monitoring influenza epidemiology and disease; and
- global alert for novel influenza viruses and other respiratory pathogens.

GISRS currently comprises institutions in 123 WHO Member States.”

The FAO works with international partners and regional veterinary laboratories to perform early warning activities at the human-animal-environment interface. The Veterinary Diagnostic Laboratory (VETLAB) Network currently consists of 72 laboratories in Africa and Asia with the potential to expand into Europe, Latin America, and the Caribbean.<sup>9</sup> As part of its remit to avert threats to the food chain, the FAO has implemented the Food Chain Crisis–Emergency Prevention System (FCC–EMPRES) to monitor global threats to food safety, including highly transmissible infectious diseases in animals. A specialized unit within EMPRES is devoted to transboundary animal diseases (TADs), such as African swine fever, avian influenza, and Middle East respiratory syndrome coronavirus.<sup>10</sup>

The OIE monitors animal pathogens worldwide and coordinates efforts to respond to disease outbreaks in animals. Its Global Framework for Transboundary Animal Diseases (GF-TADs), launched in partnership with the FAO, provides a structure for controlling TADs at the local, regional, and national levels; coordinates response across country lines; and builds capacity to control selected TADs.<sup>11</sup> The

Global Early Warning System for Major Animal Diseases, including Zoonoses (GLEWS) is a contributor to GF-TADs. A joint initiative among the OIE, FAO, and WHO, GLEWS coordinates the risk assessment of zoonotic threats, data sharing, and initiation of public health responses. It works alongside existing FAO and WHO surveillance systems to strengthen their early warning efforts and provide a network of stakeholders to address such actions.<sup>12</sup>

These UN-driven surveillance efforts focus on identifying and addressing outbreaks in human and animal populations<sup>13</sup> for various purposes, including protecting the food chain.<sup>14</sup> Still, they do not coordinate early detection efforts across a broad range of pathogenic threats. As the one exception, GISRS does conduct active, longitudinal surveillance but only for influenza in humans. By harnessing and enhancing the current surveillance efforts of the WHO, FAO, OIE, and other specific pathogen surveillance efforts, the field can gain a better understanding of the elevated risk of potential spillover and spread. In adopting a One Health approach to disease surveillance at the

early warning stage, the current systems should track known and, importantly, uncharacterized pathogens, and identify diseases in animals that could jump to humans, which are central components to monitoring disease risk in humans. A risk-based approach<sup>15</sup> is needed to fill these gaps.

As demonstrated in **Figure 1**, the inclusion of wildlife and livestock in global health surveillance efforts, in addition to non-event-based pathogen monitoring, is an unmet gap that a coordinated early warning system will fill upstream in the ecosystem.

**Figure 1. Alignment of an Early Warning System within the Surveillance and Response Ecosystem**



Source: Milken Institute (2021)

An early warning system will act alongside existing surveillance and response efforts to execute pre-event surveillance based on an outbreak risk approach and early outbreak detection. It will take longitudinal sampling from humans, livestock, and wildlife (i.e., biologic, epidemiologic, and ecologic samples) to monitor spread and detect emerging pathogens and variants. It will also leverage nontraditional data sources to monitor viral evolution over time and to advance forecasting capacities for early outbreak indicators and will aspire to integrate different data sources into potentially actionable information. The entire enterprise will include human and animal-based surveillance to identify risky behaviors and practices that could trigger risk-reduction responses, focused response efforts by areas of effect such as real-time monitoring and threat-level reclassification, and resource dissemination from entities in responding to an outbreak. Indeed, such a system will focus on risk characterization and will identify appropriate decision-making frameworks and evidence that are necessary for response.



# *Now is the catalytic moment to mobilize existing surveillance systems with stronger global coordination to detect pre-pathogenic events as early as possible.*

## **Constraints of the Existing Systems**

Although these UN agencies have well-established relationships with member countries, they face numerous obstacles, including underfunding, constrained analytical capabilities, restrictive organizational structures, and a limited ability to leverage the technology and capabilities developed and deployed by the private sector.

To date, the OIE, FAO, and WHO have leveraged their separate surveillance systems to mobilize GLEWS, yet each agency utilizes a different technology platform for event-based monitoring.<sup>16</sup> This approach has recognized shortcomings, such as variations in the information collected given the systems' different functionalities and limited independence to report and respond in a timely manner. Yet any effort to enhance these systems through new technologies or private-sector collaboration will be constrained by existing operating procedures, organizational architecture, and complex UN processes. This lack of modernization is highlighted by calls for better-coordinated efforts to tackle future pandemics that involve UN entities, governments, non-governmental organizations, laboratories, and academia but that fail to involve the private sector as a collaborative partner.

Despite strong collaboration among the WHO, FAO, and OIE, there is a recognized need to strengthen and standardize data analytics and information sharing across organizations, improve surveillance coverage, enhance zoonotic surveillance, coordinate early signal verification processes, and coordinate risk assessment communication.<sup>17</sup> Engagement with the private sector can advance early warning system mobilization by providing infrastructure, analytics and modeling, and funding for new technologies and innovative surveillance efforts. Many of these resources and tools have been significantly underutilized in supporting the detection of emerging public health threats but would enhance actions being carried out by government, public health, or academic labs.

Now is the catalytic moment to mobilize existing surveillance systems with stronger global coordination to detect pre-pathogenic events as early as possible. Such a coordinated global system builds on existing infrastructure; fosters collaboration and coordination across multilateral and multisectoral players; and shares information to identify, track, and respond quickly to emerging pathogenic threats. This vision for global coordination for early warning efforts is an opportunity to enhance existing systems, harmonize siloed functionalities, and mitigate political and financial constraints. It will take the best of existing capacities to create a more rapid, nimble system for early warning activities.



# GUIDING PRINCIPLES FOR AN EARLY WARNING SYSTEM

The success of a coordinated and efficient early warning system depends on a foundation of key principles:

- 1. Leverage existing infrastructure.** Organizations and initiatives already exist to conduct disease surveillance activities. This existing infrastructure should not be replaced or re-created but rather leveraged to maximize resources and identify gaps where additional investment may be needed.
- 2. Encourage collaboration and standardization.** The activities of an early warning system must encourage collaborative behavior by standardizing protocols and sharing the benefits of such a system.
- 3. Promote sharing of data.** Data generated through surveillance activities must be protected against exploitation. Any benefits realized as a result of these data must be equally distributed. We must focus on a federated data model to mitigate misuse.
- 4. Integrate the private sector.** The private sector has an essential role to play in offering resources, technology, capacity-building, and analytical capabilities to support early warning activities.
- 5. Prioritize country ownership.** Investments must be made in country-level surveillance capacities. Risk-based data and early insights must enable country-led responses. Strong local ownership is necessary for driving global action.
- 6. Instill trust and transparency.** Trust is the foundation for mobilizing a credible and fully utilized system, and transparency is a key driver for demonstrating the value of sharing information.



## GISAID<sup>18</sup>

*An example of an initiative that warehouses data and establishes trust in those sharing data*

“The GISAID Initiative promotes the rapid sharing of data from all influenza viruses and the coronavirus causing COVID-19. This includes genetic sequence and related clinical and epidemiological data associated with human viruses, and geographical as well as species-specific data associated with avian and other animal viruses, to help researchers understand how viruses evolve and spread during epidemics and pandemics.

GISAID does so by overcoming disincentive hurdles and restrictions, which discourage or prevent sharing of virologic data prior to formal publication. The Initiative ensures that open access to data in GISAID is provided free-of-charge to all individuals that agreed to identify themselves and agreed to uphold the GISAID sharing mechanism governed through its Database Access Agreement.”



# CONSIDERATIONS FOR A SUCCESSFUL EARLY WARNING SYSTEM

Below are considerations that must be acknowledged at every stage of early warning system mobilization:

- 1. Political will.** Strong leadership must exist at the local, national, and global levels for early warning efforts. We are at a promising starting point in gaining support given the current spotlight on pandemic preparedness, including strong interest across the globe in reaction to the inadequate and incomplete response to COVID-19 that caught many countries unprepared. Countries such as the UK and US have expressed interest in providing early mobilization and investments to create capacity for early warning activities.<sup>19</sup> Still, buy-in across G20 countries and around the world is critical for the effectiveness of such an endeavor.
- 2. Governance.** A governing body should set standards and practices for gathering data, sequencing samples, and sharing information in a transparent and neutral manner. Responsibilities for collaborating countries and priorities for alignment must be established upfront and be agreed upon by all parties.
- 3. Financing.** Funds should come from a blend of government, private, and philanthropic sources. Although each sector will play a role, government support will be especially critical to ensure the development of key local infrastructure. Innovative models can offer creative financing solutions for more specific needs such as data sharing, data-related improvements, technical assistance, and global coordination. Specifying such requirements will clarify the types of funding required.
- 4. Incentives.** Incentives must be devised to encourage participation and protect against deterrents for proactive data sharing. Such deterrents include possible negative impacts to a country's economy, trade, travel, and tourism should a novel pathogen be discovered.
- 5. Local capacity.** Access to resources, capacity, and technology is unequal across the globe, but a level playing field is essential to the success of an early warning system. Workforce and technical capacity must be strengthened in certain regions. For example, the implementation of basic lab infrastructure built within the context of local health delivery and agricultural systems across the globe will enhance surveillance efforts.
- 6. Data sharing and ownership.** Concerns about intellectual property, ownership rights, benefits, trust, competitive edge, and exploitation must be addressed. Consideration must also be given to ways to access and integrate traditional and nontraditional data sources, which together could offer powerful insights into an emerging outbreak.
- 7. Risk assessment.** A shared framework for risk assessment is necessary to ensure a standardized approach to recording and reporting risk (e.g., through a "heat map"). It is important that sufficient information and resources be provided to countries and local labs so they may conduct such risk assessment based on a common approach.
- 8. Dissemination and communication.** Rapid communication of identified risk is crucial to initiating a timely public health response. Resources must be available within communities to communicate signals appropriately and enable real-time information flow to regional and global partners.



## PREDICT<sup>20</sup>

*An example of a global surveillance model focused on strengthening local capacity*

“PREDICT, a project of USAID’s Emerging Pandemic Threats (EPT) program, was initiated in 2009 to strengthen global capacity for detection of viruses with pandemic potential that can move between animals and people. PREDICT has made significant contributions to strengthening global surveillance and laboratory diagnostic capabilities for both known and newly discovered viruses within several important virus groups, such as filoviruses (including ebolaviruses), influenza viruses, paramyxoviruses, and coronaviruses.

PREDICT activities supported emerging pandemic threats preparedness and the Global Health Security Agenda, primarily in Africa and Asia. A decade later, more than 30 countries around the world have stronger systems to safely detect, identify, prevent and respond to viral threats. PREDICT initiated One Health Surveillance, a transdisciplinary collaborative approach to understanding infectious disease risk at the animal-human interface. The PREDICT-trained workforce, including zoonotic disease specialists and laboratory scientists at more than 60 national, university and partner laboratories, is one of the best response resources to assist with safe and secure detection and response to COVID-19 and other emerging biological threats.”



## INITIAL STEPS TO OUTLINE THE SCOPE OF AN EARLY WARNING SYSTEM

The scope of an early warning system must be well understood. In building the case for executing early warning coordination activities, we must:

- 1. Map the surveillance ecosystem.** A comprehensive mapping of the ecosystem will identify existing efforts and stakeholders to engage in bringing key competencies and resources to bear. This map will clarify the warning system’s objectives and ensure that the right actors are involved in the development and maintenance of the system—including those upstream in the value chain who may not traditionally participate in public health discussions (e.g., from the livestock industry). This map will also inform understanding of what data are being collected and what data are missing. Knowledge of the disease surveillance landscape at the local, national, and global levels will support the coordination of efforts and help identify where (and what type of) needs exist. Assessment efforts should first start at the local and regional levels and then extend to the global level.
- 2. Calculate the cost of doing nothing.** The magnitude of human and economic costs due to a pandemic is well understood to be significant but should be quantified. In this way, the field will better understand the scale of resources likely needed to mitigate those costs. The economic cost of an outbreak caused by only

high-risk viral pathogens is estimated to be more than \$50 billion—this does not account for other outbreak-causing pathogens and risks.<sup>21</sup> In addition, communicating the cost-benefit of investing in early warning activities will incentivize funding for proactive, rather than reactive, efforts.

- 3. Gain commitment on the need for an early warning system.** Multisectoral and multilateral players will comprise the structure of the early warning system, so it is necessary to socialize the need for this system to garner widespread commitment. Sustained commitment from global leaders is imperative to the long-term viability of an early warning system. Harnessing

political will from the G7, G20, existing UN entities, and other international stakeholders is central to this effort.

The outlining process will underscore the need for an early warning system and support the establishment of subsequent activities to mobilize the system. Many solutions for the appropriate structure and governance of a global early warning system will emerge, and the pros and cons of each solution set should be carefully weighed. Active global engagement and participation from multiple stakeholders are critical to arriving at a shared solution. In the next section, we outline a model for achieving a shared vision that focuses on timely action and efficiency.



## Global Virome Project<sup>22</sup>

*An example of an innovative network partnership among public, private, philanthropic, and civil organizations*

“The Global Virome Project (GVP) is an innovative 10-year partnership that will pivot [the] approach from responding to outbreaks to proactively preparing for them.

GVP is a strategic response to the growing need to better predict, prevent, and respond to future viral pandemic threats and to protect us all from their worst consequences. By bringing multi-disciplinary units under one umbrella, the global consortium will establish a joint coordinated effort, whereby partners and participants will gain the benefits of shared global and regional strategies while maintaining autonomy to respond to local needs.”



# A MODEL TOWARD A SHARED VISION FOR AN EARLY WARNING SYSTEM

As envisioned, the coordination structure will employ a “hub-and-spoke” model to mobilize a federation of multisectoral entities who represent and support localities throughout the world in their early surveillance efforts. It will link existing activities at the local and regional level, work alongside existing entities to facilitate connections and fill gaps, and provide a governance framework for collaboration.

A model for global, regional, and local coordination pathways is depicted in **Figure 2** and is supported by text describing the attributes of each coordinating center. Because capacity will vary significantly across localities, the global coordinating center will provide central leadership and technical assistance to coordinate surveillance activities where gaps exist at the local level.

## Governance and Relationship Structure

The early warning system—comprising entities representing the global, regional, or local coordinating centers—will work alongside established institutions, such as the WHO, to coordinate early warning activities. As detailed earlier, an initial mapping process will enable clear distinctions between ongoing efforts and the gaps to be filled by an early warning system.

Stakeholders from multiple sectors, including government agencies, the private sector, and philanthropic organizations, will guide the early warning system’s overall efforts. The system will strategically focus on building political will for participation in this warning effort from regions worldwide.



## Infection Innovation Consortium<sup>23</sup>

*An example of a public-private-philanthropic partnership for pandemic preparedness*

“The UK’s Infection Innovation Consortium (iiCON) is a \$200 million collaboration between the UK Government, industry, philanthropy and academia to radically accelerate the R&D pathway for drugs, vaccines, diagnostics and public health interventions to combat critical priority pandemics, including antimicrobial resistance and coronavirus. The group mobilised at the start of the COVID-19 pandemic to act as the UK regional centre for COVID vaccine trials, and is also a FIND and WHO accredited center for diagnostic validation.

Over the next five years, iiCON aims to align further with international partners in its mission to drive innovative diagnostics, therapeutics, vaccines and antibodies into accelerated clinical trials to address the critical global issue of infectious disease preparedness.

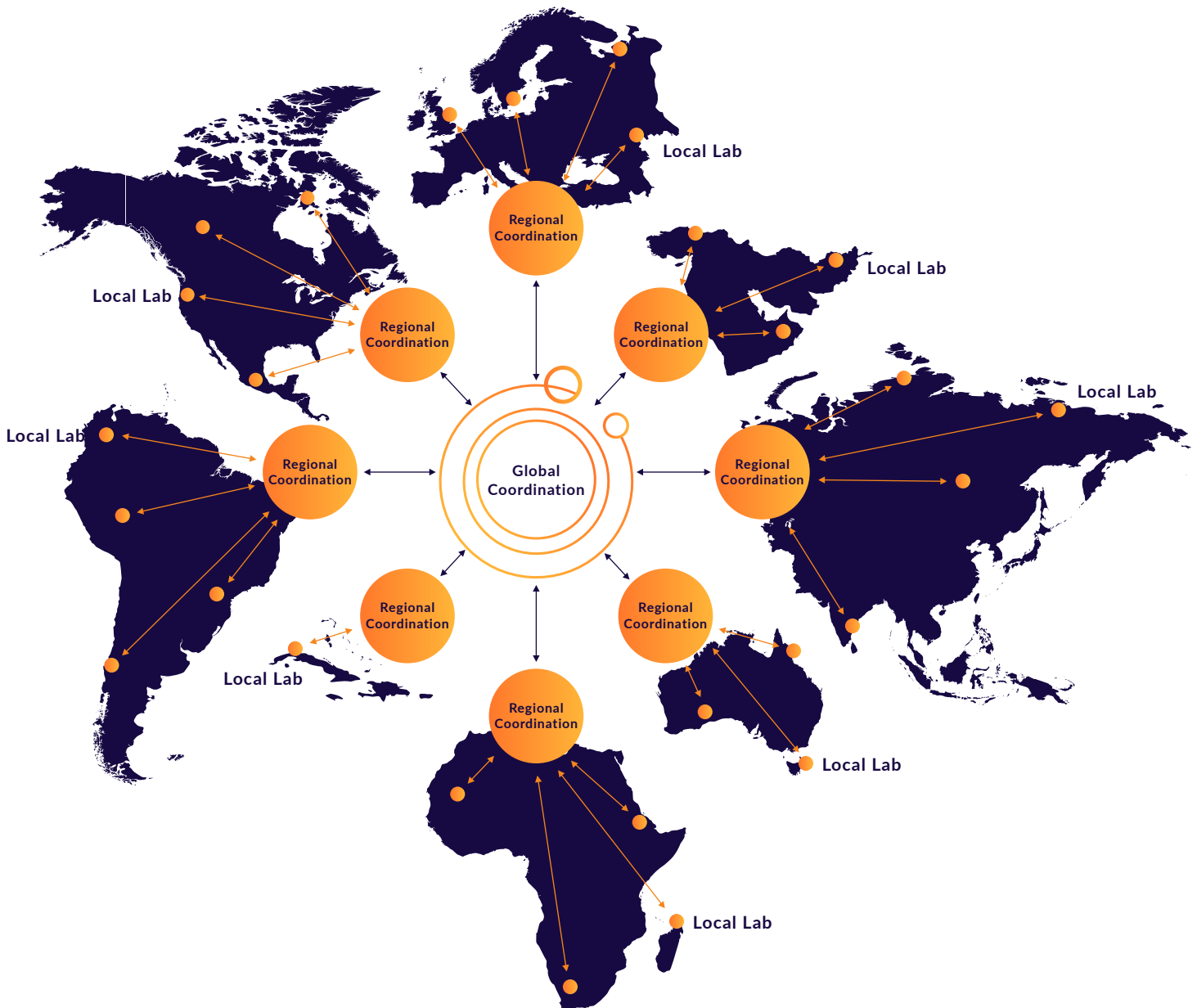
The iiCON founding partners are UK Research and Innovation, Liverpool School of Tropical Medicine, Liverpool University, INFEX Therapeutics, Unilever, Evotec and the Royal Liverpool Hospital NHS Trust.”

## Global Coordination

A central, global coordinator (the “hub”) will query information coming from regional early warning centers (the “spokes”). The global coordinating center will play a key role in creating a central repository for data analysis, developing methodology, sharing data, and establishing

data-sharing processes. It will disseminate critical information to public health decision-makers to inform appropriate responses and work alongside the scientific community to develop trustworthy medical countermeasures. The global coordinating center will also link existing surveillance efforts and facilitate collaboration and partnership among such efforts.

Figure 2. Coordination Flow for a Global Early Warning System



Source: Milken Institute (2021)



## Global Coordinating Center

- Coordinates surveillance and data collection activities occurring at the regional and local levels
- Establishes governance and principles for guiding coordinated activities and manages the risk assessment framework
- Secures funding from various sources for use throughout the early warning system
- Develops data management, security measures, and use standards to maintain a level of trust and value
- Standardizes protocols and methodologies for surveillance and data management
- Ensures quality control of data
- Coordinates with regional coordination centers to build capacity, infrastructure, and training; deploy technical expertise; ensure quality control; and distribute resources to communities
- Engages a range of stakeholders for garnering political will and local buy-in
- Ensures early warning activities work alongside the UN, WHO, and Global Health Security Agenda efforts

## Regional Coordinating Centers

- Serve as central communication points between local entities and the global coordinating center
- Work with localities to establish community buy-in and ownership of ongoing early surveillance activities
- Ensure the financial, human, and technological resources are effectively mobilized to appropriate localities
- Leverage data-sharing agreements at local centers

## Local Coordinating Centers

- Comprise data collection entities, including academic labs and clinics
- Generate data
- Share de-identified, limited datasets to appropriate regional hubs for analysis and risk identification
- Take ownership in data collection, reporting, and garnering of community buy-in
- Analyze data for immediate public health and policy response



Several activities are essential to the successful mobilization of an early warning system. These include building the infrastructure for data sharing and standardization, establishing standards and norms for propagating resources, establishing country and regional ownership, garnering political will, and identifying financial resources and their appropriate distribution. Subject-area specific task forces can carry out these activities.

Regional coordinating centers and subsequent local systems will be responsible for reporting

information to the global coordinating center. They will comprise regional coordinating centers and local data collection and reporting centers. Local centers will report their data to their regional coordinating centers, which will then report to the global coordinating center. Frequent communication must exist between the global, regional, and local coordinating centers to ensure proper action in the event of early outbreak detection.



## Program for Monitoring Emerging Diseases<sup>24</sup>

*An example of an open access reporting system for emerging threats*

“The Program for Monitoring Emerging Diseases – ProMED – is an internet-based reporting system dedicated to the rapid global dissemination of information on outbreaks of infectious diseases and acute exposures to toxins that affect human health, including those in animals and in plants grown for food or animal feed. Electronic communications enable ProMED to provide up-to-date and reliable news about threats to human, animal, and plant health around the world as quickly as possible.

By providing early warning of outbreaks of emerging and re-emerging diseases, public health precautions at all levels can be taken in a timely manner to prevent epidemic transmission and to save lives.”

## Africa CDC Institute of Pathogen Genomics<sup>25</sup>

*An example “hub-and-spoke” model advancing data collection and surveillance capacity at the regional level*

“Africa CDC Institute of Pathogen Genomics, through the Africa Pathogen Genomics Initiative (Africa PGI) aims to enhance disease surveillance and public health partnerships through integrated, cross-continent laboratory networks equipped with the tools, human resource capacity and data infrastructure to fully leverage critical genomic sequencing technologies. Nearly 140 disease outbreaks are detected annually across Africa. Genomic sequencing technology will provide the scientific evidence needed for health systems to better prevent, identify and track these outbreaks, thus helping public health experts to stay ahead of novel pathogens and re-emerging diseases.”

## Examples of Key Data-Related Questions

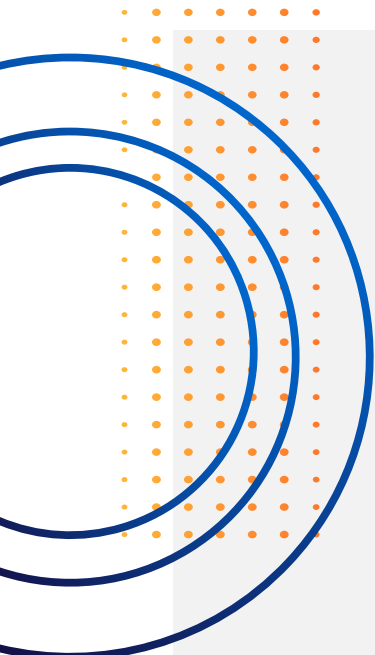
Local data collection sites will be charged with generating individual, de-identified, and privacy-protected data for analysis at the regional and global coordinating centers. Key questions that these data should regularly answer include those that will define outbreak hotspots and stratify risk.

1. Where are the hotspot areas most likely to experience animal-to-human disease spillover? Which animal hosts are most likely to be involved?
2. What human behaviors and practices elevate the risk of spillovers?
3. Where are there new and potential pathogens? What are they? Could they reach pandemic potential?
4. Which viruses are seasonal, and where do they pose the greatest risk (e.g., influenza in the US during the winter months)?
5. What diseases are spiking in animal species, and where are these spikes happening?
6. Where is the initial emergence of zoonotic pathogens in humans occurring?

7. Where are the first resistant or mutant strains with significantly different potential impact within humans emerging? What are they?
8. Where does antimicrobial resistance currently exist? Where is increased antimicrobial resistance emerging?

## Financial Outlook

Funding for the early warning system will likely come from governments, the private sector, and philanthropic organizations, and each funder type will play a unique role in this effort. Governments allocate budgets based on policy priorities. The private sector offers innovative solutions and global networks to benefit multilateral efforts, and can support the technological components, data systems, and analytical capabilities for early warning activities. Philanthropic investments traditionally support the global public good, such as building capabilities at the local level. The specific contribution of each funder type, where the funding flows, and when the funding will be needed will become clear as components within the “hub-and-spoke” model are better defined. The majority of funds will likely be committed at the local level to build infrastructure and fill gaps in capacity.



## Coalition for Epidemic Preparedness Innovations<sup>26</sup>

*An example of an innovative global partnership with a blend of financial commitments*

“CEPI [The Coalition for Epidemic Preparedness Innovations] was founded in Davos by the governments of Norway and India, the Bill & Melinda Gates Foundation, Wellcome, and the World Economic Forum.

To date, CEPI has secured financial support from Australia, Austria, Belgium, the Bill & Melinda Gates Foundation, Canada, Denmark, the European Commission, Ethiopia, Finland, Germany, Hungary, Iceland, Indonesia, Italy, Japan, Kuwait, Lithuania, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Panama, Romania, Saudi Arabia, Serbia, Singapore, Switzerland, The Republic of Korea, United Kingdom, USAID, and Wellcome.

Additionally, CEPI has also received support from private sector entities as well as public contributions through the UN Foundation COVID-19 Solidarity Response Fund.”



# IMMEDIATE ACTIONS TOWARD AN EARLY WARNING SYSTEM

Immediate recommendations for guiding action to mobilize an early warning system are:

**1. Create a blueprint for global coordination of existing efforts and new technologies for early warning activities.** Many efforts are underway in surveillance, but they are fragmented. Global coordination will link existing efforts and provide a governance structure for collaboration and partnership.

- **Develop a governance framework.** A governing body should establish the guidelines for gathering and analyzing data, sequencing samples, and sharing information in a transparent and neutral manner. This body should also establish roles and responsibilities for collaborating countries and organizations to communicate with political stakeholders for buy-in and support. Further, the roles of global entities in conducting surveillance activities at the global level should be delineated. The International Health Regulations largely drive the current surveillance system, so the limitations of this legal framework should be reviewed while considering the path forward. Establishing a governance structure may require a convergence of existing regulatory frameworks but with modifications to address the current constraints.
- **Define the costs for operating the system.** Cost variables can include data collection and sharing platform technologies, regional and country capacity building, ongoing operational financing, and “surge” financing to establish the global coordinating center. Once these costs are defined, each of

these activities can then be matched to potential funding mechanisms. It will also be important to pre-determine what areas the public sector should finance (e.g., areas in which information should remain globally accessible as a public good).

- **Develop incentives for sharing data.** For countries with major disincentives to reporting data, data sharing can be tied to financial incentives or other health goals such as universal health care or achievement of Sustainable Development Goals (SDGs). These incentives need to be carefully crafted to offset any “penalties” incurred as a result of reporting data of an outbreak (e.g., a decline in tourism). Successes with data sharing in other fields may be used as a guide in surveillance-related activities. A robust, legal framework, which protects the ownership of data from the original provider to subsequent users, may be necessary to secure confidence in data sharing.

In addition, the benefit of contributing data should be clear. The “price of admission” should be decided upon and conveyed upfront.

- **Create mechanisms for public-private partnerships.** Collaboration with the private sector should be seamless. The resources and capabilities of for-profit partners, such as technology companies, should be leveraged in building the capacity and infrastructure for early warning activities. We can also look to the private sector to provide innovative solutions for surveillance efforts.

- **Support mechanisms for collaboration and capacity building.** To develop a robust global system that spans multiple sectors, mechanisms that support collaboration and capacity building must be created. Capacity-building should include equipping localities with diagnostic, detection, and characterization capabilities. Each locality should collect early signals, utilize data to identify threats, and relay information systematically to regional and global counterparts. Such established infrastructure and capabilities at the local level are critical to sustaining the global response.
2. **Identify core data elements.** A set of core data elements that are crucial for indicating potential disease spread should be established. To do so, international stakeholders must be convened to align on these core data questions, identify traditional and nontraditional data sources, and develop guidance on data collection activities and interoperability standards.
  3. **Incubate a technology-focused collaborative.** The private sector (including the technology and alternative investment communities) has data and infrastructure readily available to conduct early warning activities. A consortium of such private-sector companies should collaborate to identify data sources, assess the current data and technology landscapes, establish data governance, identify potential approaches to elevating local data collection and sharing efforts, and establish methods for real-time analysis in a limited geography. These activities could be shared with global entities, such as the WHO, as a proof-of-concept on the current state of the early warning and surveillance systems. Once financial investments are secured, this collaborative can be incubated immediately to identify emerging pathogens, such as SARS-CoV-2 variants.
  4. **Explore financial incentives to encourage public- and private-sector participation.** Despite a statutory responsibility to respond to pandemics, governments need strong incentives to participate, particularly if budgets are constrained, and there is competition for health resources (e.g., to meet SDGs). For the private sector, government leadership will be critical. While the resources and capabilities that the private sector can contribute are substantial, governments must create incentives to guide the private sector.
  5. **Engage stakeholders through effective communication strategies.** Stakeholders need to realize a shared interest, responsibility, and opportunity for a global early warning system. The motivations, advantages, and disadvantages for creating a standardized system must be understood, and resource requirements must be articulated and addressed. Multiple communication strategies should be utilized to engage all actors while conveying the benefits of participating in such a system. It is also necessary that we broaden our dialogue and engagement beyond traditional public health and surveillance entities. In bringing forward a variety of stakeholders, we need to calculate the cost of pathogenic threats relative to local priorities. In seeking action, it will be necessary to design a digestible set of policy proposals to ensure efforts are undertaken.



# CONCLUSION

There is widespread agreement that the political will exists today for a global early warning system that not only alerts but also characterizes the risks and helps guide local and regional responses. To capitalize on this moment in history, this report outlines the building blocks for realizing a vision for an early warning system. By enabling greater early warning coordination around the world, international players can leverage existing capacities, emerging technologies, and scientific advances to better address the various risk factors that could signal the next epidemic or pandemic.

FasterCures continues to facilitate convenings with global stakeholders to support the coordination of an early warning system.

# APPENDIX

Stakeholders represented during the discussions for a vision of an early warning system:

Access to Medicine Foundation  
Africa Centres for Disease Control and Prevention (Africa CDC)  
altLabs  
Asia Pacific Society of Clinical Microbiology and Infection  
Biobot Analytics  
Boston Consulting Group  
The Office of David Cameron, Former Prime Minister of the United Kingdom  
Celdara Medical, LLC  
Centers for Disease Control and Prevention (CDC)  
Coalition for Epidemic Preparedness Innovations (CEPI)  
Council on Strategic Risks  
COVID Act Now  
Duke-Margolis Center for Health Policy, Duke University  
EY-Parthenon  
FHI 360  
Fogarty International Center  
The Food and Agriculture Organization (FAO)  
Bill & Melinda Gates Foundation  
Bill & Melinda Gates Medical Research Institute  
George Washington University  
Ginkgo Bioworks  
GISAID  
The Global Fund  
Global Virome Project  
Global Virus Network  
GSK  
IDEA Pharma  
Illumina  
INFEX Therapeutics  
In-Q-Tel  
International Society of Infectious Diseases (ISID)  
Jacobs  
Johns Hopkins Center for Health Security  
Johns Hopkins University  
KBBO Americas  
LifeArc  
The London School of Hygiene and Tropical Medicine  
Medidata  
Merck  
Metabiota  
National Academies of Sciences, Engineering, and Medicine  
National Institutes of Health (NIH)  
National University Hospital, Singapore  
One Health Institute  
Pacific Life Fund Advisors  
Palladium  
Risk and Return  
Royalty Pharma  
Sabin Vaccine Institute  
Sarissa Capital  
Stanford Healthcare Innovation Lab  
Tony Blair Institute for Global Change  
Two Sigma Ventures  
US Agency for International Development (USAID)  
US Department of Health and Human Services (HHS)  
University of Buffalo Jacobs School of Medicine and Biomedical Sciences  
University of Maryland  
The Wellcome Sanger Institute  
Wellcome Trust  
WorldQuant Predictive

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