Panel 3: Early Warning for Pandemic Preparedness

Presenters:

- James Golden, PhD – *Chief Data Officer, The Rockefeller Foundation*
- Niamh B. O'Hara, PhD, *Research Assistant Professor SUNY Downstate Health Sciences University, CEO and Cofounder Biotia*
- Rafael Maciel-de-Freitas, PhD, *Researcher in Public Health Instituto Oswaldo Cruz, Fiocruz and Institute for Tropical Medicine*

Respondents:

- Soojin Jang, PhD, *Founder and Head of the Antibacterial Resistance Laboratory at Institut Pasteur, South Korea*
- Dr. Maria Almiron, *Unit Chief of Health Emergency Information and Risk Assessment, WHO Regional Office for the Americas*

Key messages:

A. COVID-19 pandemic revealed global health, social systems, and economies are surprisingly fragile in increasingly interconnected world. Ironically, COVID-19 also demonstrated the value of community-based technology and data sharing.

B. More than half of all infectious diseases could be made worse by climate change.

C. Remarkably, during 2022, we saw a dismantling of essential infectious disease monitoring programs across countries.

D. A global early warning system, leveraging community-based tools and data is needed to enhanced our collective capacity to respond (Figure 1).

E. Some existing platforms constitute pieces of this infrastructure: GISAID, WHO EWARS, Ecohealth Alliance, and CZID.

F. A global PEWs differs from previous efforts which were more siloed and single issue-focused
  - These platforms ingest single data streams, such as epidemiological or genomic data to the exclusion of climate and other environmental datasets outlined (Figure 1B)
  - Often focus on a single infectious disease threat, instead of diverse pathogens

- Challenged working across nations, including restrictions on cross-nation data sharing, but a global PEWs uses a federated data sharing approach to address these challenges (1C).
- Previous platforms have not leveraged community sourced analysis tools to build regional relevance (1D).

G. Fortunately, dramatic improvements in computational technology, access to growing numbers of digital data resources have catalyzed significant breakthroughs in quantitative research over the last 30 years.

H. We outline the components of a cross-sector, multi-modal global PEWs framed around *data philanthropy* and *modern data logistics*. This vision relies on creation of a global network of researchers connected through an open-source data science platform, representing a globally unique resource.

I. This platform simultaneously ingests multi-omic datasets, climate, land use, epidemiological, and microbial genomics data (Panel B), while respecting global data sharing privacy, to create the foundation for predictive modeling.

J. **Recommendation:** a global early warning system is needed, leveraging community-based models and data to enhance our collective capacity to respond to infectious disease threats.

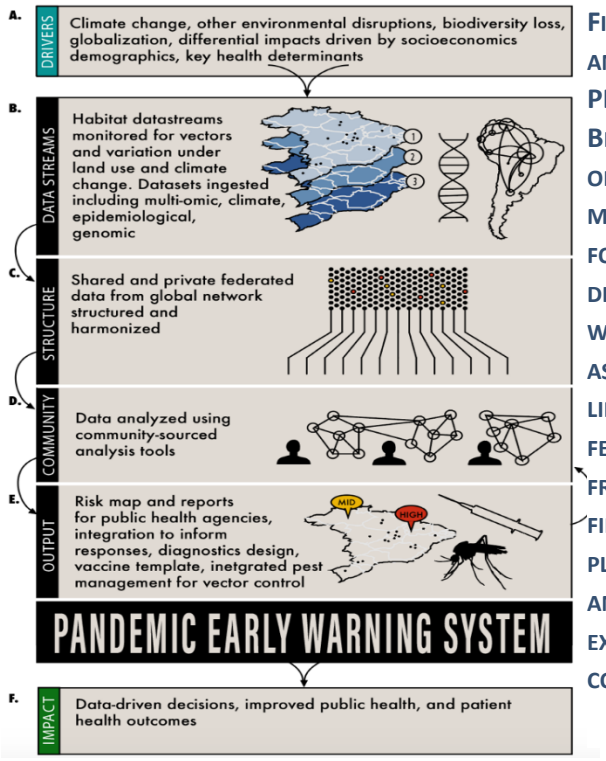

FIGURE 1 OVERVIEW OF A GLOBAL PLATFORM FOR MONITORING AND PREDICTING INFECTIOUS DISEASE OUTBREAKS (GLOBAL PEWS), WITH AN INITIAL USE-CASE FOR DENGUE VIRUS IN BRAZIL. THIS PLATFORM SIMULTANEOUSLY INGESTS MULTI-OMIC DATASETS, CLIMATE, LAND USE, EPIDEMIOLOGICAL, AND MICROBIAL GENOMICS DATA (PANEL B) TO CREATE THE FOUNDATION FOR PREDICTIVE MODELING. THIS NEW PLATFORM DIFFERS FROM PREVIOUS EFFORTS TO MONITOR PATHOGENS WHICH ONLY FOCUSED ON INDEPENDENT DATA STREAMS, SUCH AS EPIDEMIOLOGICAL OR GENOMIC DATA, AND HAVE SUPPORTED LIMITED COMPONENTS OF THE OVERALL SYSTEM, SUCH AS THE FEDERATED SHARING OF DATA ONLY (C), AND SOME FRAGMENTARY INTERNATIONAL COLLABORATION (D), AND FIRST-ORDER RISK MAPS (E). FURTHERMORE, PREVIOUS PLATFORMS HAVE NOT LEVERAGED COMMUNITY SOURCED ANALYSIS TOOLS TO BUILD LOCAL RELEVANCE. THE PEWS EXPLICITLY INTEGRATES THESE SEVERAL PREVIOUSLY DISTINCT COMPONENTS.

Responses to questions posed:

1. ***What are the roles for member states and the scientific community in implementing early warning systems? Could parts of the early warning system be tailored to geographic environments?***

Our view is that an effective early warning system will be geographically specific consisting of regional models on a global platform. We believe that an effective early warning system will use community models, an approach that has worked well in the climate research community.

Each geographic region has unique cultural and environmental properties which are best understood by researchers in that region. We envision researchers building relatively small models specific to their region. These models can be shared broadly and adapted by other research teams to their specific needs. Small models can be aggregated together into complex and global systems.

This approach rewards engagement in a global early warning system from a member state. By building and sharing models and data (with appropriate protections for data sovereignty) a member state will gain more scientific and research scrutiny of their local systems. Inevitably this scrutiny will improve local models leading to better pandemic early warning within that member state.

2. ***How can sufficient incentive be created for countries to report outbreaks? How can privacy and confidentiality of data be protected in the exchange of data?***

The most direct incentive for member states to report outbreak data will be the access to a global talent pool which will help to model and predict the course of that outbreak. By reporting data to a global early warning system a member state will tap into a global network of researchers and predictive models. This will help the member state to make informed decisions for how to use public health resources.

Other incentive structures may also prove useful. By reporting certain kinds of biomedical data a member state may effectively lay claim to part of their biosphere, which is increasingly being recognized as a valuable resource. The global financial markets may also be useful to create monetary incentive for accurate data which could lead to better economic models.

Protecting privacy and data sovereignty is paramount in a pandemic early warning system. Much can be done to build a pandemic early warning system without person-specific data. Aggregated statistics like the case rate in a region or among a certain section of the population are useful without exposing an individual's data. Sharing microbial genomes (such as SARS-CoV-2 genomes during the COVID-19 pandemic) is useful without exposing any human DNA.

Technological solutions like federated learning and data storage are also likely to be useful. These

solutions allow will a country to make their data available for statistical models without giving full access to another group. Ultimately, effective data sharing will require an international framework agreed upon by member states.