ASM abstract 2023

Early Warning System for Global Pandemic Using Genomic, Epidemiological, Climate and Environmental Data

David C. Danko[1, 4], James Golden[2], Charles Vörösmarty[5,6,7], Anthony Cak[5], Fabio Corsi[5,6], Adam Nagyhazy-Horvath[4], Gábor Jozsa[4], Tamas Nemcsok[4], Christopher E. Mason[1,4, 10, 11], Rafael Maciel-de-Freitas[8,9], Dorottya Nagy-Szakal[3,4], Niamh B. O'Hara[3,4, 12]

Commented [DN1]: Add Biotia members?

Affiliations:

1. Department of Physiology and Biophysics, Weill Cornell Medicine, New York, NY, USA
2. Rockefeller Foundation, New York, NY, USA
3. Department of Cell Biology, SUNY Downstate Health Sciences University, New York, NY, USA
4. Biotia, New York, NY, USA
5. Environmental Sciences Initiative, Advanced Science Research Center, Graduate Center, City University of New York, New York, NY, USA
6. Department of Geography and Environmental Science, Hunter College, New York, NY
7. Department of Earth and Environmental Sciences, Graduate Center, CUNY, New York, NY, USA
8. Laboratório de Mosquitos Transmissores de Hematozoários, Instituto Oswaldo Cruz, Fiocruz, Rio de Janeiro, RJ, Brazil. CEP: 21040-360.
9. Department of Arbovirology, Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany. PLZ: 20359
10. The HRH Prince Alwaleed Bin Talal Bin Abdulaziz Alsaud Institute for Computational Biomedicine, Weill Cornell Medicine, New York, NY, USA
11. The Feil Family Brain and Mind Research Institute, Weill Cornell Medicine, New York, NY, USA
12. Jacobs Technion-Cornell Institute, Cornell Tech, New York, NY, USA

`

Abstract Text (2,200-character limit without spaces, no sub-titles)

Our health, social, and economic systems are becoming increasingly interconnected across the globe. Though substantial benefits have emerged global interconnection has created novel biological risks. Invasive species, habitat destruction, and the spread of human infectious disease have all been consequences of globalized systems. The COVID-19 pandemic showed that these risks not only pose risk to people and the environment but can create domino effects in systems themselves. Recent studies have shown that more than half of all infectious diseases could be made worse by climate change, further exacerbating these risks.

In spite of this there are few effective systems to model biological risk at a global scale. This is partly because modeling biological systems is difficult. Such systems are inherently complex and cannot be understood using only one type of data. Any framework for modeling data must necessarily incorporate data from genomics, earth systems, public health, and sociology. It must be able to incorporate local knowledge and empower experts to share their approaches and expertise.

We present GeoSeeq, a platform for community driven modeling of biological and pandemic risks. GeoSeeq provides tooling to integrate geospatial, genomic, public health and sociological data. It enables researchers to share data while maintaining data sovereignty and to apply techniques to a geographically broad and diverse set of data. Currently, GeoSeeq contains ~30,000 genomic samples from over 60 countries alongside climate and public health data. The guiding principles behind GeoSeeq are based on similar efforts by climate scientists to model the effects of climate change. We demonstrate GeoSeeq by showing how the system can be used to model Dengue outbreaks in Brazil.

Sub-tracks
CCM02 Microbial Diversity: Cascading Effects of Climate Change
CCM01 Health, Microbes and Environment

Oral presentation: Is climate change affecting the epidemiology of infections and AMR?

Key Words
genomics, pandemic, global health, climate change, land use, antimicrobial resistance

Science Policy Paper Abstract
The COVID-19 pandemic revealed that global health, social systems, and economies can be surprisingly fragile in an increasingly interconnected and interdependent world. Yet, during the last half of 2022, and quite remarkably, we began dismantling essential infectious disease monitoring programs in several countries. Absent such programs, localized biological risks will transform into global shocks linked directly to our lack of foresight regarding pandemics. Additionally, recent studies indicate that more than half of all infectious diseases could be made worse by climate change, complicating pandemic containment. Despite this complexity, the factors leading to pandemics are largely predictable but can only be realized with a well-designed global early warning system. This system should integrate data from genomics, climate and environment, social dynamics, and healthcare infrastructure. The glue for such a system is community-driven modeling, a modern logistics of data, and democratization of AI tools. As we highlight in a use-case focused on dengue virus in Brazil, we can demonstrate how thoughtfully designed technology platforms can build global-scale precision disease detection and response systems that significantly reduce exposure to systemic shocks, accelerate science-informed public health policies, and deliver reliable healthcare and economic opportunities as an intrinsic part of a global sustainable development agenda.

Control/Tracking Number: 2023-A-5810-MICROBE
Activity: Regular Abstract
Title: Early Warning System For Global Pandemic Using Genomic, Epidemiological, Climate And Environmental Data: