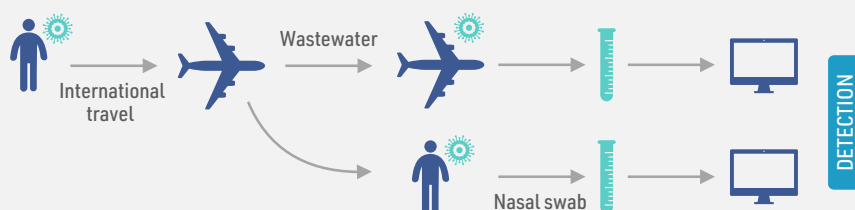
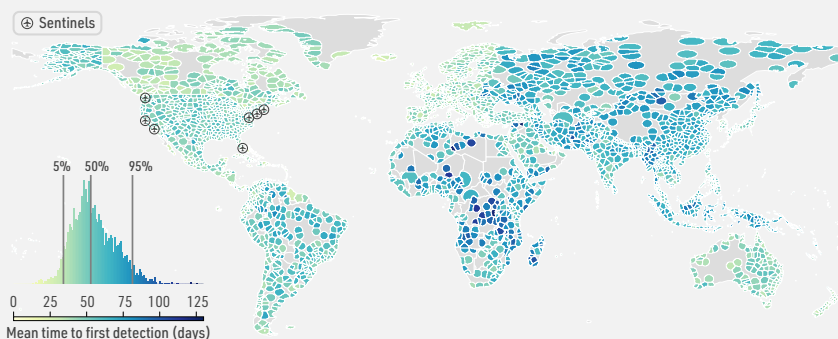


# Modeling Traveler-Based Genomic Surveillance of Infectious Pathogens at Airports

As seen in recent pandemics, airports are critical hubs for the global spreading of infectious diseases. At the same time, they could be used as primary sentinel points for novel pathogen detection. The detection of specific pathogens among international travelers through nasal swabs upon arrival or via airplane wastewater surveillance at points of entry is a promising strategy for a global surveillance network against emerging infectious disease threats. This approach enhances our ability to monitor and respond to potential outbreaks effectively, leveraging both direct sampling from individuals and sampling from aircraft wastewater to provide an efficient early warning system.



We developed a computational platform using the GLEAM model<sup>1</sup> and advanced analytics based on probability generating functions<sup>2</sup>. This model integrates the global air-travel network to simulate the transmission and spreading of pathogens and their detection at a given set of airports, referred to as the sentinel network. Biosurveillance mechanisms include nasal samples from passengers and wastewater sampling from individual airplanes or airport tritulators. Given any initial conditions for an outbreak, the model generates stochastic realizations of the global epidemic spread. Simulated data includes international and domestic infection importations, incidence of infections, and individual level detection at sentinel sites with a daily resolution.



1. Davis, Jessica T., et al. "Cryptic transmission of SARS-CoV-2 and the first COVID-19 wave." *Nature* 600:7887 (2021):127-132.

## What's new

**Approach:** Modeling of global aircraft-based genomic surveillance networks (nasal swabs and wastewater) for global pathogen monitoring.

**Advanced Modeling:** Use of an epidemic and mobility model combined with probability generating function analytics to estimate the performance and optimization of global wastewater surveillance networks.

**Assessment and Optimization:** Identification of the placement of sentinel sites for timely situational awareness and early warning, with optimization strategies to improve effectiveness and minimize resource use.

## Key takeaways

The model can systematically simulate the detection of pathogens through a travel-based genomic surveillance network at airports. The model adapts to various surveillance methods, including nasal-swab testing and wastewater from aircraft monitoring.

## Public health relevance

Provides Federal, state, tribal, local, and territorial (STLT) public health officials and policymakers with increased situational awareness, and advanced tools to timely inform data-driven decision-making.