



Strengthening
University-Industry
Partnerships

Infectious Disease Intelligence: Predicting the Next Pandemic

March 24, 2021 12 - 1 PM ET



Moderator

John King

Center for the Ecology
of Infectious Diseases,
University of Georgia



Presenter

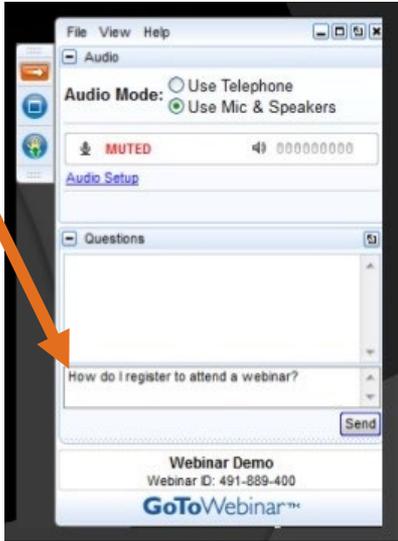
John Drake

Center for the Ecology
of Infectious Diseases,
University of Georgia

March 24, 2021 | The webinar will begin momentarily

How to Participate

Webinar Logistics



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Infectious Disease Intelligence: Predicting the Next Pandemic



**UNIVERSITY OF
GEORGIA**
Odum School of Ecology

**Ecology
across scales**

Ecosystem Ecology
Biogeography
Sustainability
Watershed Ecology
Evolutionary Ecology

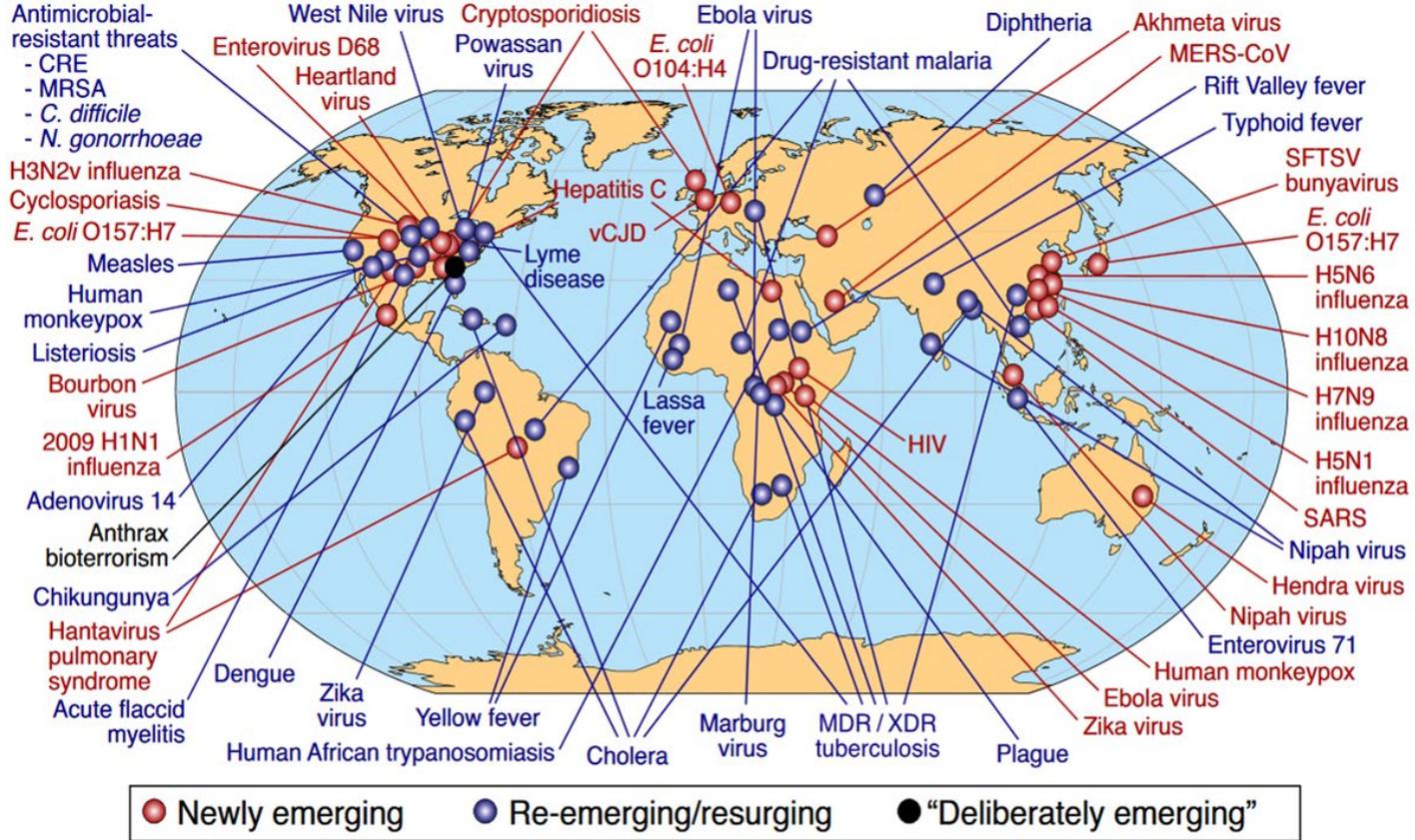
Infectious Diseases



- + Distinguished Research Prof. John M. Drake, Director
- + Founded 2016
- + 90 researchers in 15 UGA departments, schools, colleges and external organizations
- + 8 Government, industry & other universities represented
- + \$4.1 million in grant funding from National Science Foundation & other agencies
- + 541 peer-reviewed publications and 65 pre-prints to date
- + Five Working Groups







Source: A World at Risk: Annual report on global preparedness for health emergencies.



Estimated Costs of Selected Epidemics/Pandemics in US\$ Billions (2001 - 2017)



Source: A World at Risk: Annual report on global preparedness for health emergencies.

Global Preparedness Monitoring Board, September 19, 2019. https://apps.who.int/gpmb/assets/annual_report/GPMB_annualreport_2019.pdf



This Issue Views **110,076** | Citations **8** | Altmetric **3779** | Comments **1**

Viewpoint

October 12, 2020

The COVID-19 Pandemic and the \$16 Trillion Virus

David M. Cutler, PhD¹; Lawrence H. Summers, PhD²

[» Author Affiliations](#) | [Article Information](#)

JAMA. 2020;324(15):1495-1496. doi:10.1001/jama.2020.19759

Table. Estimated Economic Cost of the COVID-19 Crisis

Category	Cost (billions), US\$
Lost GDP	7592
Health loss	
Premature death	4375
Long-term health impairment	2572
Mental health impairment	1581
Total	16 121
Total for a family of 4	196 475
% of annual GDP	90

Abbreviation: GDP, gross domestic product.

Source: Journal of the American Medical Association

CORONAVIRUS | Jan 5, 2021, 03:49pm EST | 1,798 views

The Psychological Trauma Of Covid-19



John Drake Contributor

Science

I'm a professor at the University of Georgia.



Listen to this article now

03:33



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t

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Source: Forbes.com - <https://www.forbes.com/sites/johndrake/>

Billions-Dollar Disasters

BY THE NUMBERS (1980–2020)



DROUGHT



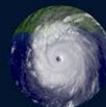
FLOODING



FREEZE



SEVERE STORMS



TROPICAL CYCLONE



WILDFIRE



WINTER STORM

For more info:
www.ncdc.noaa.gov/billions/

1980

The year NOAA started tracking billion-dollar disasters

119

Number of billion-dollar events from 2010-2019



22

Number of U.S. billion-dollar disasters in 2020—the most on record



7.0

Average number of billion-dollar disasters per year since 1980

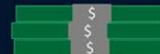
285

Number of billion-dollar disasters in the U.S. since 1980

\$1.875

TRILLION

Total cost of the 285 billion-dollar disasters



7

Number of billion-dollar tropical cyclones that struck the U.S. in 2020



15.1

Average number of billion-dollar disasters per year since 2015

50

Number of states that have had at least one billion-dollar disaster

124

Number of billion-dollar disasters that have impacted Texas since 1980—the most of any state





Global Risks Perception Survey 2020

World Economic Forum

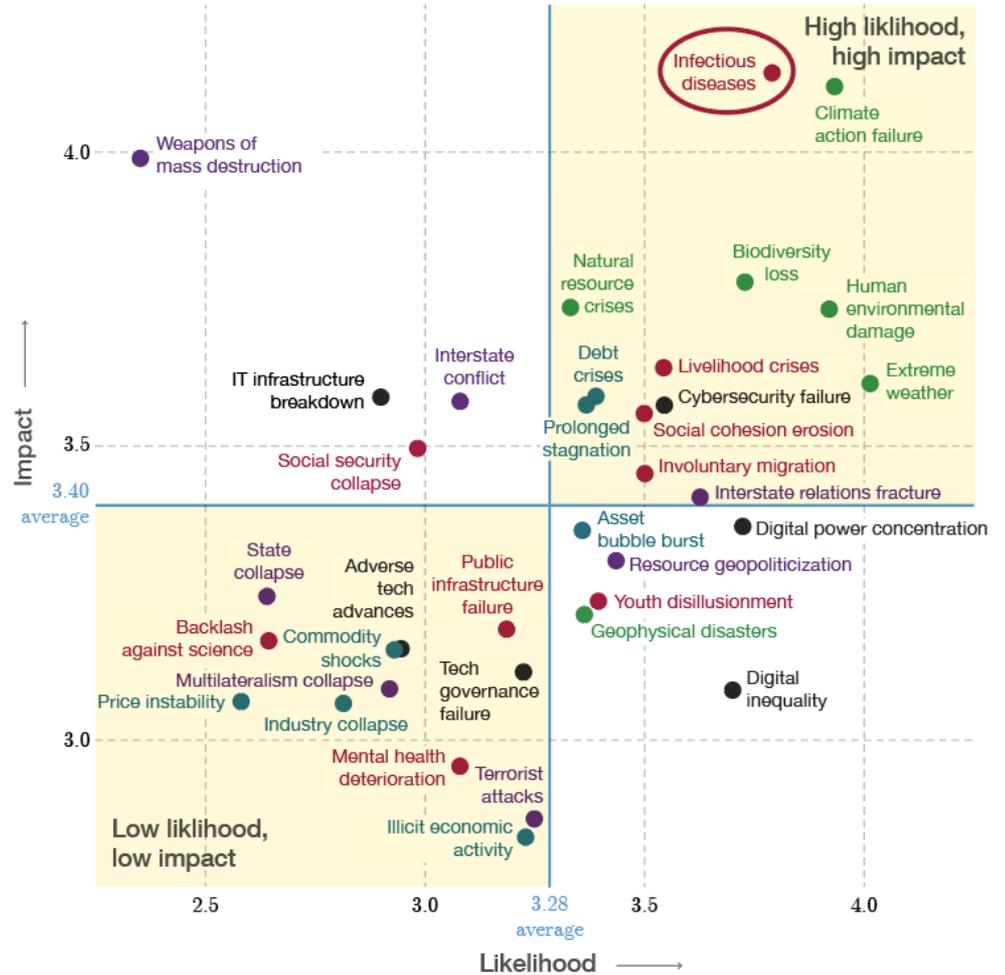


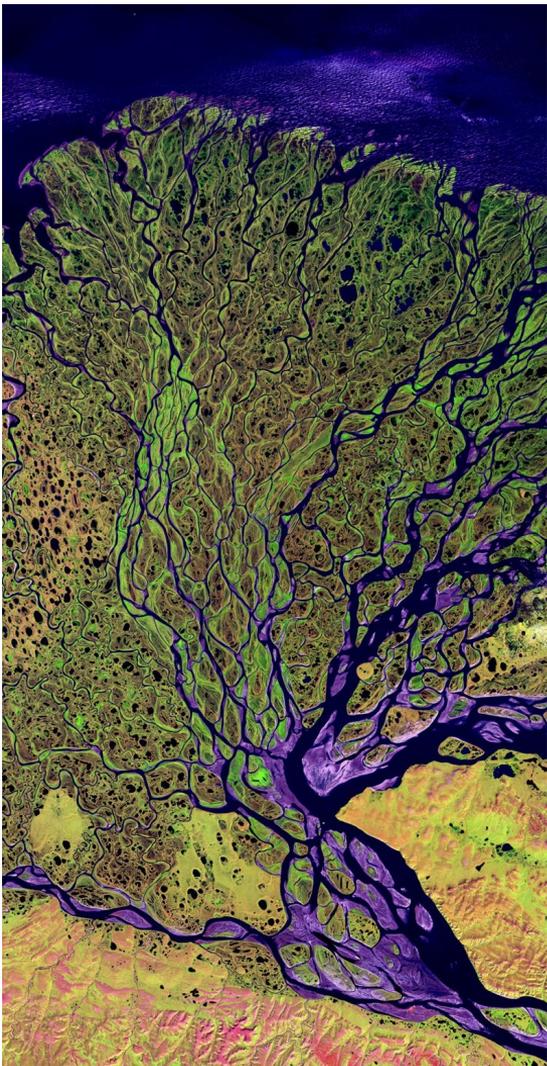
Highest Impact Events

1. Infectious diseases
2. Climate action failure
3. Weapons of mass destruction
4. Biodiversity loss
5. Natural resource crisis

Highest Likelihood Events

1. Extreme weather
2. Climate action failure
3. Human environmental damage
4. Infectious diseases
5. Biodiversity loss

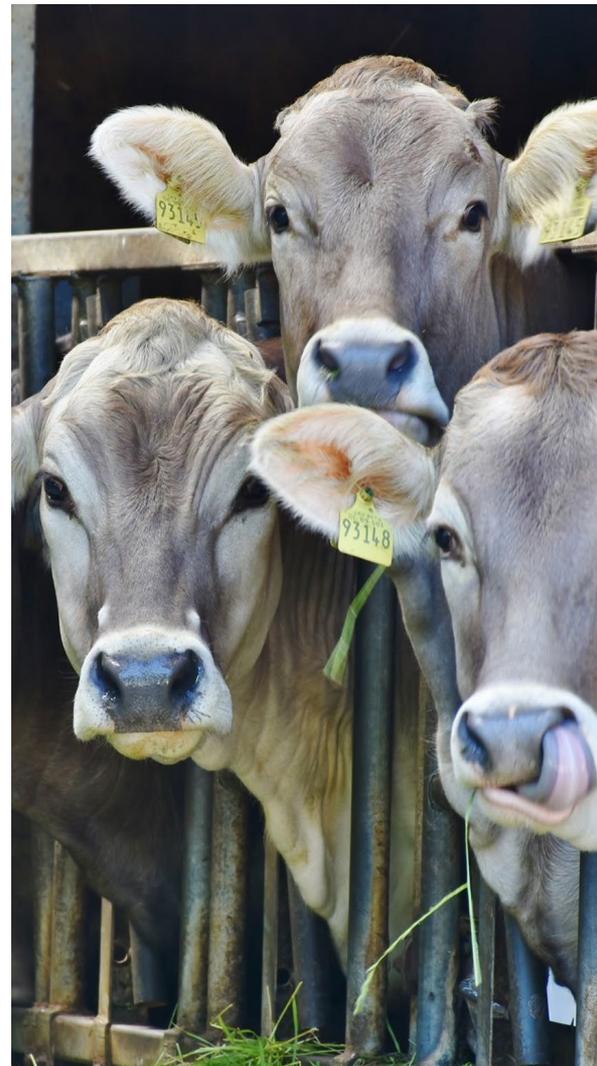




THE
HILL

“America Needs a
National Center for
Infectious Disease
Intelligence”

John M. Drake
June 21, 2020





Can disease outbreaks be predicted?

I WATCH

PREVENTATIVE MANAGEMENT

Infection sources present.
No human infections detected.



II WARNING

INTERVENTION & CONTAINMENT

Spillover infection has occurred.
Human disease verified.



III EMERGENCY

CONTAINMENT & DAMAGE CONTROL

Outbreak threatens to overrun control efforts.
Potential for high human morbidity & fatality.



A three-tiered alert system

Source: Barbara A. Han & John M Drake. Future directions in analytics for infectious disease intelligence:
Toward an integrated warning system for emerging pathogens. EMBO Reports, 2016. <https://www.embopress.org/doi/full/10.15252/embr.201642534>

I WATCH

PREVENTATIVE MANAGEMENT

Infection sources present.
No human infections detected.



Census data
Business data
Transportation data
Mobility data
Pathogen resistance
Economic & societal conditions

II WARNING

INTERVENTION & CONTAINMENT

Spillover infection has occurred.
Human disease verified.



+ Outbreak investigations
+ Transmission pathways
+ Contact tracing
+ Seroprevalence in humans

III EMERGENCY

CONTAINMENT & DAMAGE CONTROL

Outbreak threatens to overrun control efforts.
Potential for high human morbidity & fatality.



+ Interventions
+ Testing levels
+ Quarantine & shelter orders
+ Sanitation & prevention efforts
+ Case counts, hospitalizations & fatalities
+ Genetic sequencing
+ Environmental testing
+ Response infrastructure & resources

Wild animal testing
Livestock surveillance

+ Seroprevalence in animals
+ Vector monitoring

Climate trends
Weather events

data

human

animal

environment



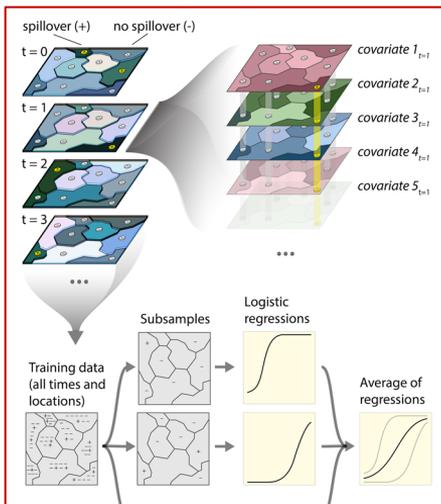
I WATCH

PREVENTATIVE MANAGEMENT

Infection sources present.
No human infections detected.



Data mining
Statistical modeling
Spillover risk mapping



Kaul, R.B. et al. Spatio-temporal spillover risk of yellow fever in Brazil. *Parasites & Vectors*. Aug 29, 2018

II WARNING

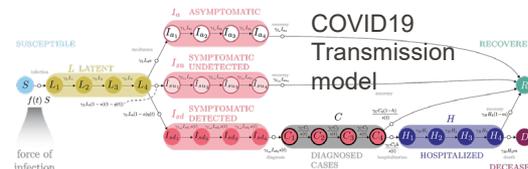
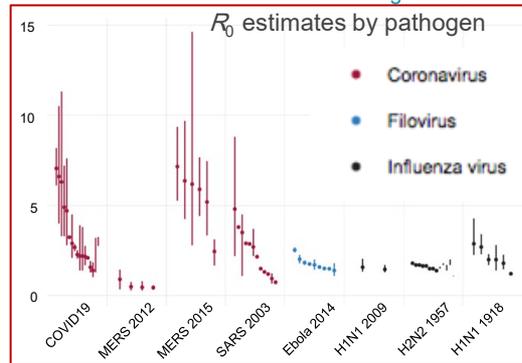
INTERVENTION & CONTAINMENT

Spillover infection has occurred.
Human disease verified.



+ Transmission dynamics
+ Phylodynamics

covid19.uga.edu/context



covid19.uga.edu/stochastic-GA

III EMERGENCY

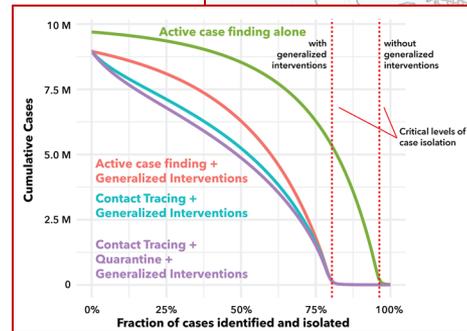
CONTAINMENT & DAMAGE CONTROL

Outbreak threatens to overrun control efforts.
Potential for high human morbidity & fatality.



+ Forecasting & Nowcasting
+ Scenario analysis
+ Disease spread risk mapping

covid19.uga.edu/us-importation-risk

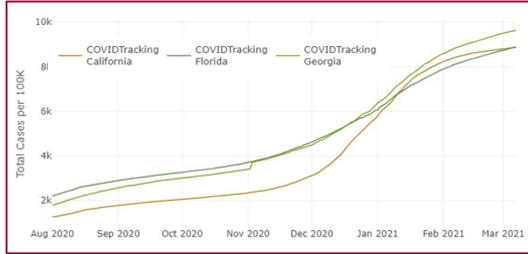


covid19.uga.edu/suppression

I WATCH

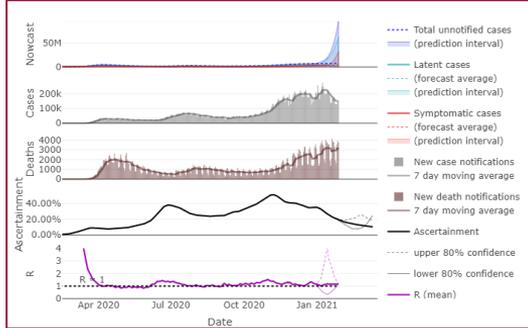
COVID-19 Tracker

A. Handel et. al. covid19.uga.edu/tracker



COVID-19 Nowcast

J.M. Drake et. al. covid19.uga.edu/nowcast



COVID-19 Importation Risk

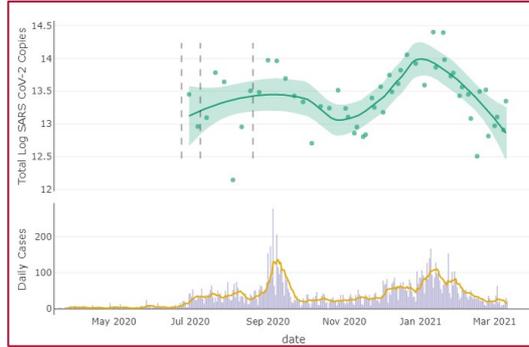
J.M. Drake et. al. covid19.uga.edu/import-risk



II WARNING

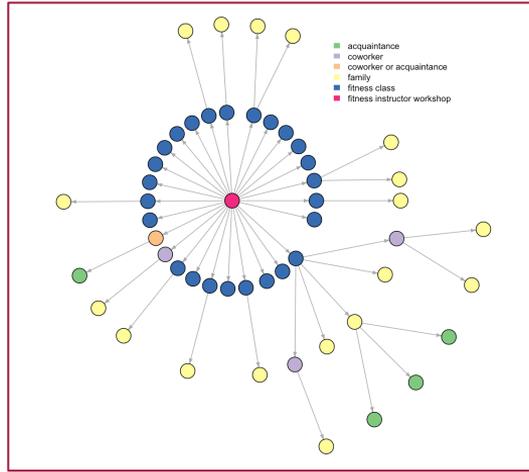
COVID-19 Wastewater Surveillance

E. Lipp et. al. covid19.uga.edu/wastewater



COVID-19 Transmission Tree Database

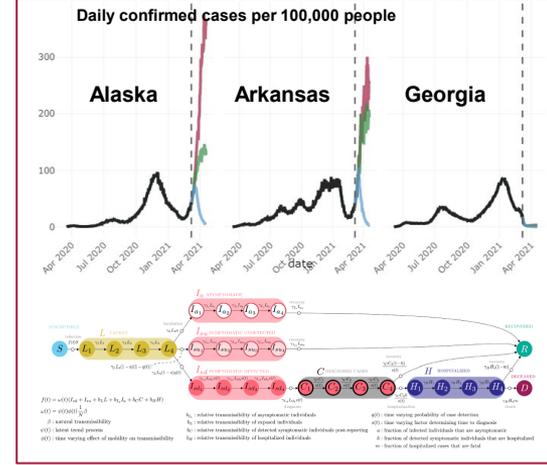
J. Taube et. al. outbreaktrees.ecology.uga.edu



III EMERGENCY

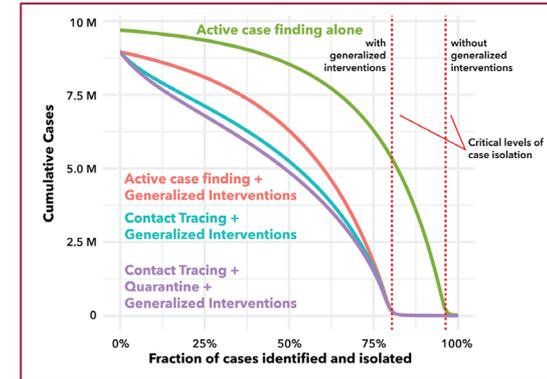
COVID-19 Forecasts for the US by State

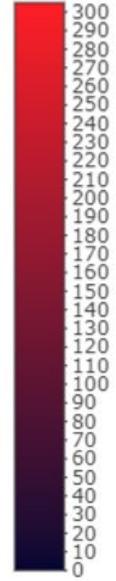
J.M. Drake et. al. covid19.uga.edu/forecast



COVID-19 Suppression without Distancing

J.M. Drake et. al. covid19.uga.edu/suppression





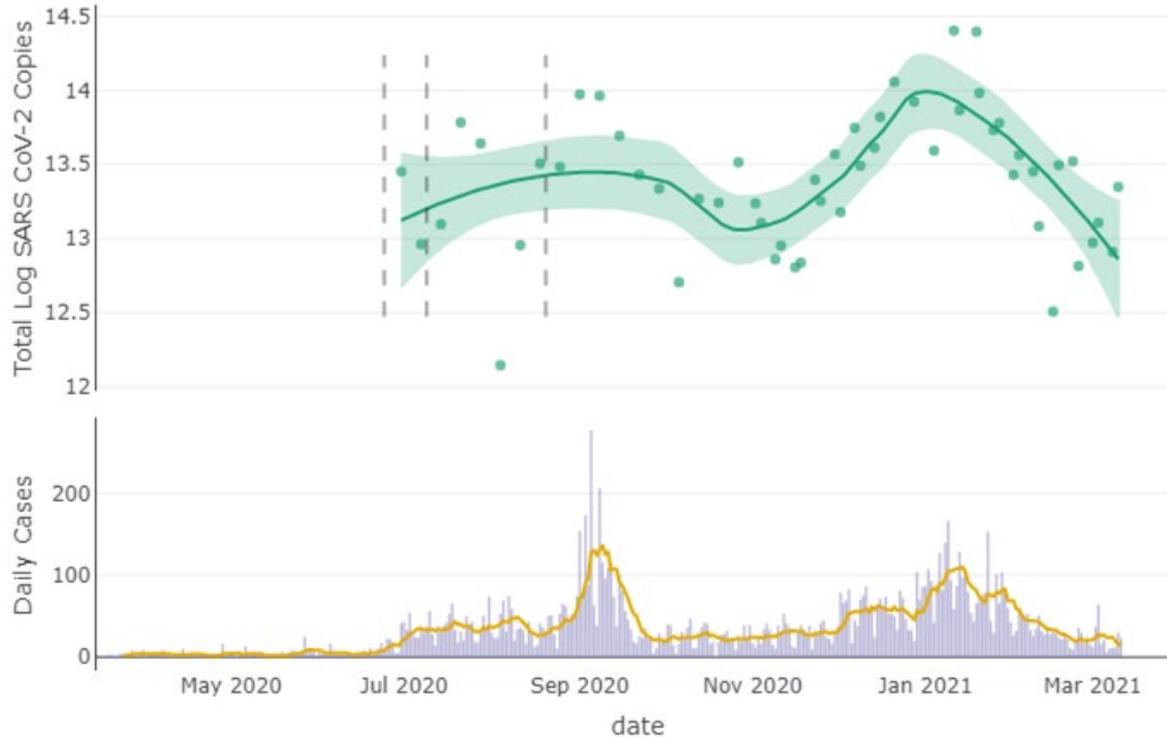
Predicted monthly importations

Top Five Airports

1. MIA Miami
2. JFK New York
3. EWR New York
4. LAX Los Angeles
5. ORD Chicago



Wastewater surveillance for SARS-CoV-2, Athens, GA



Erin Lipp et al.
covid19.uga.edu/wastewater



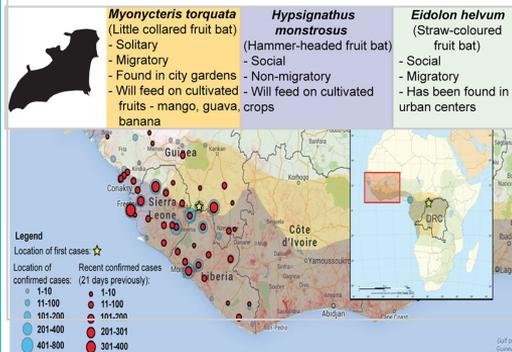
Ebola in West Africa

I WATCH

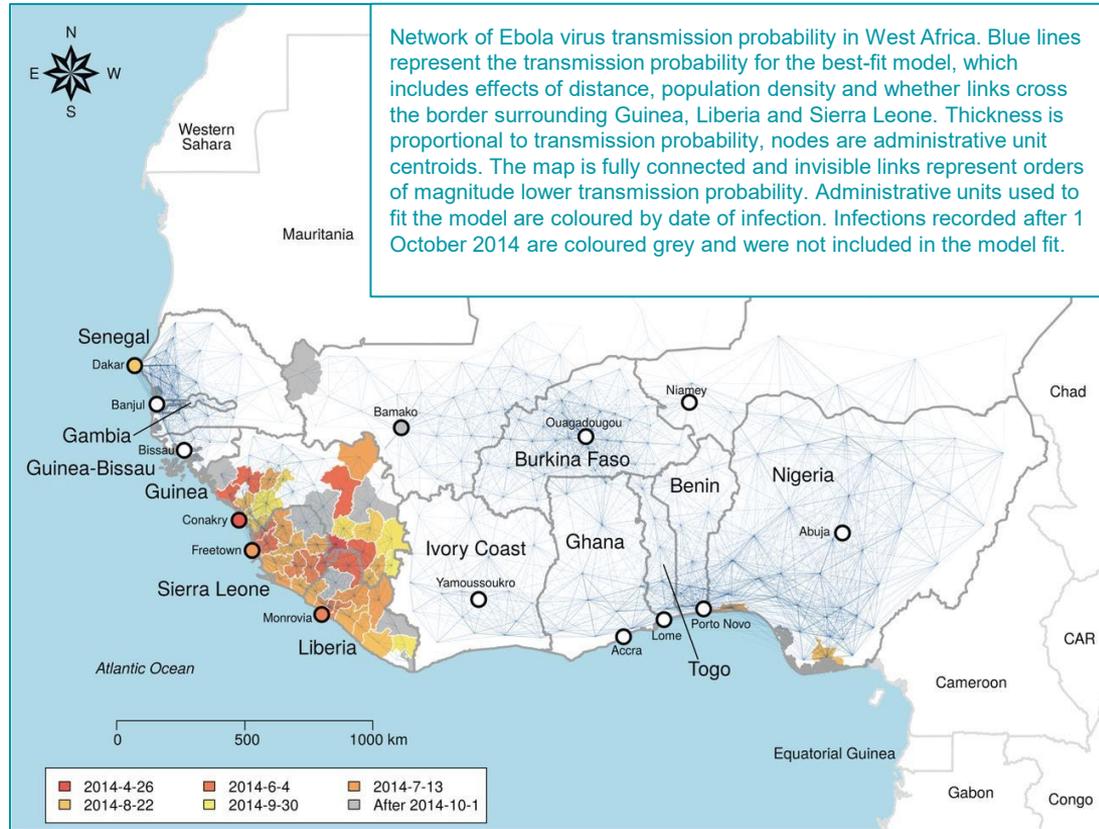
Historical Ebola outbreaks in Africa, reservoir species, and human population density.



Range: Bat species suspected of being Ebola reservoirs, human population density, and Ebola case counts by location in West Africa.

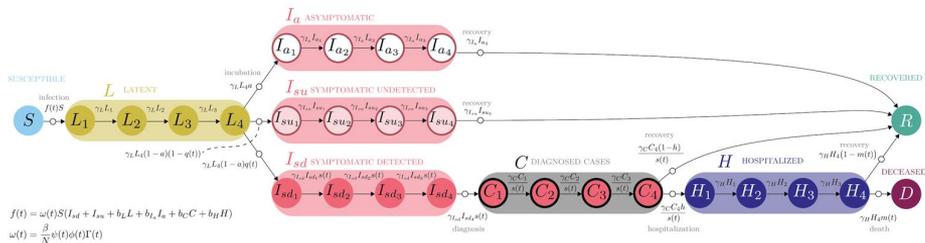


II WARNING

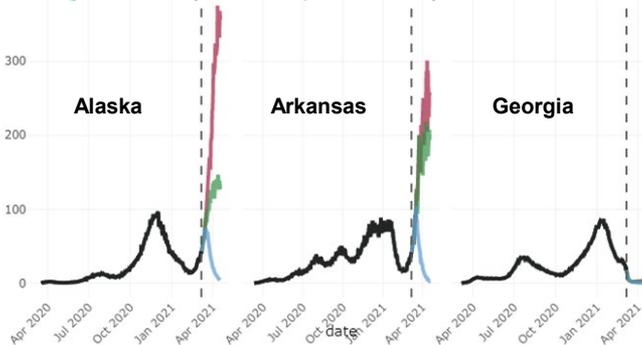


Kramer, A.M. et al. Spatial spread of the West Africa Ebola epidemic. *R. Soc. Open Sci.* Aug 1, 2016

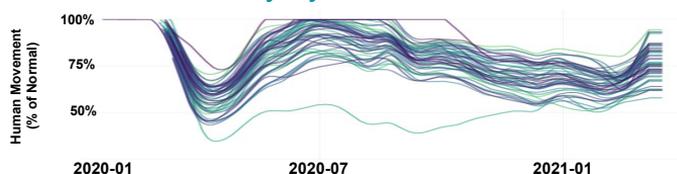
Alexander, K.A. et al. What Factors Might Have Led to the Emergence of Ebola in West Africa? *PLOS NTD* June 4, 2015



Daily Cases per 100,000 People



Relative Mobility by State



Select State(s)
 Georgia

Select scenario(s)
 Increase social distancing
 Return to normal
 Maintain social distancing

Show 80% prediction interval
 Yes
 No

Daily or cumulative numbers
 Daily
 Cumulative

Modify all plots to show daily or cumulative data.

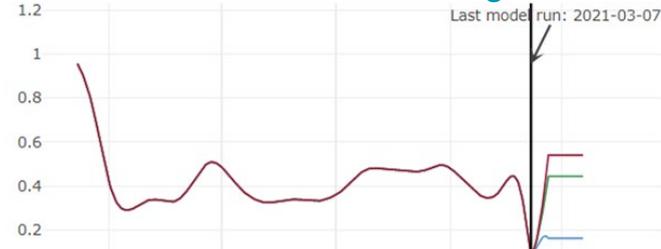
Absolute or scaled values
 Absolute Number
 Per 100,000 persons

Modify the bottom three plots to display values scaled by the state population size.

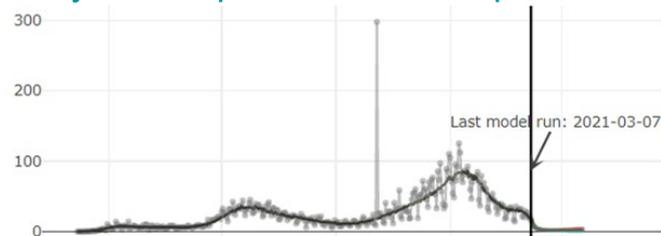
Select a range of dates to be plotted.
 2020-03-01 2021-04-14

covid19.uga.edu/forecast

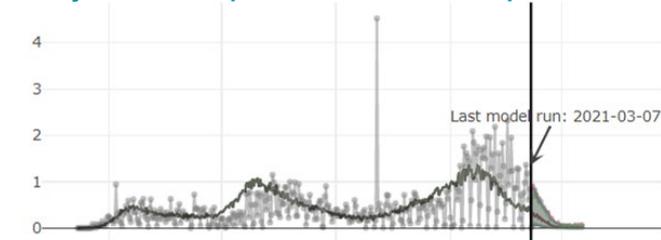
Relative Transmission Strength



Daily Cases per 100,000 People



Daily Deaths per 100,000 People





Global
Infectious
Disease
Intelligence
Consortium

GIDIC is a collaboration of leaders in academia, government, industry, & NGOs who need to be aware of emerging infectious diseases.

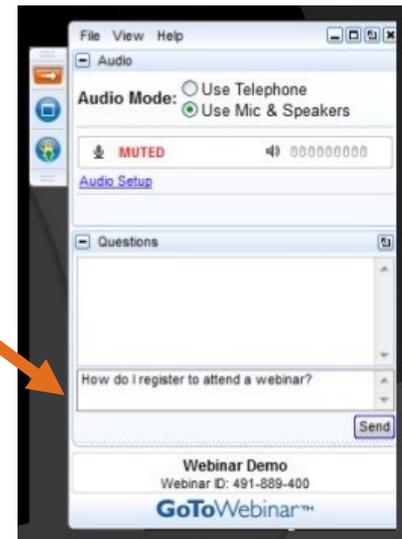
GIDIC is designed to provide members with Infectious Disease Intelligence.

GIDIC collaborators from diverse professional backgrounds work together to enhance our ability to limit the human & economic damage created by future pandemics.

Learn more: gidic.uga.edu

Contact: Dr. John Drake (jdrake@uga.edu)

Please submit your questions using the questions tab on your screen.





Machine Learning: What It Is and What Its Applications Are

April 28, 2021 12 - 1 PM ET



Moderator:
Carla Leigh
Cisco



Yiwen Xu
North Dakota
State University

THANK YOU!

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Infectious Disease Intelligence: Predicting the Next Pandemic



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**Ecology
across scales**

- Ecosystem Ecology
- Biogeography
- Sustainability
- Watershed Ecology
- Evolutionary Ecology
- Infectious Diseases