Foresight & Public Health Preparedness

2022 Virginia Public Health Preparedness Summit
September 28, 2022

Hampton, Va

Justin Crow

VDH VIRGINIA
DEPARTMENT
OF HEALTH

Foresight & COVID-19

March/Early April 2020

China's coronavirus hospital built in 10 days opens its doors, state media says **NEWS**

Construction of the hospital began Jan. 24 with a crew of 7,000 people working around the clock.

Huoshenshan Hospital construction nears completion on February 2, 2020 in Wuhan, China.

Getty Images

Image source: CNBC: https://www.cnbc.com/2020/04/03/photos-of-field-hospitals-set-up-around-the-world-to-treat-coronavirus-patients.html

Italy has a world-class health system. The coronavirus has pushed it to the breaking point. **NEWS**

"I have never seen so many people die together before my eyes," said a nurse from one of the main hospitals in Bergamo, a city in northern Italy.

Two intensive care professionals comfort each other in the ICU of a hospital in Cremona, Italy, on Friday, March 13, 2020. Paolo Miranda

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March/ Early April 2020

Trump won't impose quarantine on New York and surrounding areas

Michael Collins USA TODAY

Published 11:47 a.m. ET March 28, 2020 | Updated 8:57 p.m. ET March 28, 2020

USA TODAY

President Donald Trump speaks in front of the U.S. Navy hospital ship USNS Comfort at Naval Station Norfolk in Norfolk, Va., on Saturday. He is accompanied by Defense Secretary Mark Esper. *Patrick Semansky, AP*

Coronavirus and the States: Governors Plan Field Hospitals; Heartland Unemployment Spikes

STATELINE UPDATE   March 23, 2020   By: Christine Vestal   Topics: Business of Government, Health, Economy, Federal Impact, Jus Social Issues   Read time: 7 min

PEW

Share   Read Mode

Workers build a temporary field hospital on a soccer field for people ill with the novel coronavirus so they can isolate and recover last week in Shoreline, Washington state.
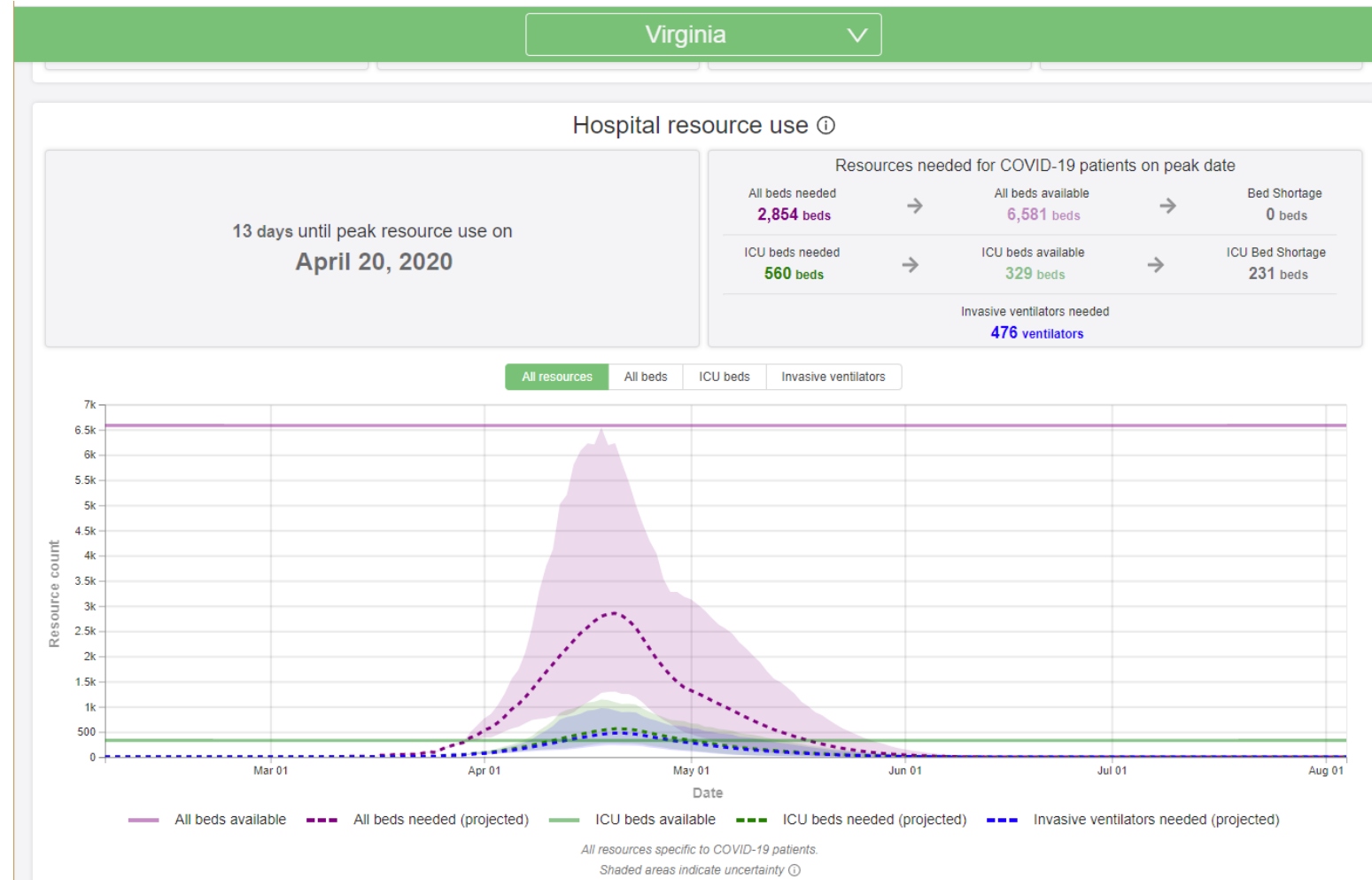
Karen Ducey/Getty Images

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University of Washington IHME Model

From Presentation Prepared April 7, 2020

Peak: April 2020

Hospitalizations: 2,854

ICU Beds: 560

Virginia

Hospital resource use ⓘ

13 days until peak resource use on
April 20, 2020

Resources needed for COVID-19 patients on peak date

All beds needed **2,854** beds	→	All beds available **6,581** beds	→	Bed Shortage **0** beds
ICU beds needed **560** beds	→	ICU beds available **329** beds	→	ICU Bed Shortage **231** beds

Invasive ventilators needed
476 ventilators

All resources | All beds | ICU beds | Invasive ventilators

— All beds available ---- All beds needed (projected) — ICU beds available ---- ICU beds needed (projected) ---- Invasive ventilators needed (projected)

All resources specific to COVID-19 patients.
Shaded areas indicate uncertainty ⓘ

VIRGINIA DEPARTMENT OF HEALTH

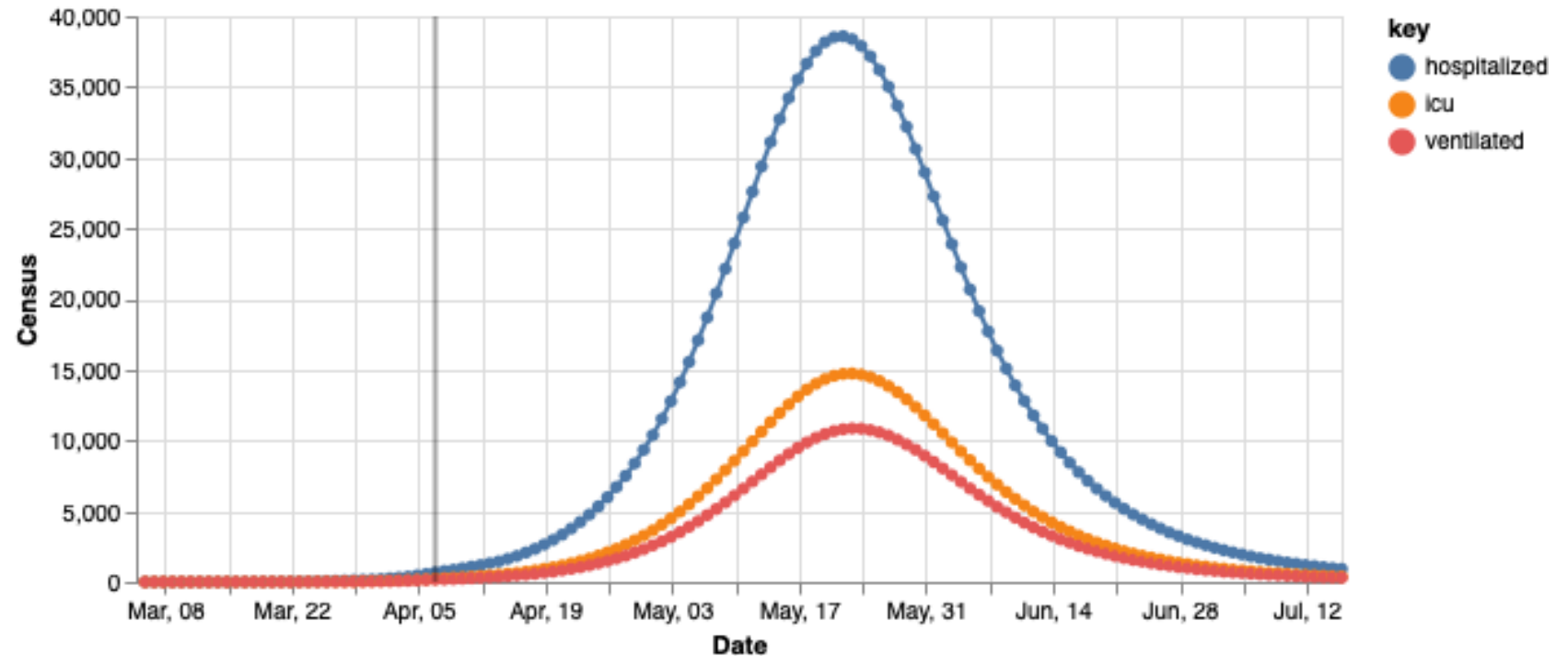# University of Pennsylvania CHIME Model – Total Census

**From Presentation
Prepared April 7, 2020**

Peak: May 22, 2020

Hospitalizations: 38,590

ICU Beds: 14,737

Ventilators: 10,852

Hospitalized Census peaks at 38,590 on May 22

ICU Census peaks at 14,737 on May 22

Ventilated Census peaks at 10,852 on May 22

Parameters included Virginia population and assumption of 95% of residents seeking care at a Virginia healthcare facility, and count of confirmed cases of COVID-19 currently admitted on 4/7/20, as reported by VHHA

March/April 2020

HAMPTON

U.S. Army Corps of Engineers ready to convert Hampton Roads Convention Center into medical care space

13NEWSNOW

The Hampton Roads Convention Center was one of three facilities selected to become a field hospital due to COVID-19.

Tennessee, Virginia prepare for COVID-19 "surge" with field hospital sites

NEWS WCYB 5

by John Engel | Friday, April 3rd 2020

Late April/May

As beds go unfilled, states scale back Army Corps makeshift hospitals

By Paul Sonne and Missy Ryan

April 25, 2020

The Washington Post
Democracy Dies in Darkness

Makeshift hospitals

The U.S. Army Corps of Engineers is building 32 alternative-care facilities around the country, 18 of which have been completed.

○ 50 beds   ○ 250   ○ 1,000   ○ 2,000   ● Completed   ● Still under construction

Javits Center
New York
1,900 beds

Colorado Convention Center
Denver
2,000 beds

TCF Center
Detroit
1,000 beds

Data as of April 25

Source: U.S. Army Corps of Engineers

THE WASHINGTON POST

Anchorage

Miami Beach Convention Center
450 beds
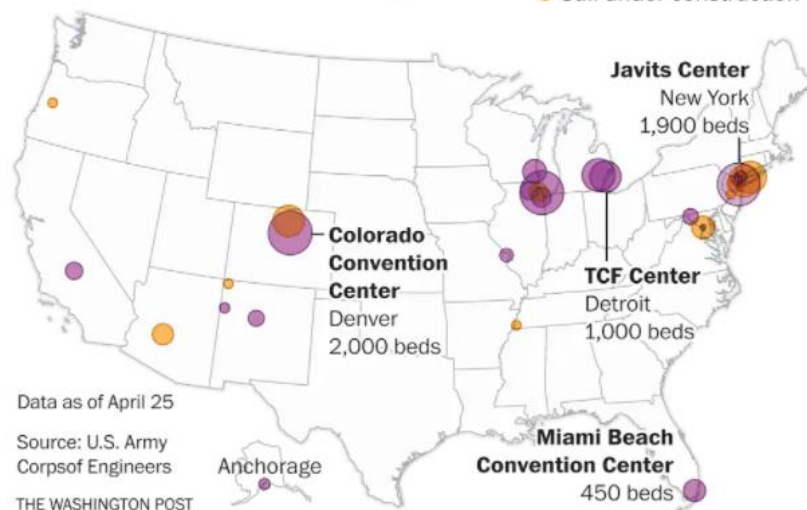
U.S. Field Hospitals Stand Down, Most Without Treating Any COVID-19 Patients

May 7, 2020 · 1:15 PM ET
Heard on All Things Considered

JOEL ROSE

npr   **radio iQ**

▶ 5-Minute Listen   + PLAYLIST

Construction at the COVID-19 field hospital at McCormick Place in Chicago on April 10. The city pared back plans for a 3,000-bed temporary hospital at the nation's largest convention center as infection numbers decreased.

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Mid-April

Virginia is 'pivoting away' from field hospitals

Dr. Danny Avula of Richmond/Henrico health departments says hospitals likely can handle coming surge.

PUBLISHED APRIL 17, 2020   BY KATE ANDREWS

virginia BUSINESS

Virginia hits pause on plans for 3 large field hospitals

12 On Your Side

Virginia is "pivoting away" from needing field hospitals to handle patient overflow because health systems believe they'll be able to manage any surge in COVID-19 cases, said Dr. Danny Avula, the director of Richmond and Henrico County's health departments, Friday evening.

"We have not seen any significant increase in hospitalization [and] ventilator use is under 25%," Avula said during a news briefing. "It feels like the calm before the storm, and hopefully the storm will never come."

Dr. Danny Avula, director of Richmond and Henrico County health departments, at his April 17 news conference

Examining the University of Virginia's COVID-19 forecasting model, Avula said, Virginia seems likely to have a "lower but longer curve," although he said the peak may be sooner than the August timeframe predicted by the U.Va. Biocomplexity Institute. Testing availability is continuing to expand, Avula said, and it's possible that antibody testing allowing doctors to determine if a patient has recovered from COVID-19 will be available in Virginia within the next month.

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VDH – UVA Biocomplexity Institute partnership

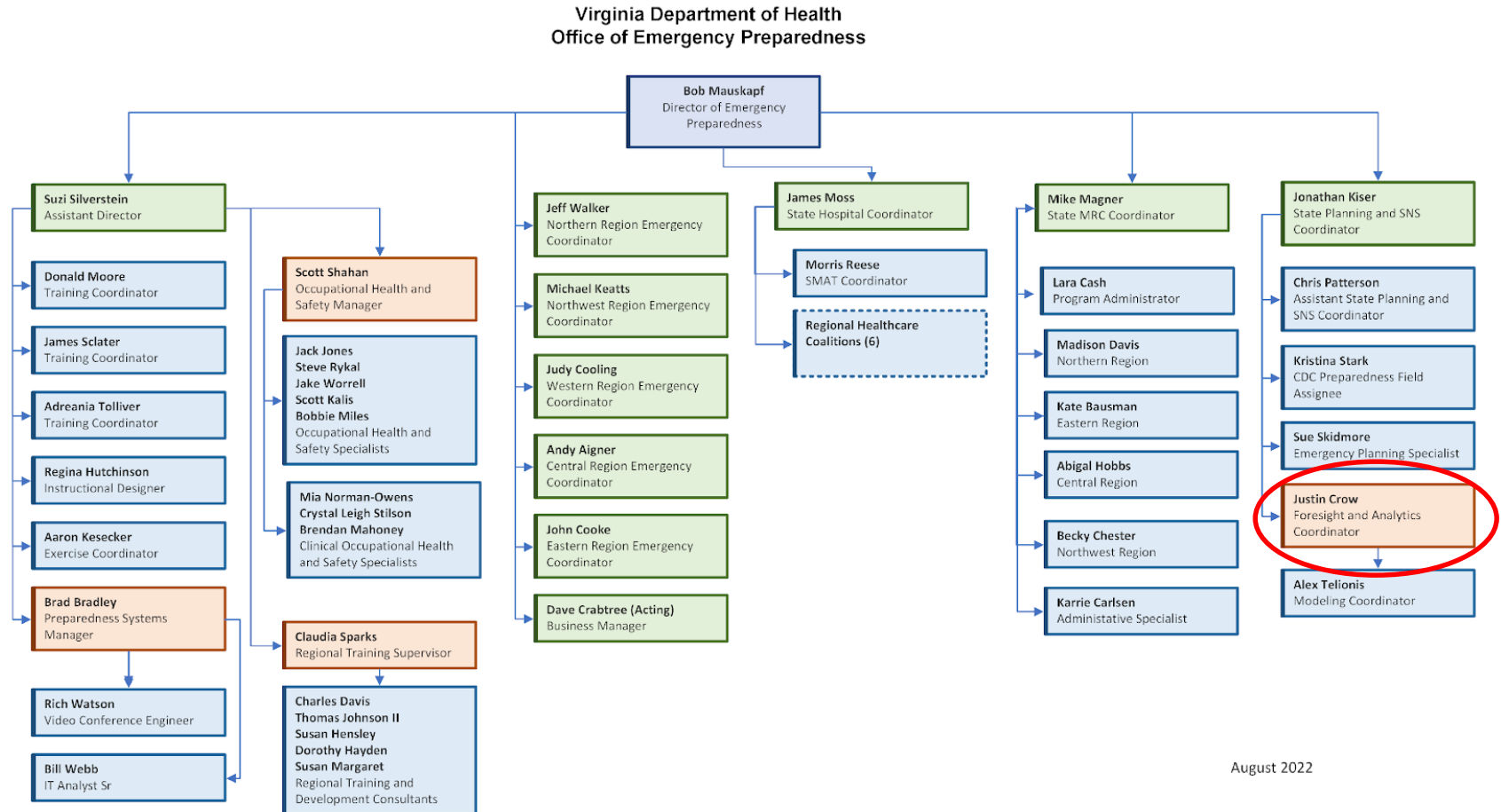Key Statistics   as of March 2022

- Invitees to the Surveillance & Modeling Stakeholder Meeting: 214
- Average Stakeholder Meeting Attendance, Dec - Mar 2022:   110
- Weekly Reports/UVA Slide Sets Posted: 93
- Total Views of UVA Model Explorer: 1.37 million
- Media Stories Identified (as of March 9):   360+

UNIVERSITY of VIRGINIA

BIOCOMPLEXITY INSTITUTE

Foresight & Analytics Unit

- Launched April 2022 in VDH Office of Emergency Preparedness

- Previously Modeling Unit during COVID-19 response

- Funded through COVID-19 funds & Public Health Workforce Grant

Virginia Department of Health
Office of Emergency Preparedness

Bob Mauskapf
Director of Emergency Preparedness

Suzi Silverstein — Assistant Director

Donald Moore — Training Coordinator
James Sclater — Training Coordinator
Adreania Tolliver — Training Coordinator
Regina Hutchinson — Instructional Designer
Aaron Kesecker — Exercise Coordinator
Brad Bradley — Preparedness Systems Manager
Rich Watson — Video Conference Engineer
Bill Webb — IT Analyst Sr

Scott Shahan — Occupational Health and Safety Manager
Jack Jones, Steve Rykal, Jake Worrell, Scott Kalis, Bobbie Miles — Occupational Health and Safety Specialists
Mia Norman-Owens, Crystal Leigh Stilson, Brendan Mahoney — Clinical Occupational Health and Safety Specialists
Claudia Sparks — Regional Training Supervisor
Charles Davis, Thomas Johnson II, Susan Hensley, Dorothy Hayden, Susan Margaret — Regional Training and Development Consultants

Jeff Walker — Northern Region Emergency Coordinator
Michael Keatts — Northwest Region Emergency Coordinator
Judy Cooling — Western Region Emergency Coordinator
Andy Aigner — Central Region Emergency Coordinator
John Cooke — Eastern Region Emergency Coordinator
Dave Crabtree (Acting) — Business Manager

James Moss — State Hospital Coordinator
Morris Reese — SMAT Coordinator
Regional Healthcare Coalitions (6)

Mike Magner — State MRC Coordinator
Lara Cash — Program Administrator
Madison Davis — Northern Region
Kate Bausman — Eastern Region
Abigal Hobbs — Central Region
Becky Chester — Northwest Region
Karrie Carlsen — Administative Specialist

Jonathan Kiser — State Planning and SNS Coordinator
Chris Patterson — Assistant State Planning and SNS Coordinator
Kristina Stark — CDC Preparedness Field Assignee
Sue Skidmore — Emergency Planning Specialist
Justin Crow — Foresight and Analytics Coordinator
Alex Telionis — Modeling Coordinator

August 2022

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Not just modeling…

- Vision: To increase and improve foresight and analysis capacity in the commonwealth, and to be a trusted resource for foresight and analysis in the commonwealth.

- Strategic Goal: To minimize the timespan between public health threat emergence and effective decision-making by stakeholders and the public.

- Programmatic Priorities:
  - Building an Anticipatory Agency
  - Informatics Planning for Emerging Public Health Threats
  - Early Warning System Coordination
  - Respond to Emerging Public Health Threats
  - Strategic Planning Support

Strategic Partners during COVID-19:

UVA Biocomplexity Institute

Metaculus Forecasting Platform

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Time Horizons
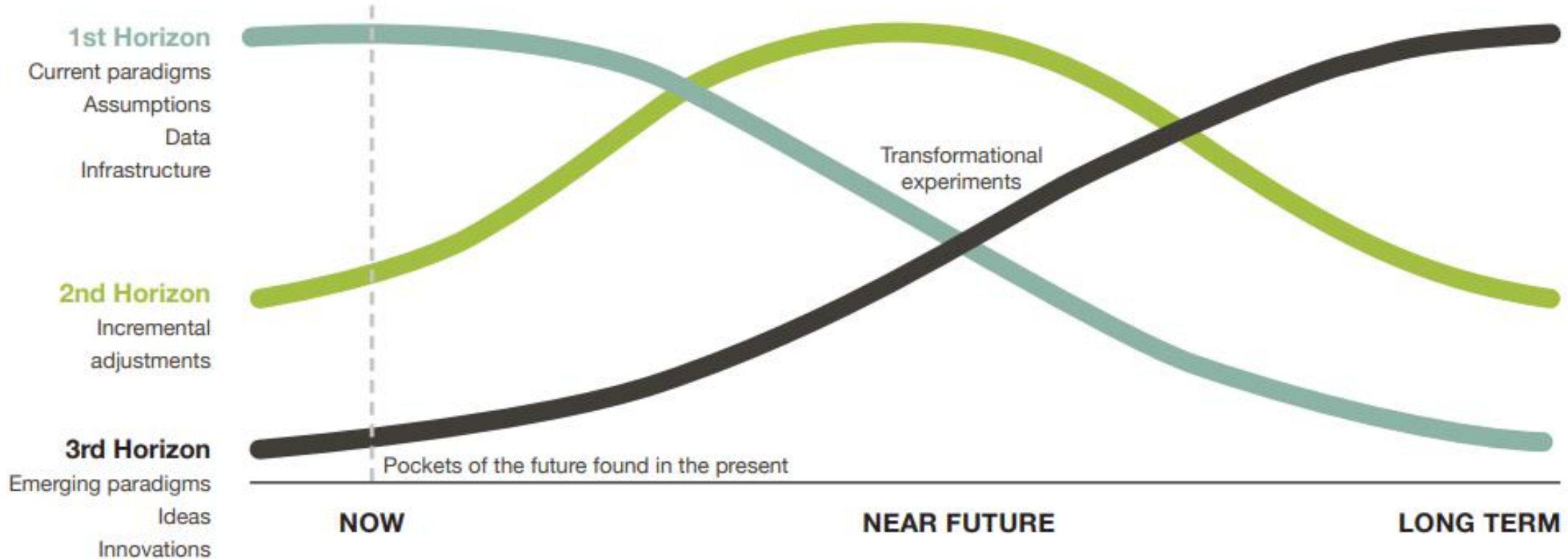
Source: IFTF Vantage, *Toward Future Readiness: A Playbook for Building Foresight Capacity*

Building an Anticipatory Agency

Foresight is…

- Strategic Foresight: a structured approach to engaging with the future

- Forecasting: projections or forecasts about the future, or about potential futures under certain conditions

- Early warning: Identifying threats, and developing accurate information on them, as soon as they emerge – or earlier!

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A Language for Foresight

"Crystal Ball Photography Variant" by Flavio~ is licensed under CC BY 2.0

Estimate: Educated approximation of a current unknown value or situation

Projection: Past trends projected forward, with varying degrees and types of complexity

Forecast: A projection or judgment about future values using uncertainty qualifiers (confidence intervals, probability)

Prediction: A certain statement about the future. "Mark my words...X will happen"

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Goal of Forecasts: Calibration
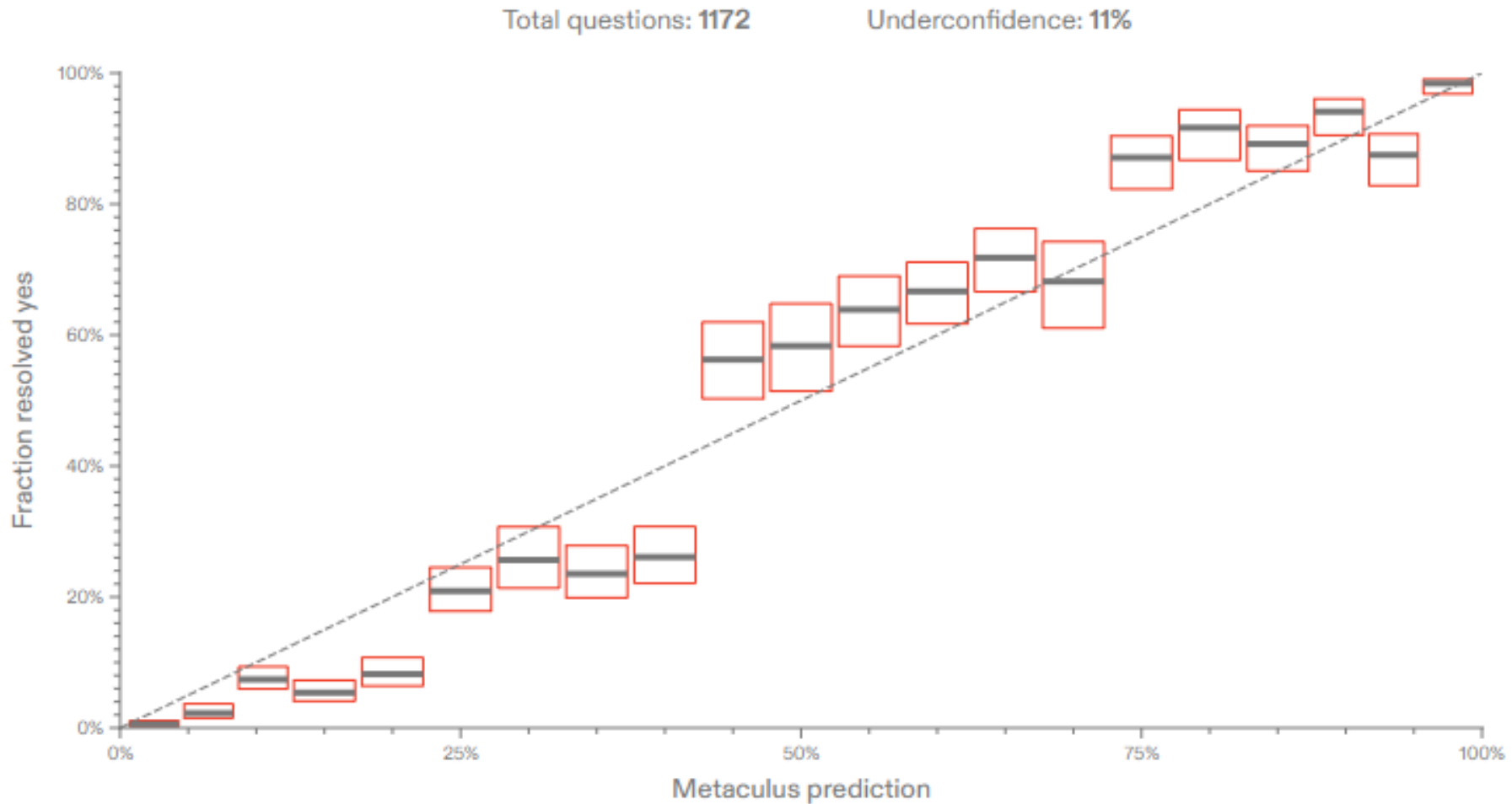
Foresight is…

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In the year 2032. . .

A Public Health Vision for 2032…

- A virulent Flu strain with a concerning genomic profile is identified in Sao Paulo, Brazil. The sequence is published and highlighted in global repositories.
- Virginia, along with other states, begins prioritizing wastewater from flights from Sao Paulo for rapid sequencing.
- Within days, the new strain is identified in a flight. Many passengers are contacted through private health and fitness apps (which also check for symptoms), or through airline apps.
- Days later, an outbreak tied to the new strain emerges among teenagers in an neighborhood in Hampton, Va.
- Epidemiologists follow commuting patterns to alert businesses whose employees may be impacted.
- Outreach staff use cellphone mobility data to host test and education events at retail and other businesses frequented by young people from the affected area.

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Strategic Foresight Tools

Focus: EXPLORING THE FUTURE

Horizon scanning

Horizon scanning is a foresight process focused on identifying and collating early warning signs of change, or emerging signals that may potentially have significant impacts when they develop.

Trend Analysis

Trends are collections of signals and events – and their build-up into patterns – that indicate likely directions of change.

Driver Mapping

Drivers are influential forces of changes that are shaping, or have the capacity to shape or transform, a system. Driver mapping is a tool used for identifying the most influential forces of change in a system.

Futures/ Implications Analysis wheel

Futures wheel, also the implications analysis wheel, is a tool that enables us to systematically explore the direct and indirect implications of important trends and issues.

Focus: CREATING ALTERNATE FUTURES

Futures Triangle

Futures triangle is a tool that helps us to map the future through the three dimensions that are shaping the future – the pull of the future, the push of the present and the weight of history. It is a simple and quick method for understanding plausible (and alternatives) futures based on the interactions and movements, namely the strengthening and ebbing of the three forces.

Scenarios

A scenario is a description of how the future may unfold based on an explicit, coherent, and internally consistent set of plausible assumptions about key relationships between drivers of change and trends.

Source: UNDP Regional Bureau for Asia and the Pacific, *Foresight Playbook*

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Detection of SARS-CoV-2 variants in aircraft wastewater

Download PDF Copy

By Dr. Priyom Bose, Ph.D.

Reviewed by Benedette Cuffari, M.Sc.

Most commonly mutated sites

Fitness app annual users 2015 to 2021 (mm)

Sources: Data.ai, eMarketer, MoEngage
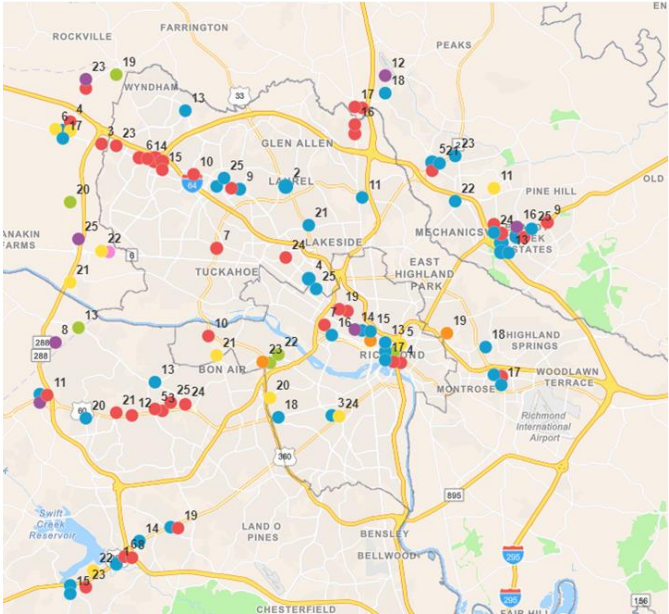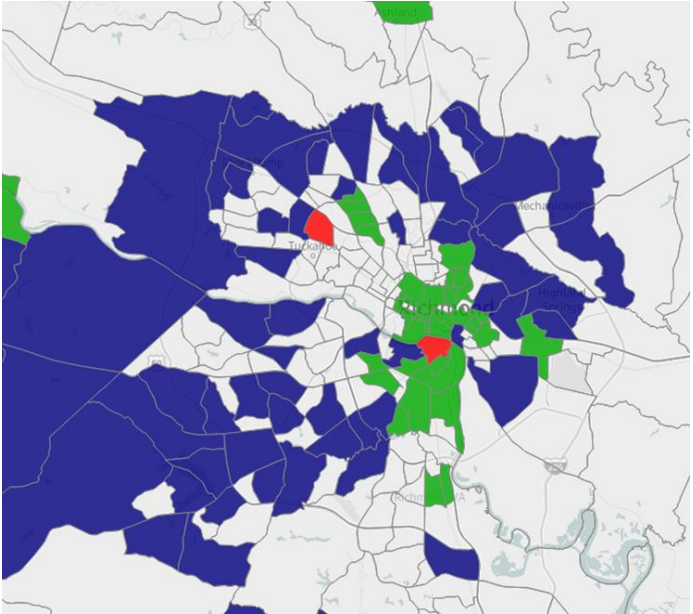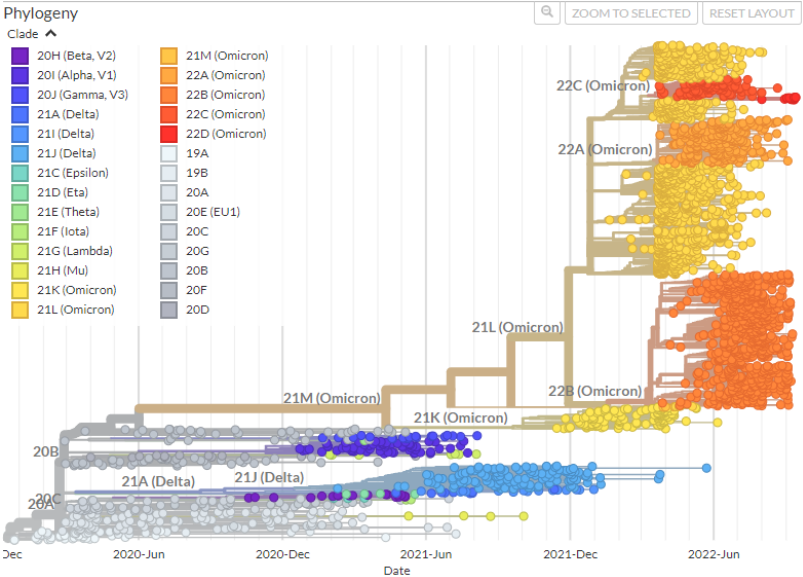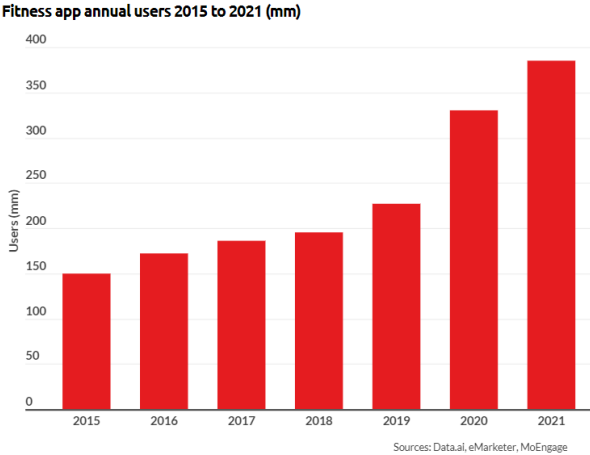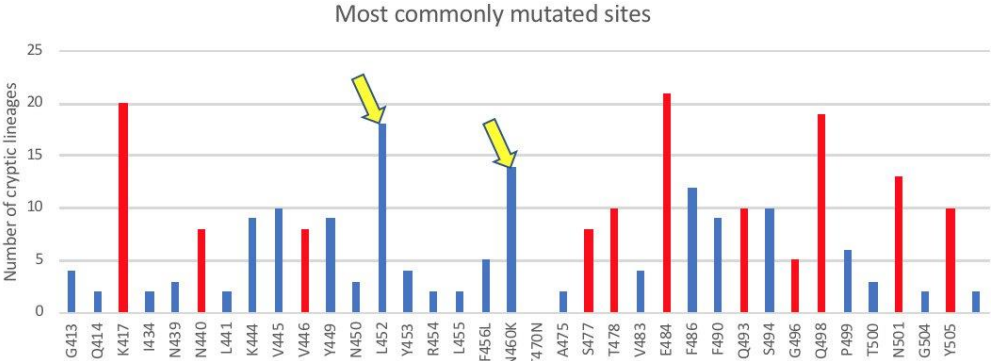
Have you seen any signals for 2032?
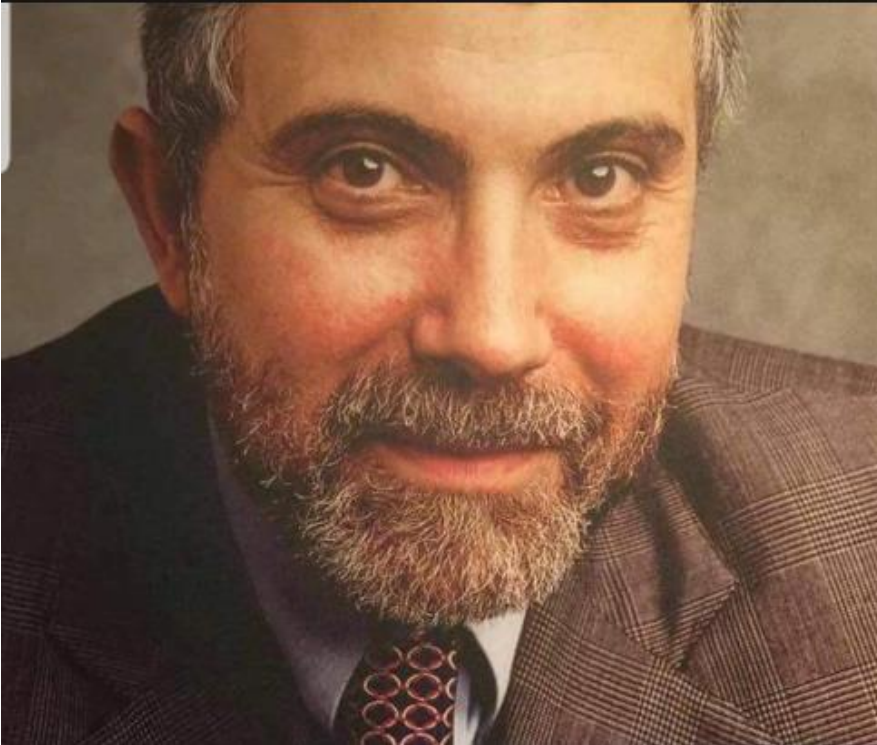
"By 2005 or so, it will become clear that the Internet's impact on the economy has been no greater than the fax machine's."

Nobel Prize-winning economist
Paul Krugman
1998

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Two Types of Forecasting

Quantitative Models
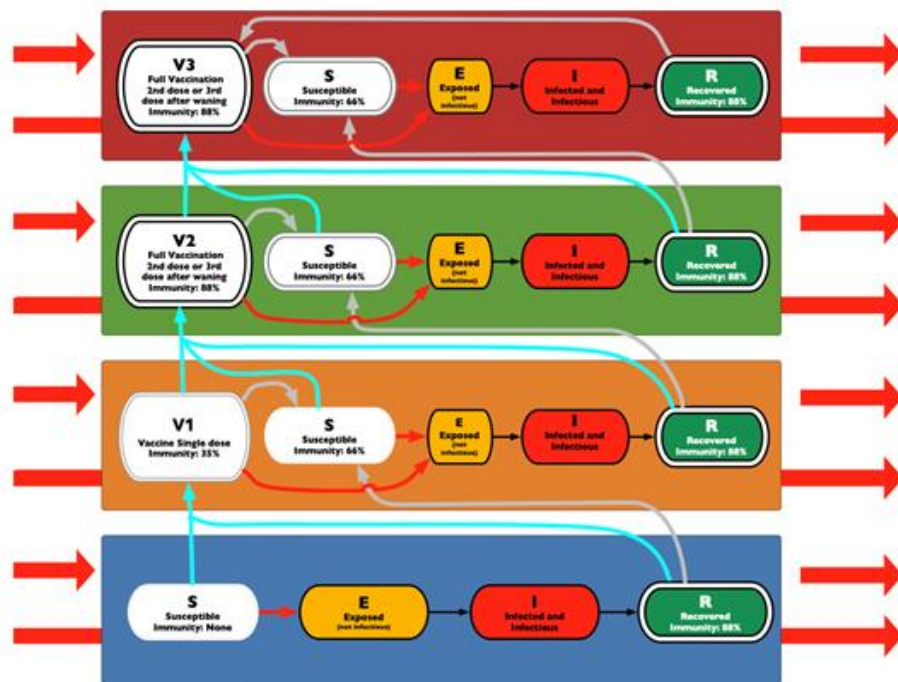
UVA Biocomplexity Institute

Aggregate Human Judgment

"Thinking New York" by Rusty Russ is licensed under CC BY-NC-SA 2.0.

Models – a primer

What is a model?

- A simplification of reality
- A tool for understanding
- A technology that improves over time

What can models do?

- Help us understand complex systems
- Make clear what we do and don't know about these systems
- Identify ongoing trends in the data
- Make approximate projections of future outcomes
- Allow us to estimate the effects of interventions

Katrina's Forecast Uncertainty: Today vs 2005

2005
2015

Improved observations, new satellites and advances in research, modeling and supercomputing have led to hurricane track forecasts that are 40% more accurate, leading to greater forecast confidence.
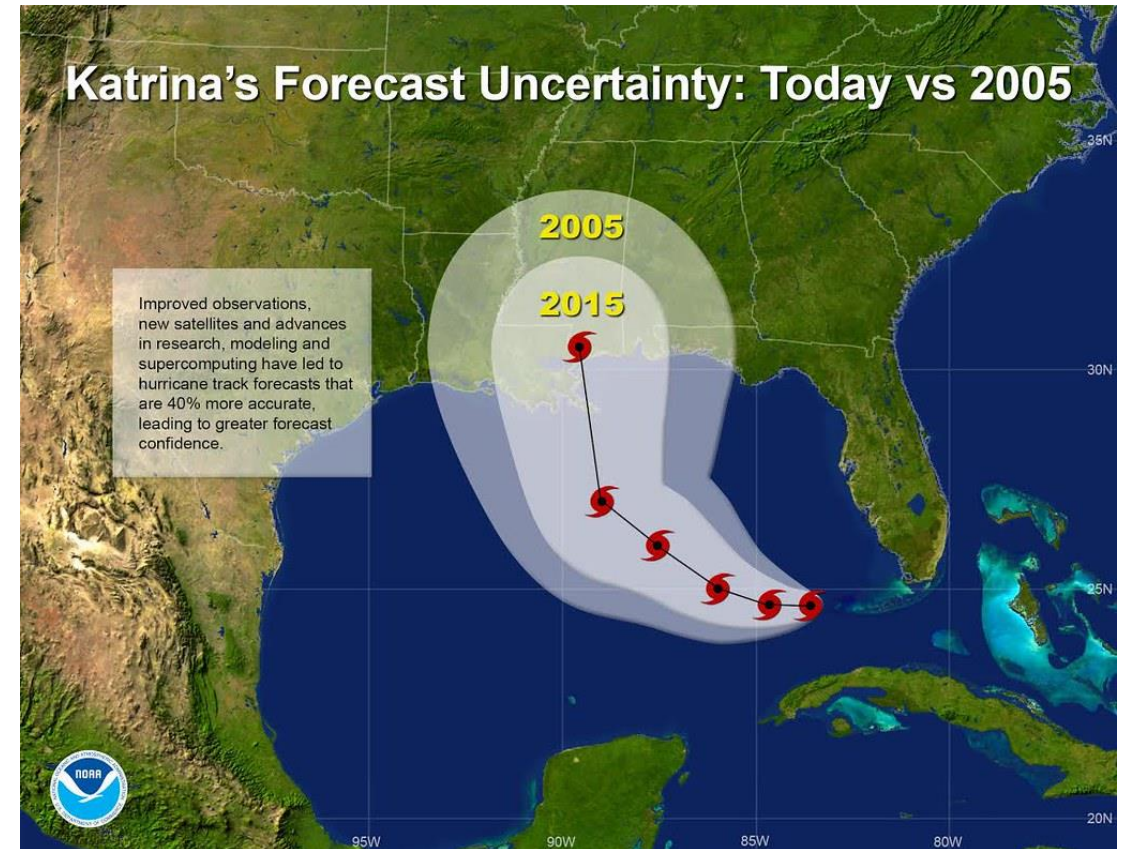
Models – a primer (con't)

What can't models do?
- Make precise predictions about future events. Models are tools, not crystal balls.
- Make choices among competing priorities.
- Make up for a lack of knowledge, data, or subject matter expertise.

Why use models?
- To make reality comprehensible.
- To see signals in the noise.
- To guide and test policy options.
- To project potential outcomes.

All models are wrong but some are useful

George E.P. Box
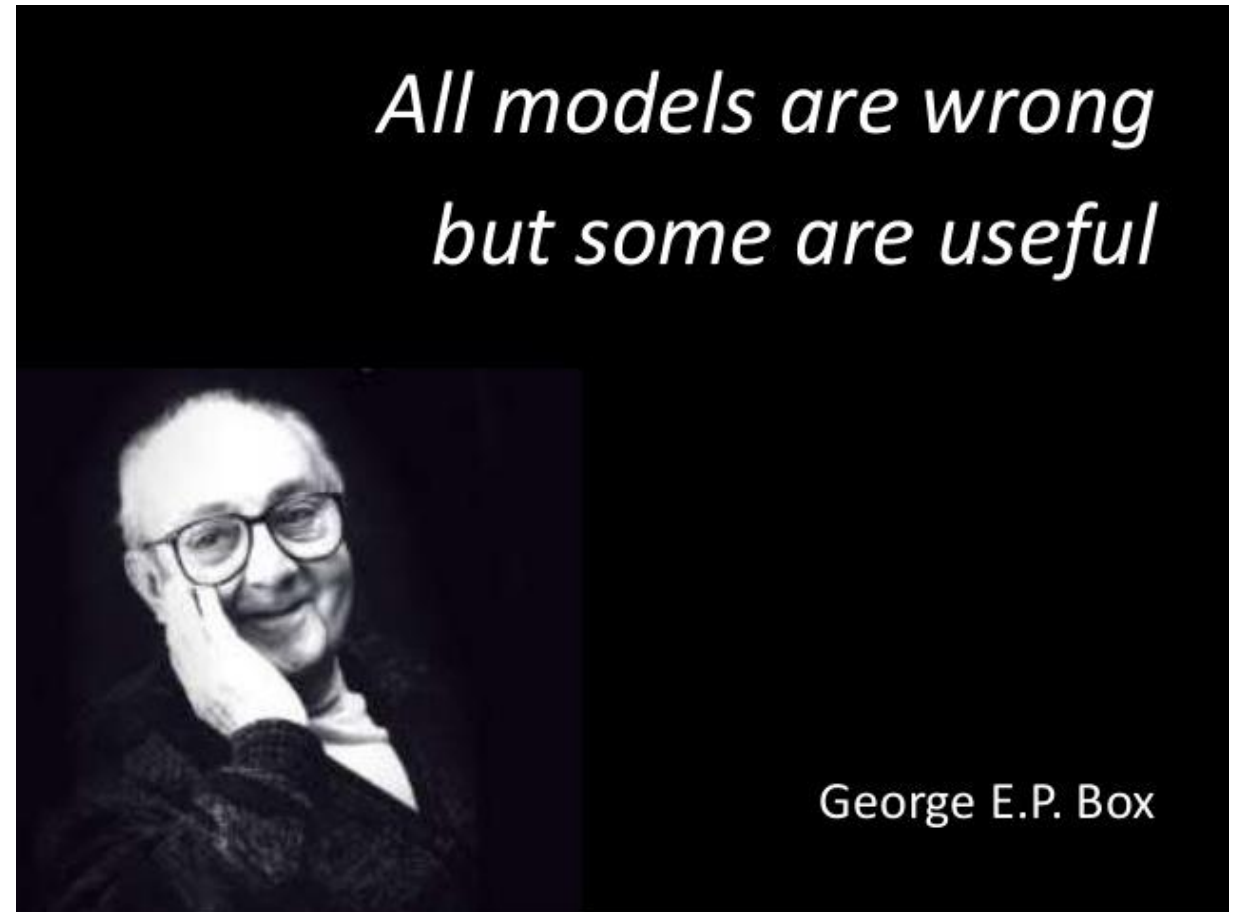
Broadly, Two Types of Forecasting Models

Statistical
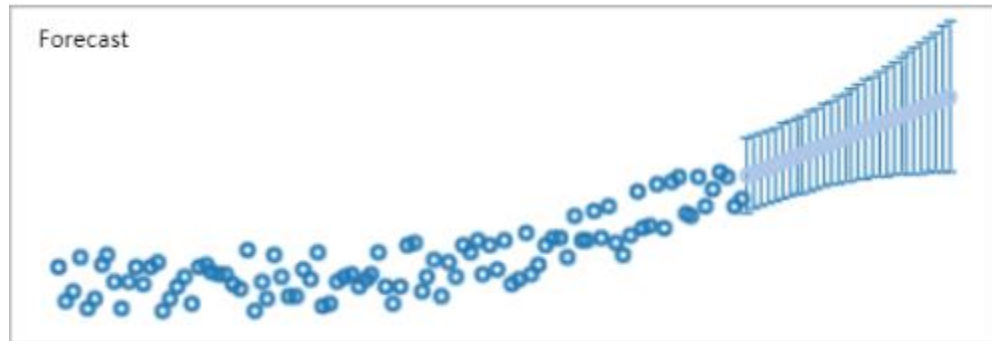
Mechanistic
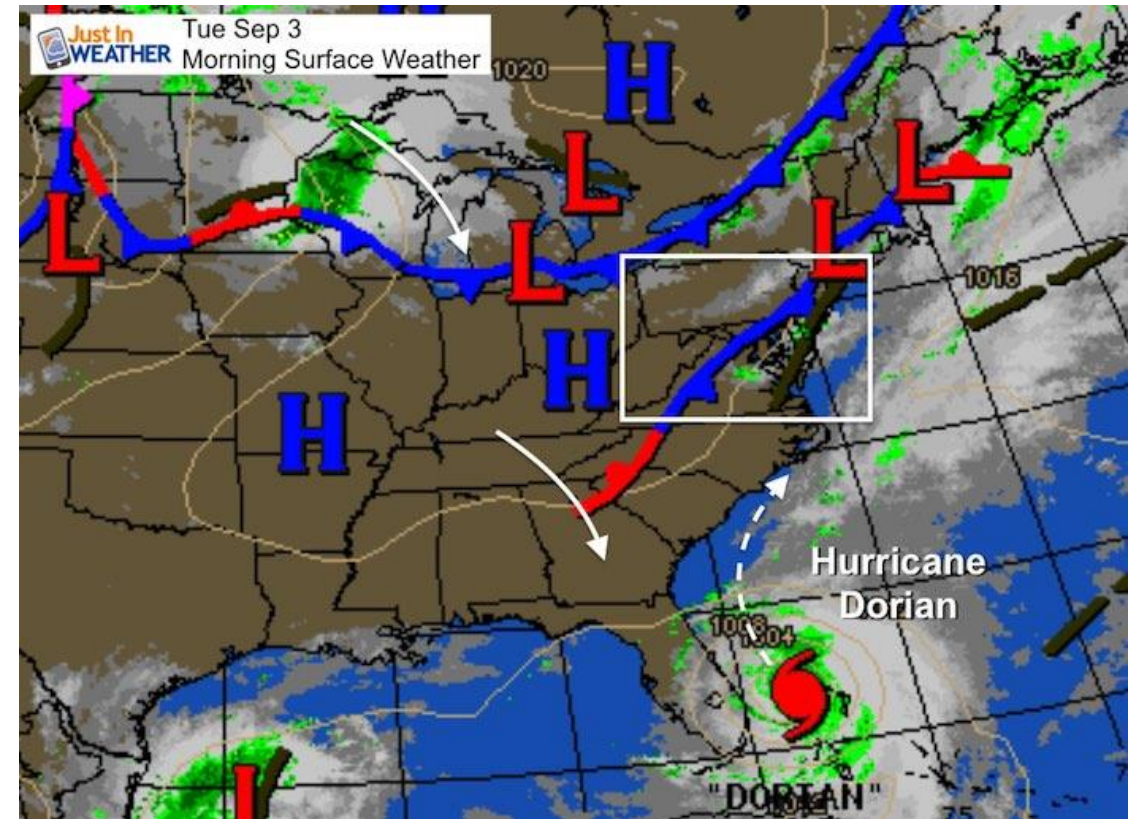
Ensembling

All models are wrong. Many models are less wrong.

Hurricane "Spaghetti" Model

Pandemic Ensemble Model
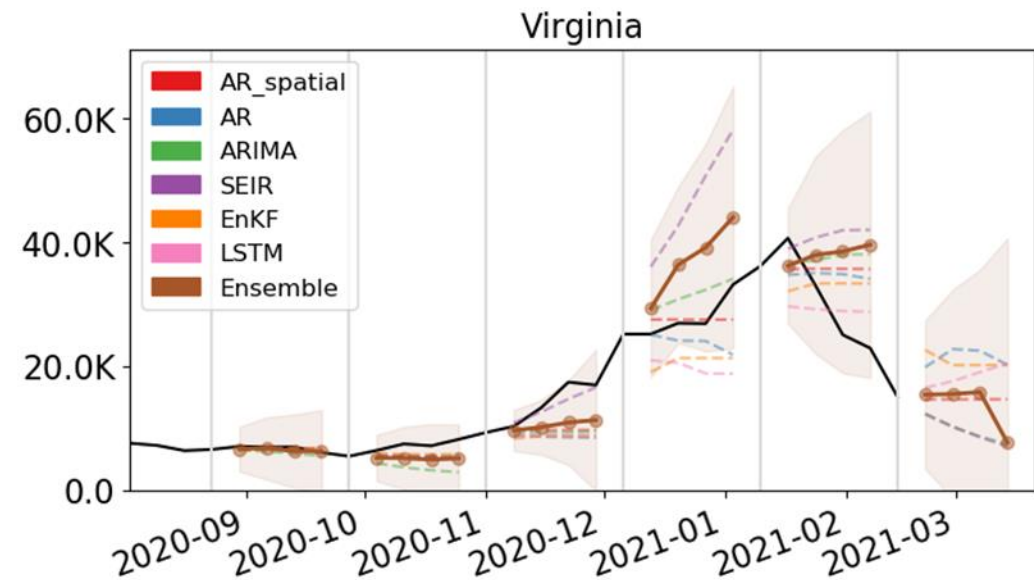
Scenarios

- Useful for policy-makers
  - Understand impact of policy decisions
  - Inform/persuade stakeholders
  - Educate the public about policy options and potential futures
- Different from forecasting
  - Which scenario will play out?
  - All else is not equal

Virginia Daily Confirmed - Comparison
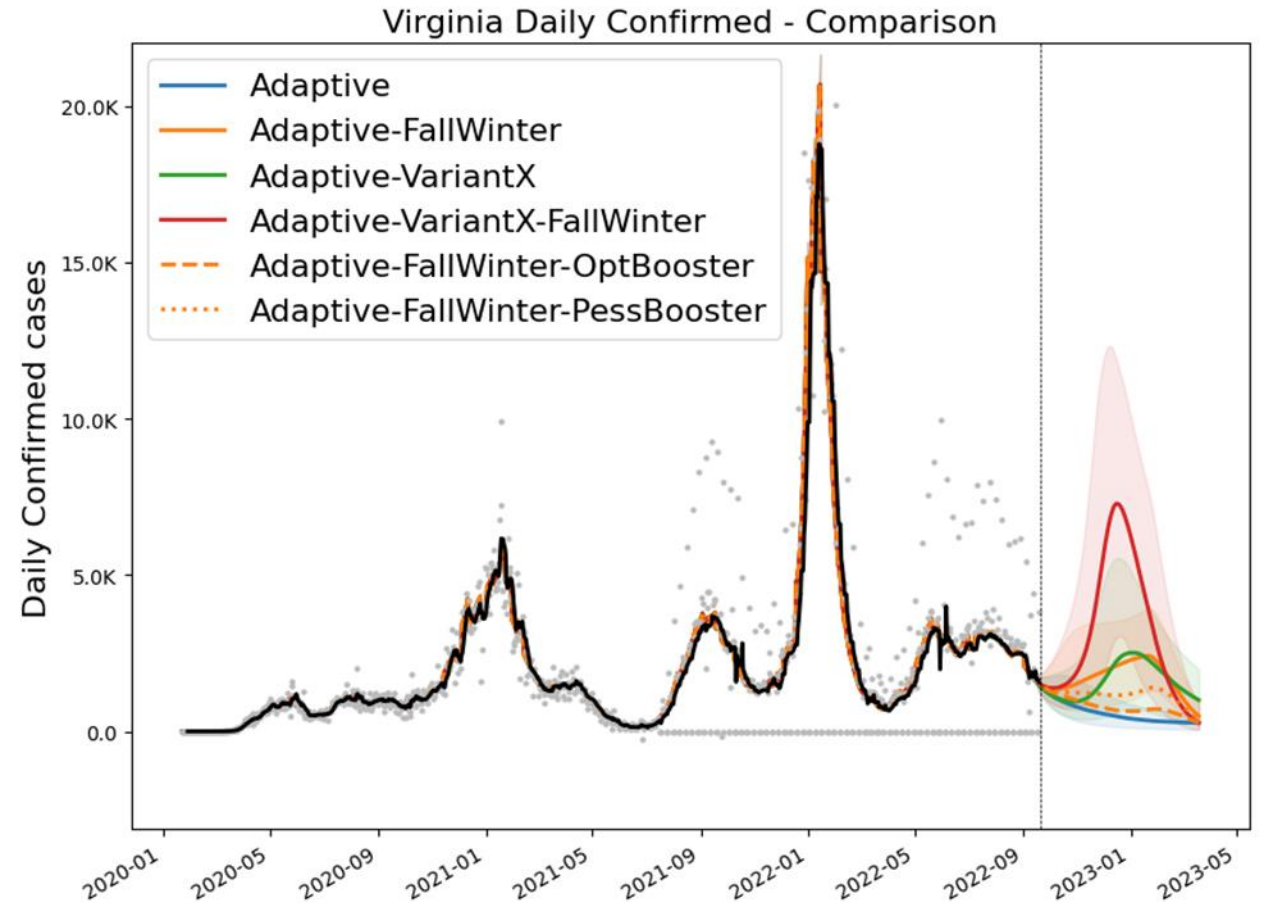
Where Models Struggle

- New events
  - Novel Coronavirus
  - New variants
- Rare events
  - Civil unrest
  - Natural disasters
- Policy decisions
  - Mandates
  - Vaccine Authorization
  - "Pandemic is over"
- Human behavior
  - Compliance w/guidance
  - Vaccine uptake
- Peaks/Troughs

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Aggregate Human Judgment

Vox Populi (The Wisdom of the Crowds)

In 1906, a statistician asked 787 villagers to guess the weight of an certain living ox once it was butchered and dressed.

A few got it right, but the average of all of the estimates was *exactly correct* – 1,197 lbs.

While no one person could be reasonably expected to guess the weight accurately, their mistakes were random – normally distributed around the mean – and thus cancelled out when averaged.

The same principle can be applied to forecasts of future events.
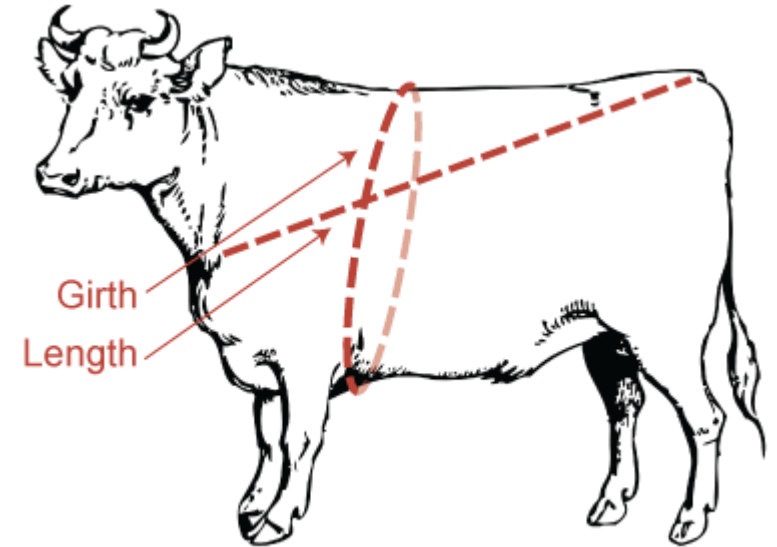
Source: Rural Heritage Magazine

OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE

L E A D I N G   I N T E L L I G E N C E   I N T E G R A T I O N
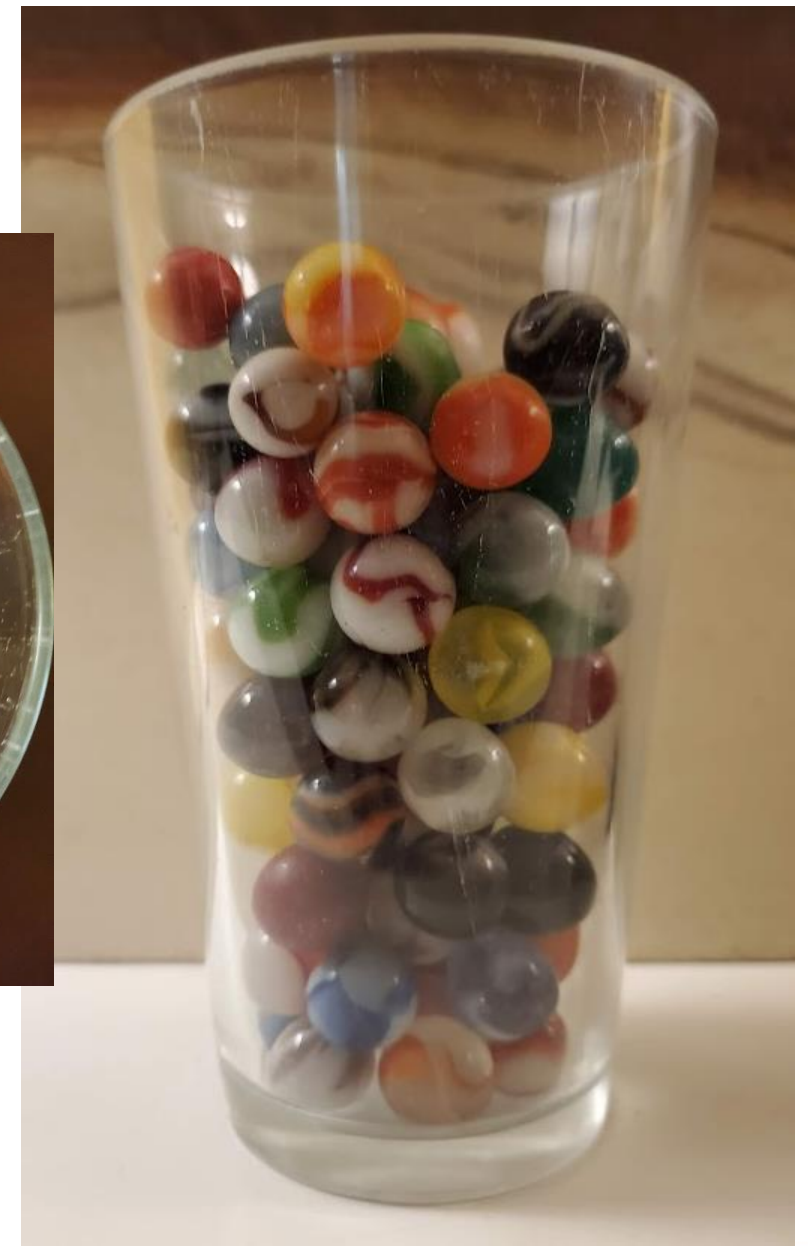
Aggregative Contingent Estimation (ACE)

- IARPA launched a 5-year forecasting tournament (2011)
  - Goal to improve accuracy of intelligence forecasts
- Good Judgment Project won the tournament

NEW YORK TIMES BESTSELLER

SUPER FORECASTING

The Art and Science of Prediction

PHILIP E. TETLOCK
DAN GARDNER

"The most important book on decision making since Daniel Kahneman's *Thinking, Fast and Slow*." — JASON ZWEIG, *The Wall Street Journal*

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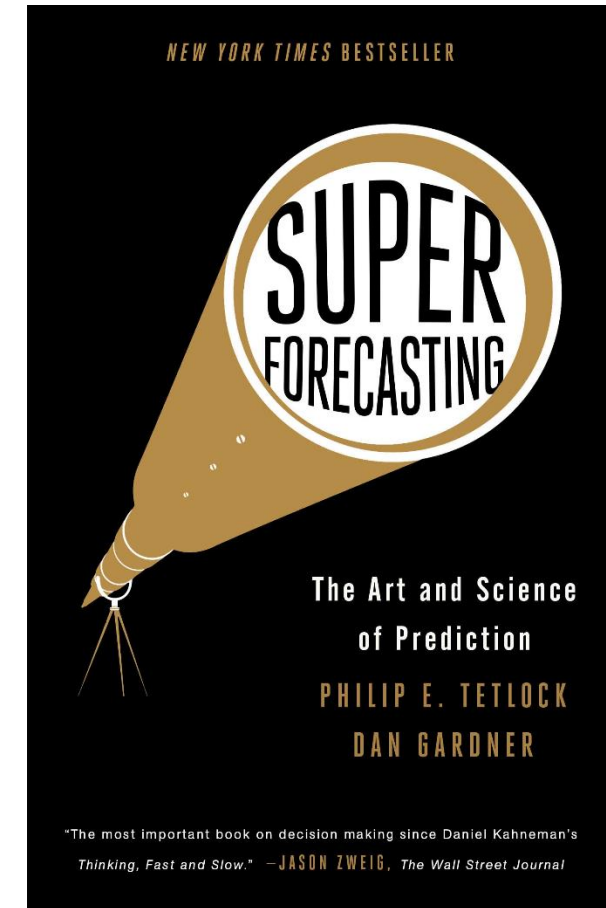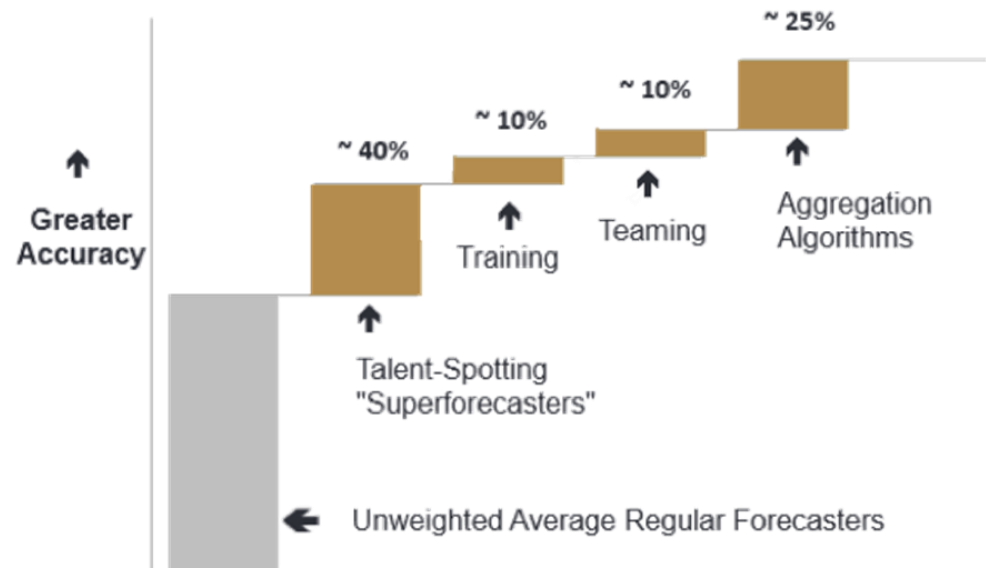
FORECASTING CAUSE
Healthy Communities

Keep Virginia Safe Forecasting Tournament

Launching Thursday April 29!

Metaculus and VDH are partnering to launch this initiative during World Immunization Week 2021. We invite you to join our forecasting community in supporting healthy communities in Virginia.

$1000 initial prize pool

Metaculus

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KVSF Tournament Questions

What will be official attendance at the 2021 University of Virginia vs Virginia Tech football game?
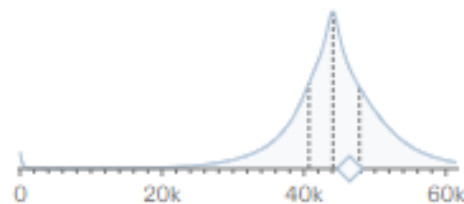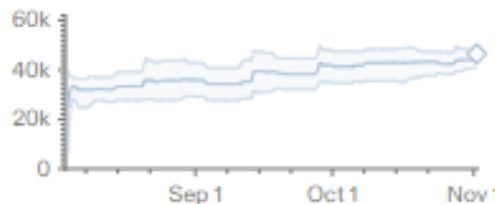
M 44.2k
Predictions 162
Resolved 46.4k

∧ 3 ∨   8 comments   ◉ Resolved

What will the average travel nurse salary in Virginia be for the 90-day period ending 31 March 2022?
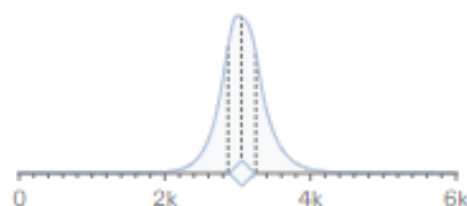
M 3.07k
Predictions 101
Resolved 3.06k

∧ 4 ∨   10 comments   ◉ Resolved

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Metaculus and Monkeypox

Aggregate Human Forecasting is particularly useful early in outbreaks, or during smaller outbreaks

- Quantitative models need:
  - Sufficient data
  - Information about parameters
  - Time and specialized resource to build or modify

- Aggregate Human Forecasting
  - Performs well in sparse information environments
  - Can be launched quickly on existing platforms
  - Can be tailored to specific needs as they arise

- The question generation process
  - Help to identify key decision points and information needs
  - Often turns up new and useful data sources

Will the US CDC recommend use of a smallpox/monkeypox vaccine for at least 10% of the US population, before 2023?

Community Predicts: 18%
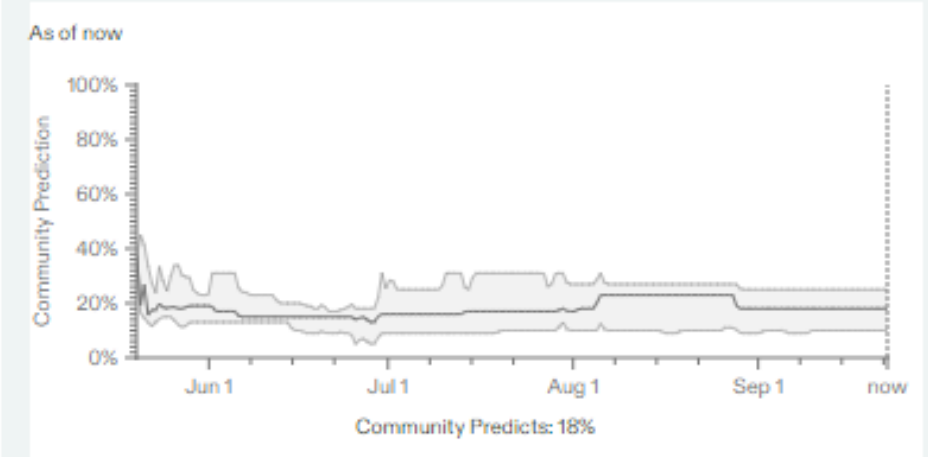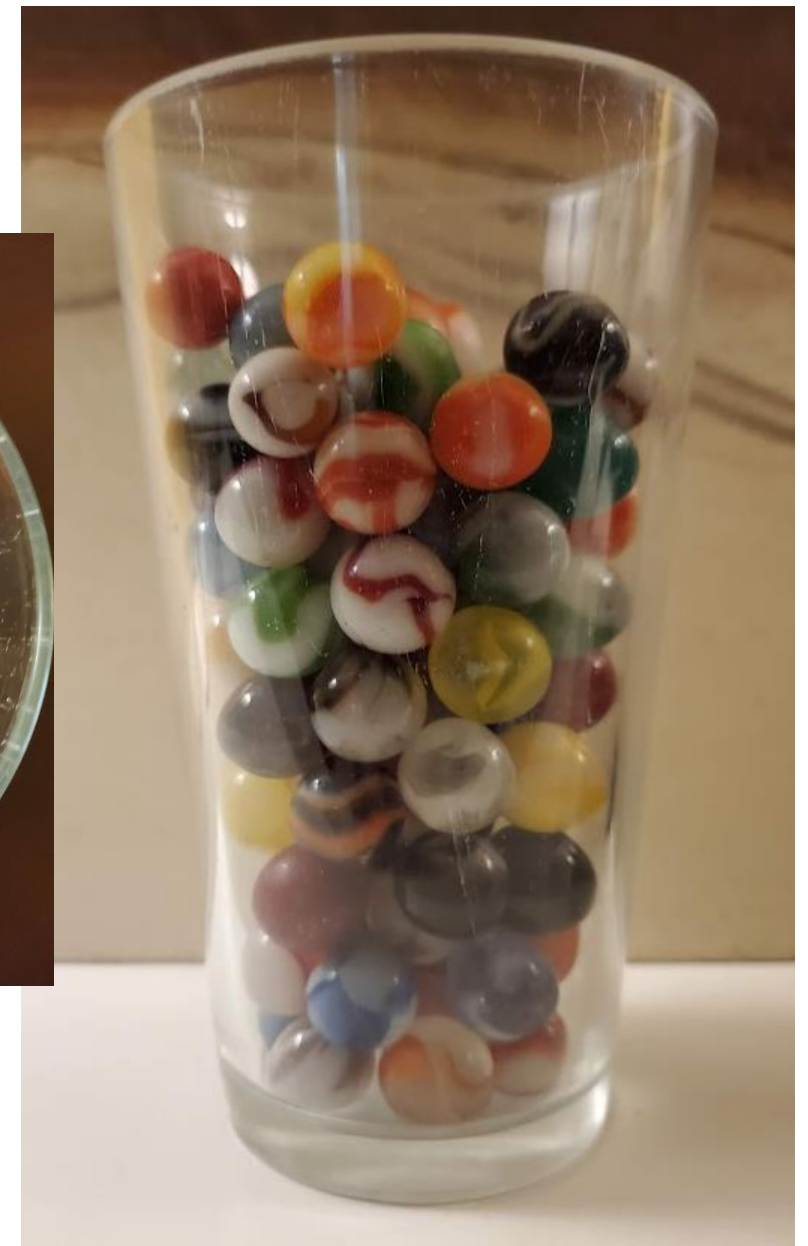
Foresight Innovation

Integrating Metaculus Forecasts & UVA Models
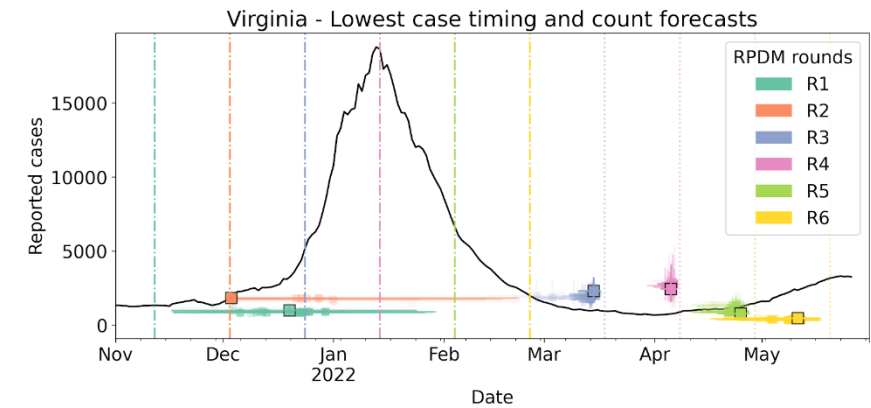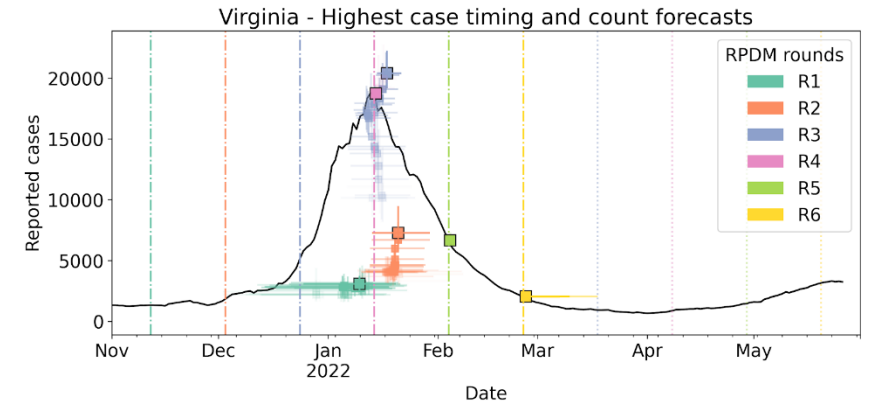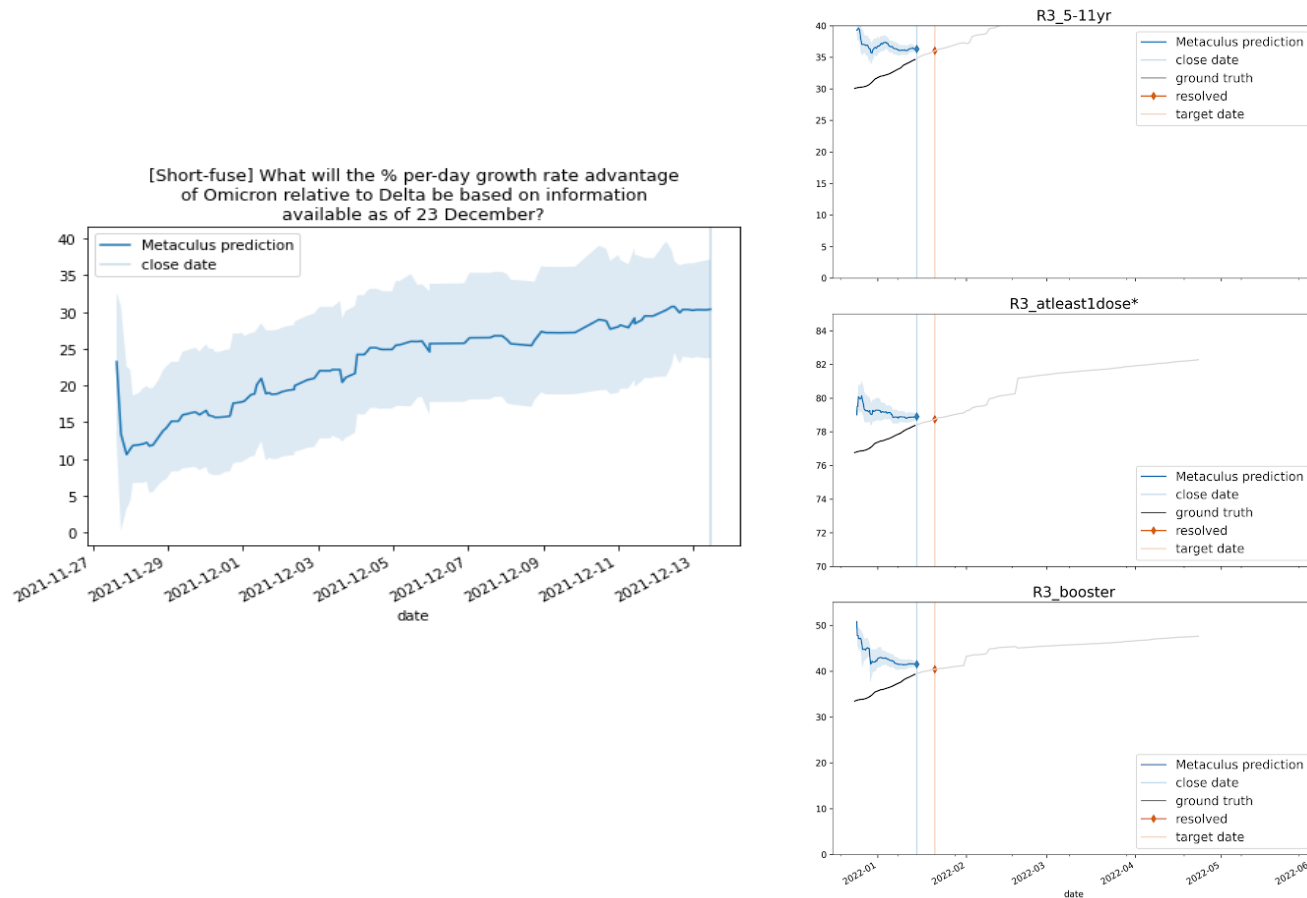
And the result is...

104 marbles

Foresight is…

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- Early warning: Identifying threats, and developing accurate information on them, as soon as they emerge – or earlier!

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The importance of early warning

- Incubation period: 7-10 days
- Days from onset to diagnosis: 5-6 days
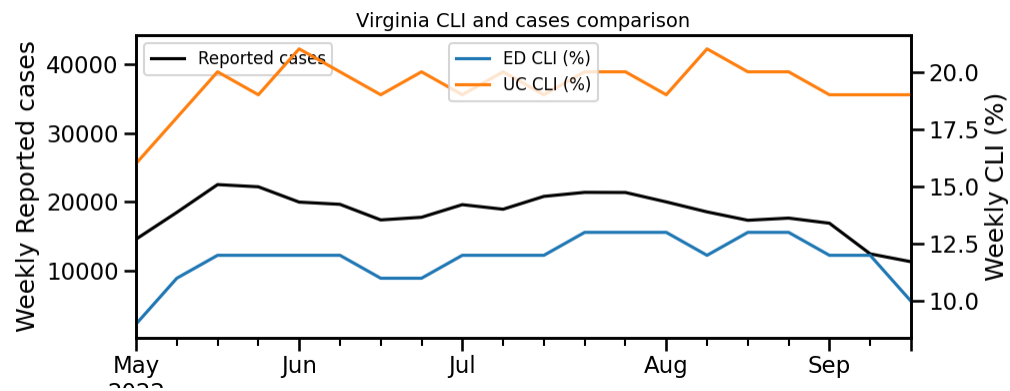- Reporting delays: 2 -??? days

- Total lag: 2 weeks minimum
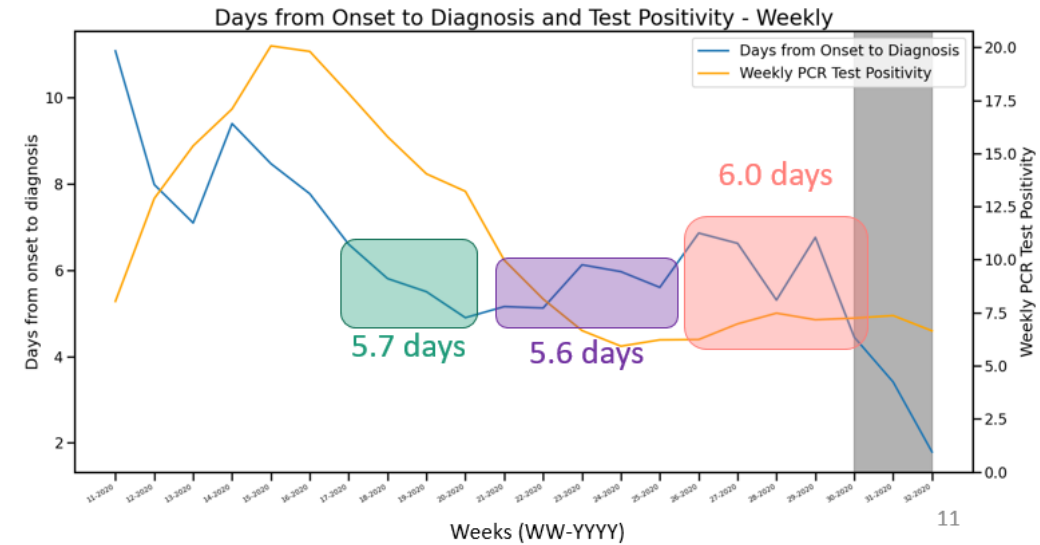
Case data during the early days of the pandemic described the situation at least two weeks prior – *at best.*

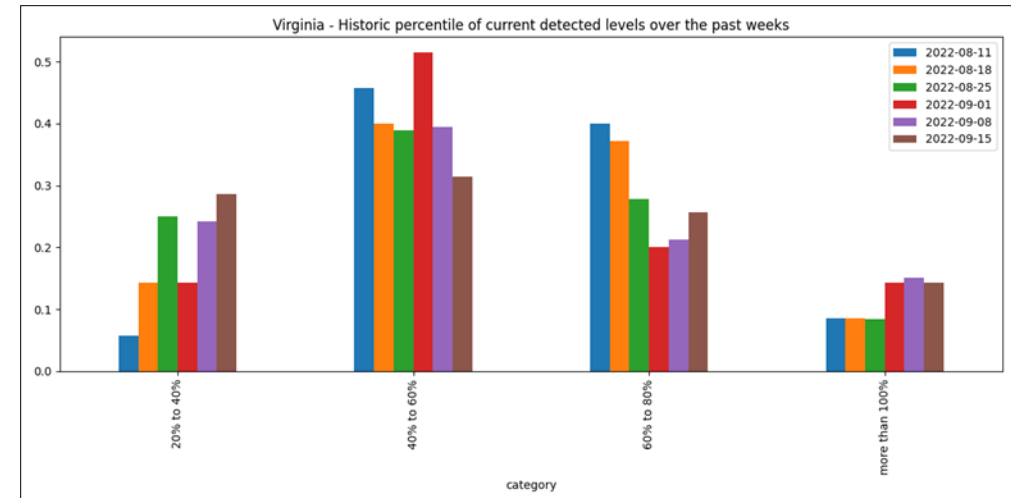Decisions made with this data were made two weeks too late.

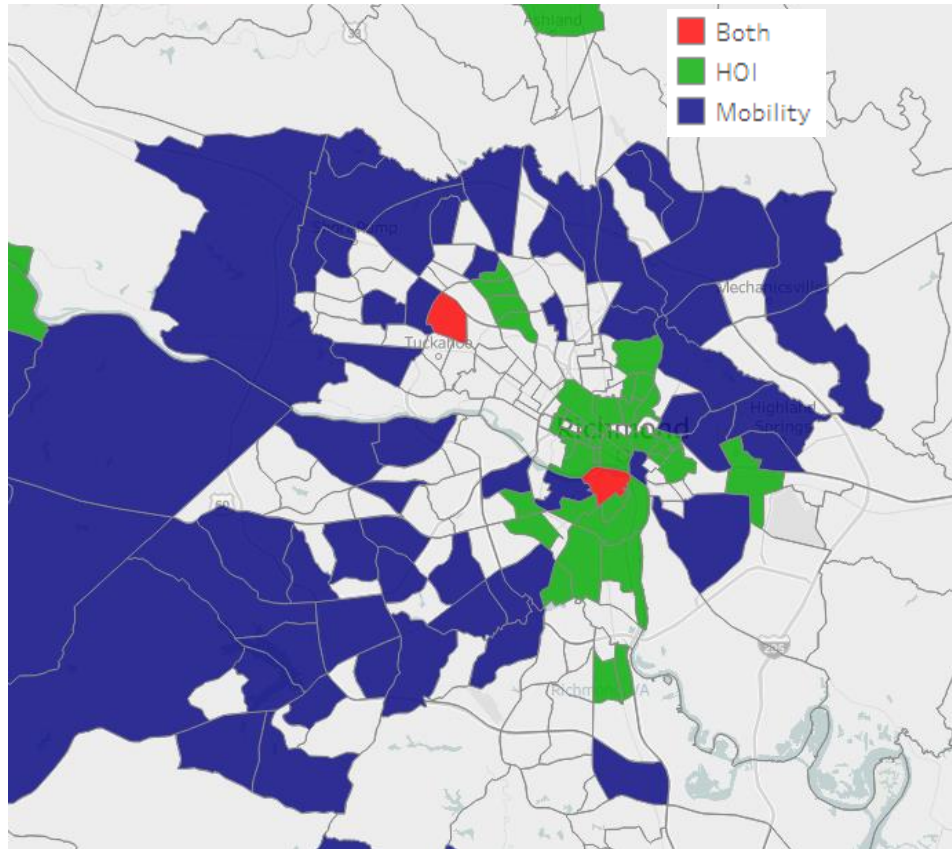# Early Warning Systems

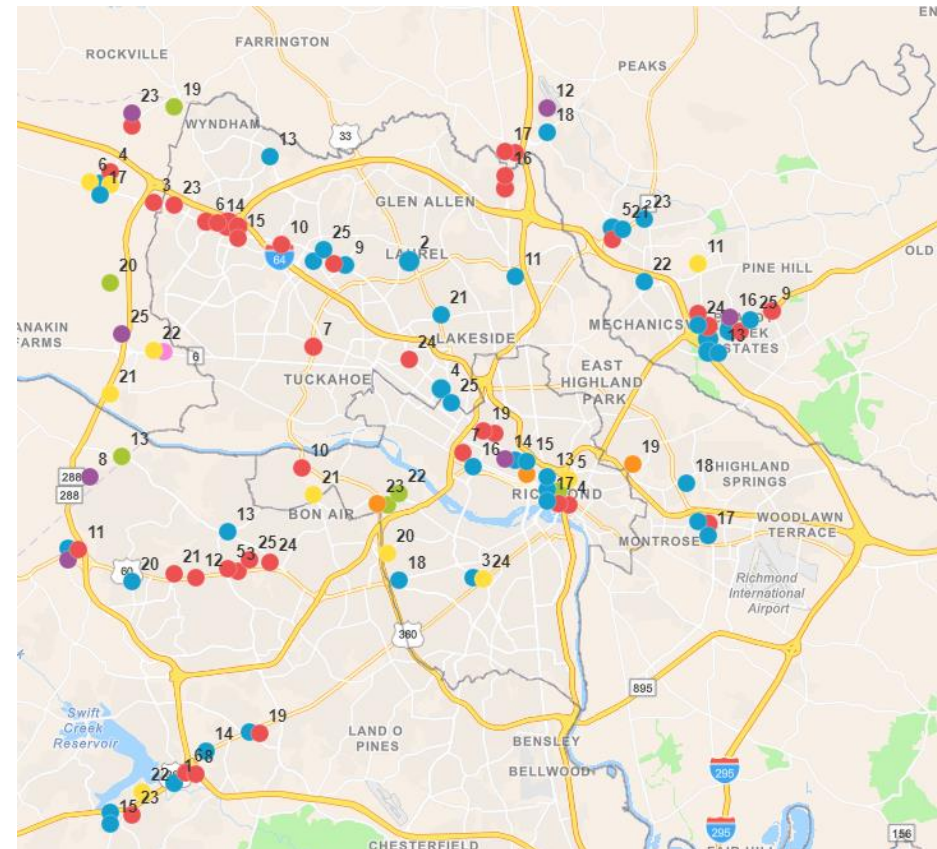## ESSENCE System (ILI/CLI)

Wastewater Testing

Predictive Analytics

Hotspot Targeting

Cellphone Mobility Maps

Growing Infrastructure

New Infrastructure

- CDC Center for Forecasting and Outbreak Analytics
  - Launched April 19, 2022
  - Still being developed
  - Three Branches
    - Predict
    - Inform
    - Innovate

- CSTE/CDC Forecasting Workgroup
  - Workshop at the end of October

- VDH Foresight & Analytics Unit
  - Programmatic Priorities
    - Building an Anticipatory Agency
    - Informatics Planning for Emerging Public Health Threats
    - Early Warning System Coordination
    - Respond to Emerging Public Health Threats
    - Strategic Planning Support

PREDICT

INFORM

INNOVATE

VDH VIRGINIA DEPARTMENT OF HEALTH

Questions?

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Thank You!