Network Systems Science & Advanced Computing

Biocomplexity Institute & Initiative

University of Virginia

Estimation of COVID-19 Impact in Virginia

April 6th, 2022

(data current to April 3rd – 5th)

Biocomplexity Institute Technical report: BI-2022-447

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biocomplexity.virginia.edu

About Us

- ## Biocomplexity Institute at the University of Virginia
  - ### Using big data and simulations to understand massively interactive systems and solve societal problems
- ## Over 20 years of crafting and analyzing infectious disease models
  - ### Pandemic response for Influenza, Ebola, Zika, and others

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Overview

- **Goal**: Understand impact of COVID-19 mitigations in Virginia
- **Approach:**
  - Calibrate explanatory mechanistic model to observed cases
  - Project based on scenarios for next 4 months
  - Consider a range of possible mitigation effects in "what-if" scenarios
- **Outcomes:**
  - Ill, Confirmed, Hospitalized, ICU, Ventilated, Death
  - Geographic spread over time, case counts, healthcare burdens

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Key Takeaways

Projecting future cases precisely is impossible and unnecessary.
Even without perfect projections, we can confidently draw conclusions:

- **Case rates and hospitalizations continue to plateau**

- VA 7-day mean daily case rate has stayed relatively flat at 9/100K from 8/100K
    - US is also flat remaining at 9/100K (from 9/100K)

- Surveillance artifacts continue to be observed which may cause isolated anomalies in some of the metrics

- BA.2 subvariant of Omicron has likely exceeded 50% prevalence and continues to grow

The situation continues to change. Models continue to be updated regularly.

Situation Assessment

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Case Rates (per 100k) and Test Positivity

- Case rate increase across all health districts
- Some past 50% of winter peak and growing
- More than 50% of counties with TPR > 10%
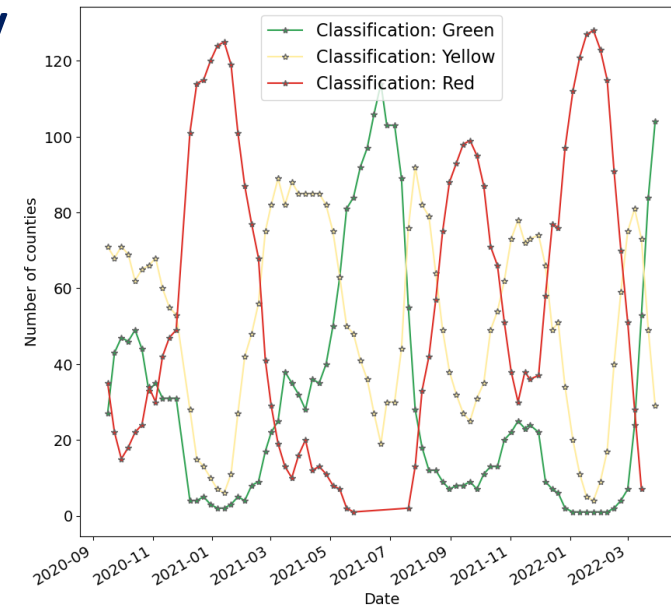
County level RT-PCR test positivity
Green: <5.0% (or <20 tests in past 14 days)
Yellow: 5.0%-10.0% (or <500 tests and <2000 tests/100k and >10% positivity over 14 days)
Red: >10.0% (and not "Green" or "Yellow")

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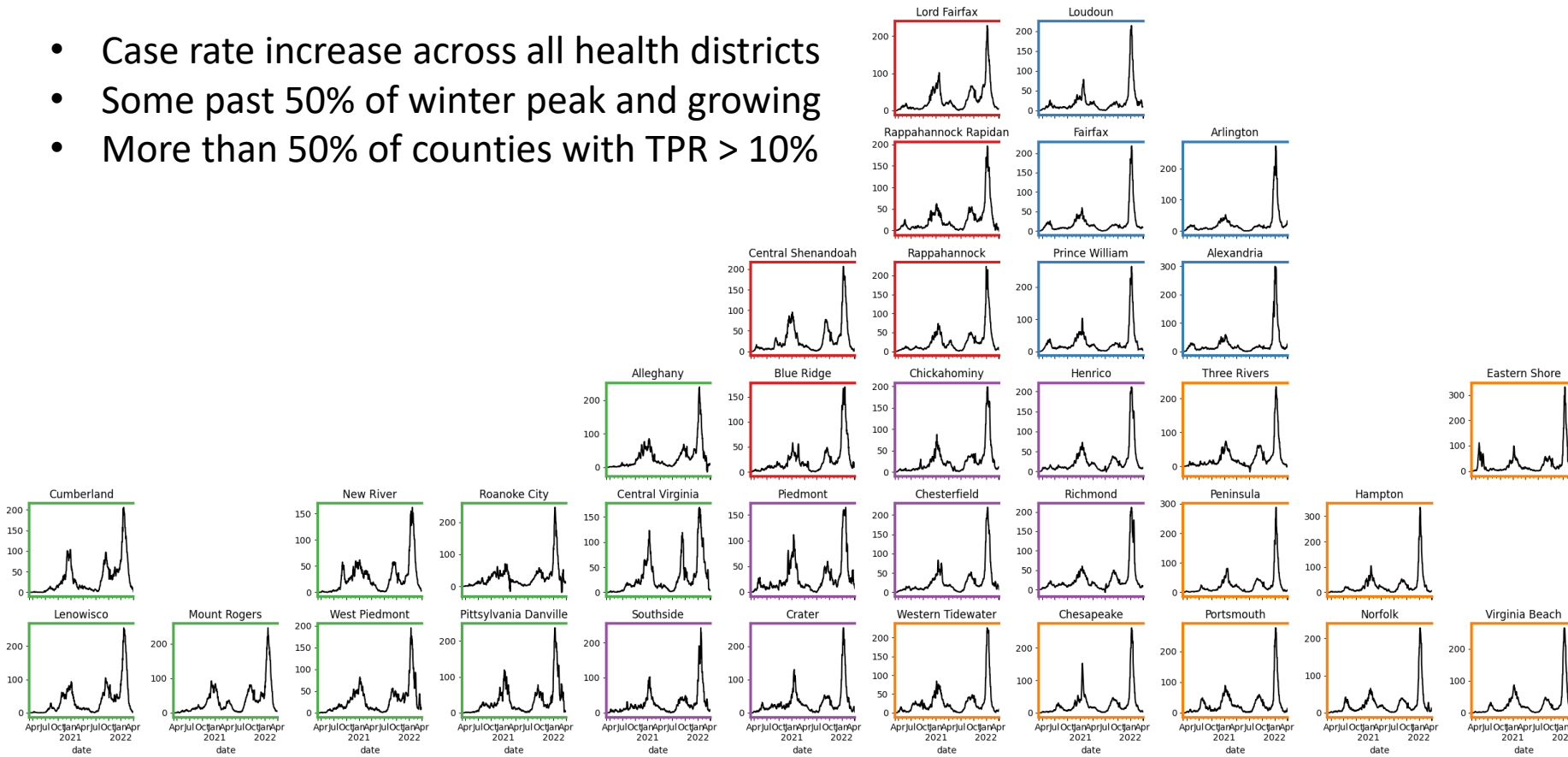
District Trajectories

Goal: Define epochs of a Health District's COVID-19 incidence to characterize the current trajectory

Method: Find recent peak and use hockey stick fit to find inflection point afterwards, then use this period's slope to define the trajectory

Hockey stick fit
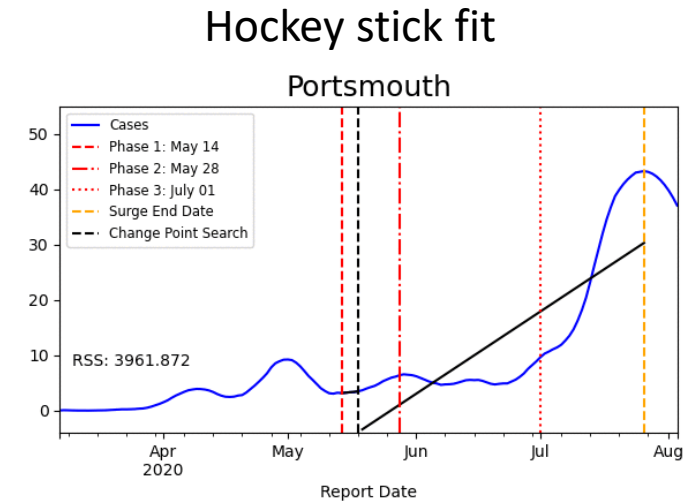
Trajectory	Description	Weekly Case Rate (per 100K) bounds	# Districts (prev week)
Declining	Sustained decreases following a recent peak	below -0.9	30 (32)
Plateau	Steady level with minimal trend up or down	above -0.9 and below 0.5	2 (0)
Slow Growth	Sustained growth not rapid enough to be considered a Surge	above 0.5 and below 2.5	3 (3)
In Surge	Currently experiencing sustained rapid and significant growth	2.5 or greater	0 (0)

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District Trajectories – last 10 weeks

Status	# Districts (prev week)
Declining	30 (32)
Plateau	2 (0)
Slow Growth	3 (3)
In Surge	0 (0)

Curve shows smoothed case rate (per 100K)
Trajectories of states in label & chart box
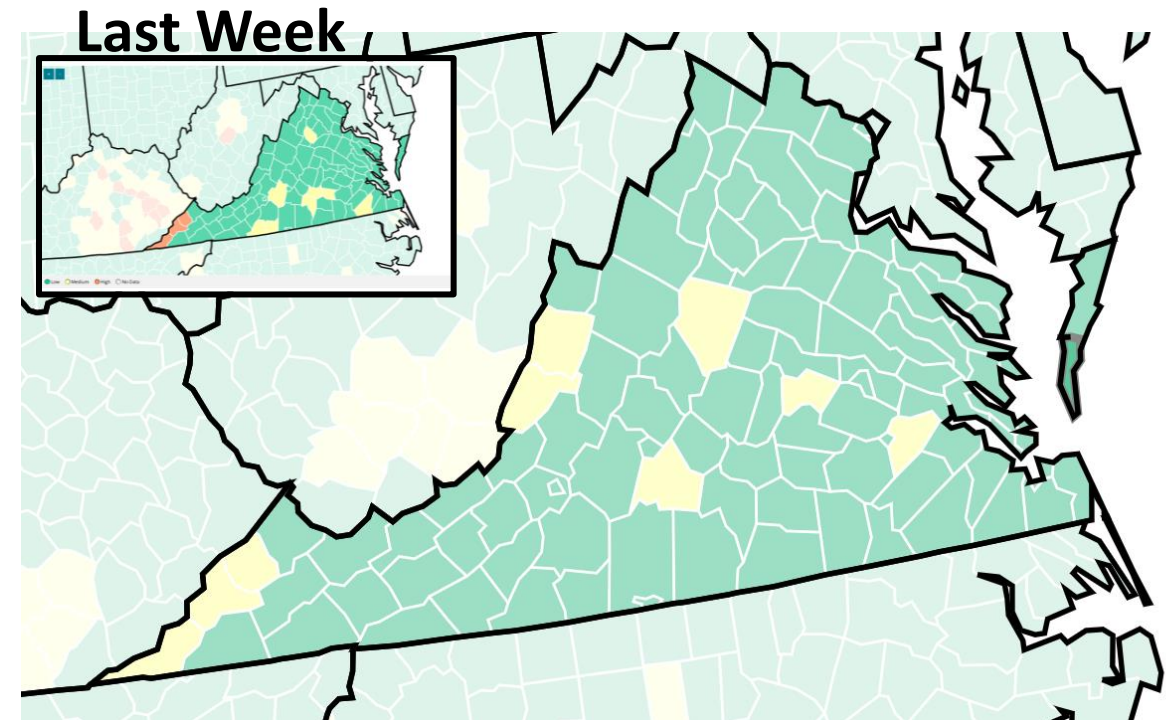Case Rate curve colored by Reproductive number

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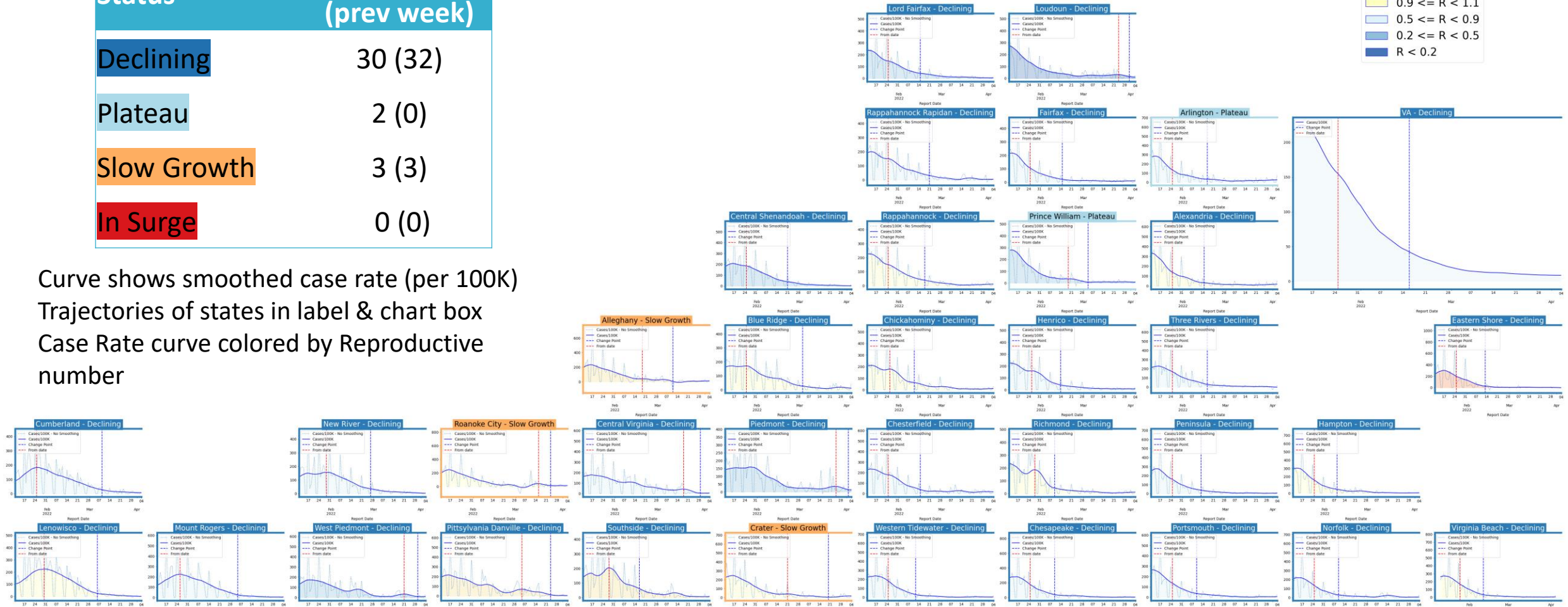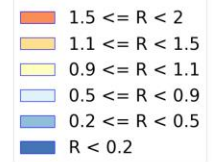
CDC's new COVID-19 Community Levels

What Prevention Steps Should You Take Based on Your COVID-19 Community Level?
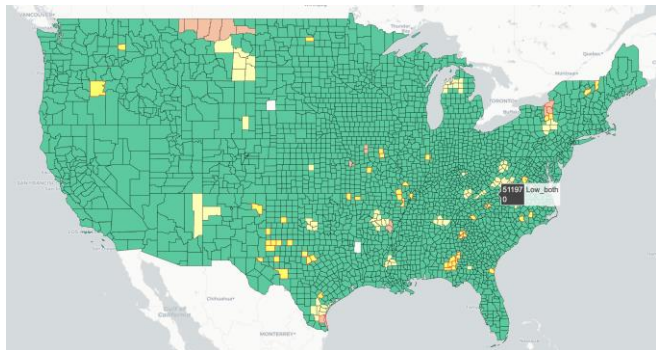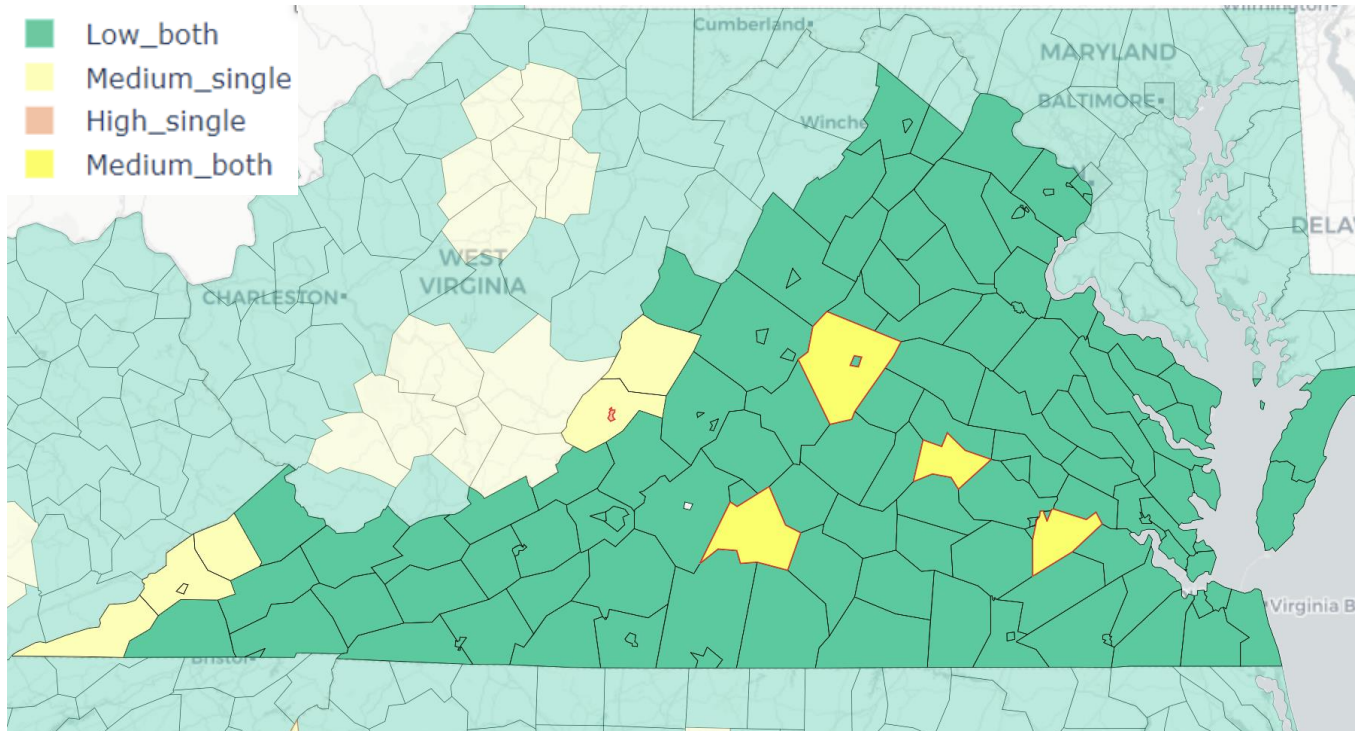
Low	Medium	High
• Stay up to date with COVID-19 vaccines • Get tested if you have symptoms	• If you are at high risk for severe illness, talk to your healthcare provider about whether you need to wear a mask and take other precautions • Stay up to date with COVID-19 vaccines • Get tested if you have symptoms	• Wear a mask indoors in public • Stay up to date with COVID-19 vaccines • Get tested if you have symptoms • Additional precautions may be needed for people at high risk for severe illness

People may choose to mask at any time. People with symptoms, a positive test, or exposure to someone with COVID-19 should wear a mask.

COVID-19 Community Levels – Use the Highest Level that Applies to Your Community

New COVID-19 Cases Per 100,000 people in the past 7 days	Indicators	Low	Medium	High
Fewer than 200	New COVID-19 admissions per 100,000 population (7-day total)	<10.0	10.0-19.9	≥20.0
	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)	<10.0%	10.0-14.9%	≥15.0%
200 or more	New COVID-19 admissions per 100,000 population (7-day total)	NA	<10.0	≥10.0
	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)	NA	<10.0%	≥10.0%

The COVID-19 community level is determined by the higher of the new admissions and inpatient beds metrics, based on the current level of new cases per 100,000 population in the past 7 days

Last Week

[CDC Data Tracker Portal](#)

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8-Apr-22

9

CDC's new COVID-19 Community Levels

	Low_both
	Medium_single
	High_single
	Medium_both

Red outline indicates county had 200 or more cases per 100k in last week

Pale color indicates only one of beds or occupancy set the level for this county

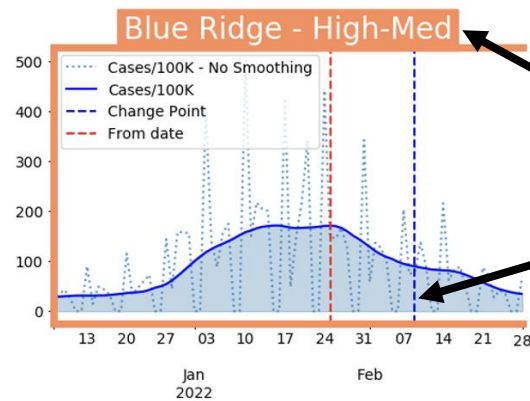**Dark color indicates both beds and occupancy set the level for this county**

COVID-19 Community Levels – Use the Highest Level that Applies to Your Community				
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District Trajectories with Community Levels
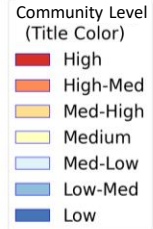
Curve shows smoothed case rate (per 100K)
CDC's new Community Level aggregated to district level in label & chart box color
Case Rate curve colored by Trajectory

Community Level (Title Color)
- High
- High-Med
- Med-High
- Medium
- Med-Low
- Low-Med
- Low

Trajectory (Curve Shading)
- In Surge
- Slow Growth
- Plateau
- Declining

District's Aggregate Community Level
Aggregate level a simple mean of all levels for counties in district

Case rate Trajectory

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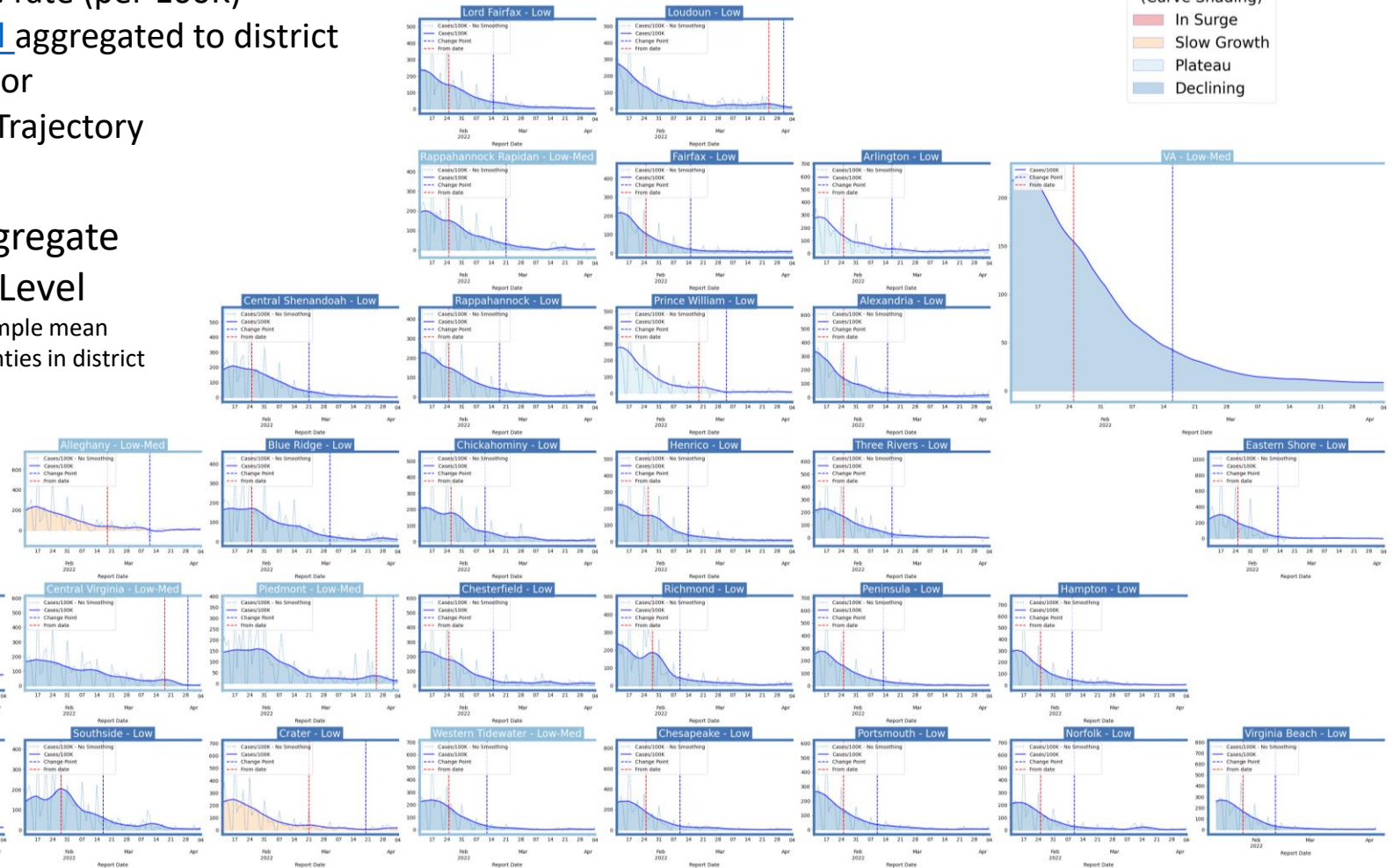
Estimating Daily Reproductive Number –
Redistributed gap

April 4th Estimates

| Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	0.980	0.193
Central	0.901	-0.080
Eastern	1.164	0.341
Far SW	0.764	0.237
Near SW	1.001	0.869
Northern	0.925	0.012
Northwest	1.051	0.093

Methodology

- Wallinga-Teunis method (EpiEstim[1]) for cases by **confirmation date**
- Serial interval: Discrete distribution from observations (mean=4.3, Flaxman et al, Nature 2020)
- Using Confirmation date since due to increasingly unstable estimates from onset date due to backfill

1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

VA state-wide RE with 7 day moving window by confirmation date redistributed GT 2022-04-04

VA RE by VHASS region with 7 day moving window by confirmation date redistributed GT 2022-04-04
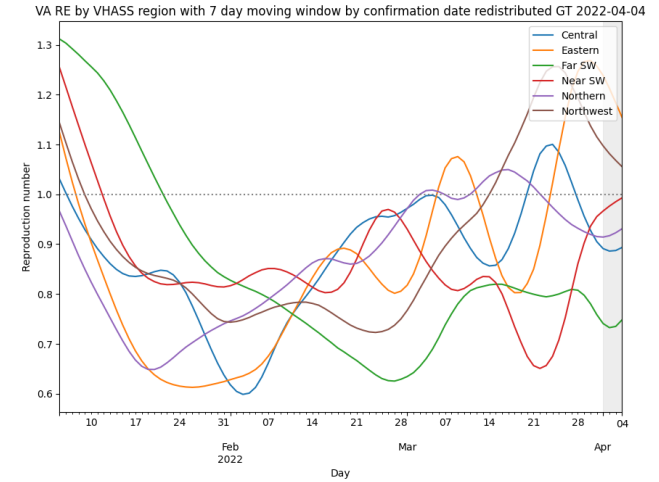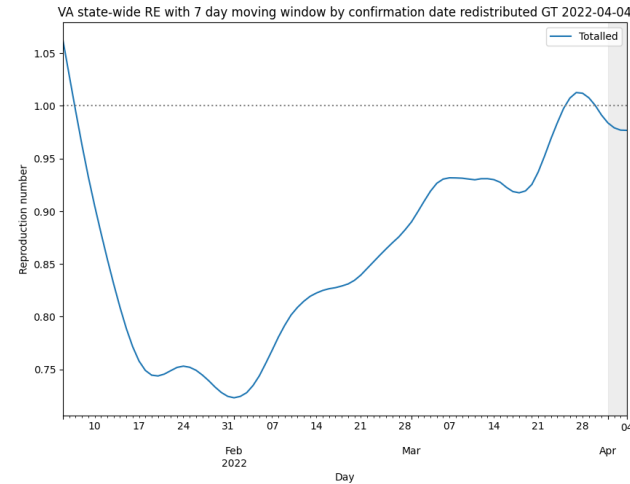
Skipping Weekend Reports & holidays biases estimates
Redistributed "big" report day to fill in gaps, and then estimate R from "smoothed" time series
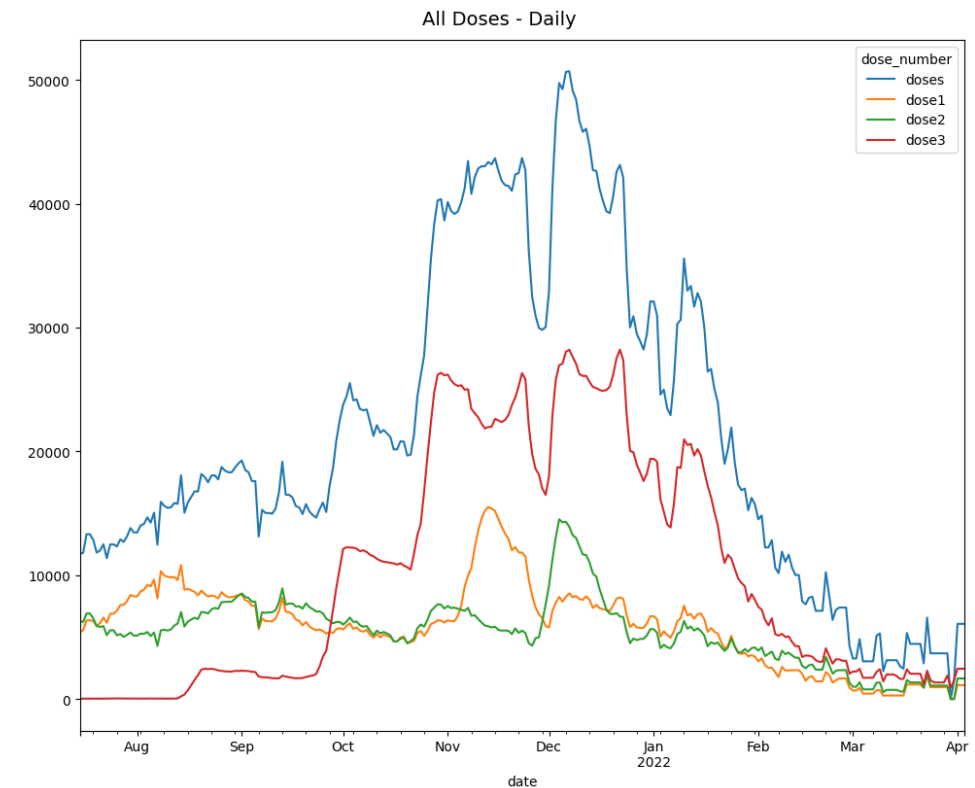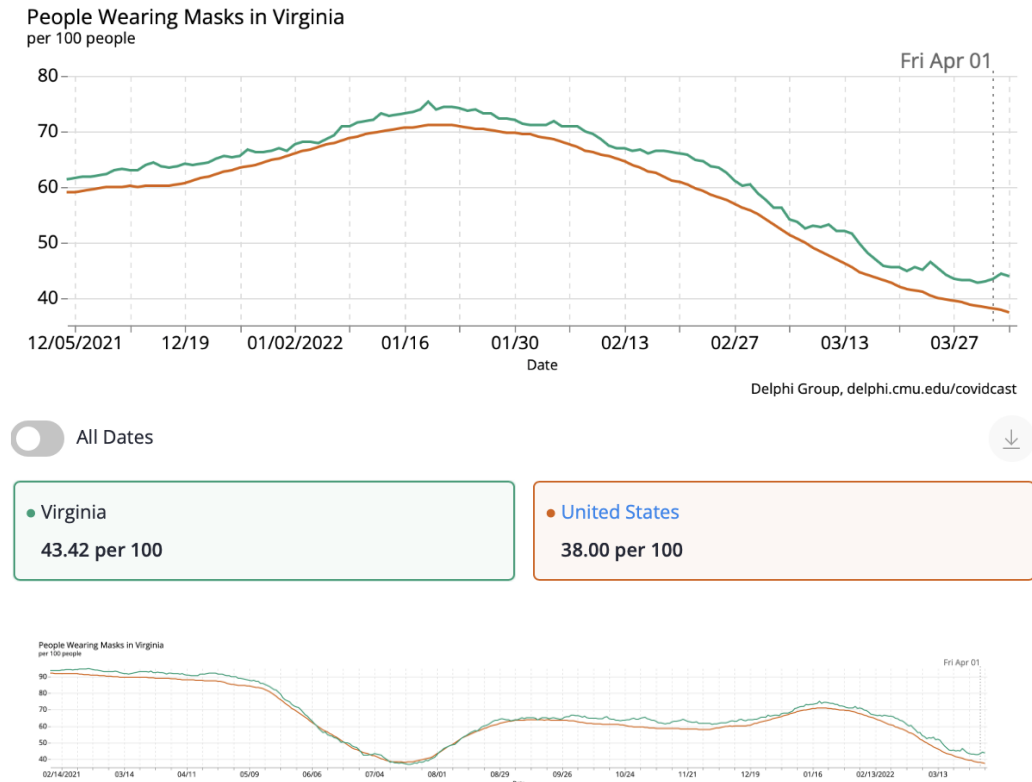

Virginia
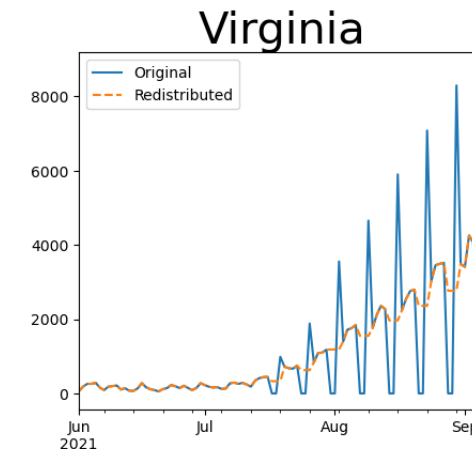
Mask Usage and Vaccination

Self-reported mask usage continues to fall
- US and VA experienced similar decreases
- Mask wearing remains lower amongst unvaccinated especially among least willing to be vaccinated

Data Source: https://covidcast.cmu.edu

SARS-CoV2 Variants of Concern

Emerging new variants will alter the future trajectories of pandemic and have implications for future control

- Emerging variants can:
  - Increase transmissibility
  - Increase severity (more hospitalizations and/or deaths)
  - Limit immunity provided by prior infection and vaccinations

- Genomic surveillance remains very limited
  - Challenges ability to estimate impact in US to date and estimation of arrival and potential impact in future
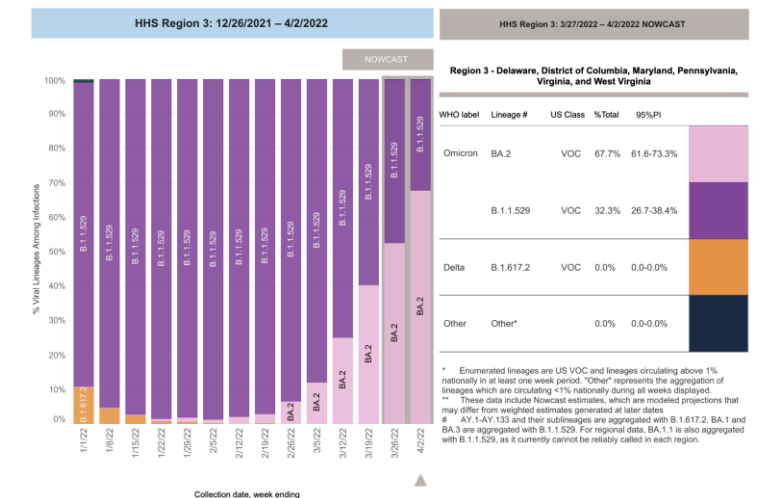
United States

Virginia

WHO label	Pango lineage*	GISAID clade	Nextstrain clade	Additional amino acid changes monitored°	Earliest documented samples	Date of designation
Alpha	B.1.1.7	GRY	20I (V1)	+S:484K +S:452R	United Kingdom, Sep-2020	18-Dec-2020
Beta	B.1.351	GH/501Y.V2	20H (V2)	+S:L18F	South Africa, May-2020	18-Dec-2020
Gamma	P.1	GR/501Y.V3	20J (V3)	+S:681H	Brazil, Nov-2020	11-Jan-2021
Delta	B.1.617.2	G/478K.V1	21A, 21I, 21J	+S:417N +S:484K	India, Oct-2020	VOI: 4-Apr-2021 VOC: 11-May-2021
Omicron*	B.1.1.529	GRA	21K, 21L	+R346K	Multiple countries, Nov-2021	VUM: 24-Nov-2021 VOC: 26-Nov-2021

World Health Organization [WHO](#)
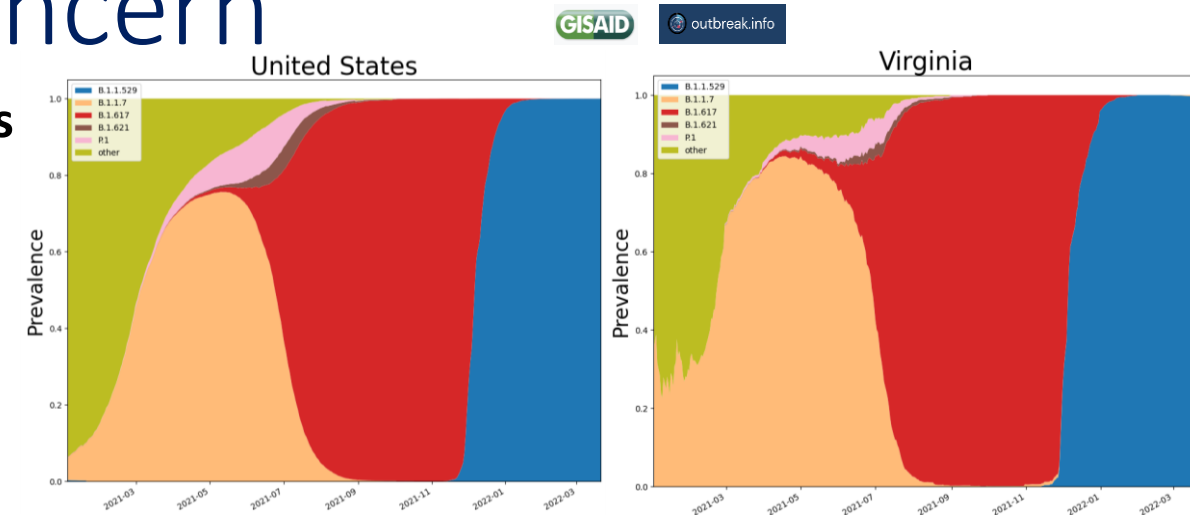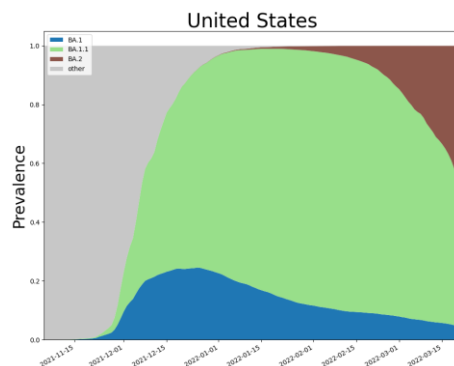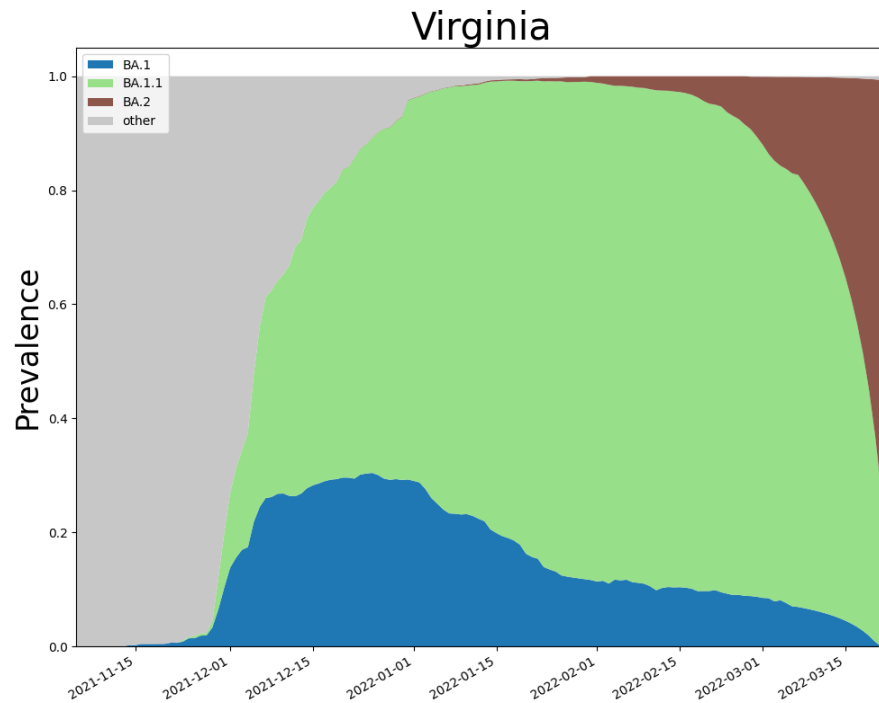
Omicron Prevalence

CDC nowcast for week ending April 2nd shows 67% BA2 in Region 3 (52% last week) and last observed for Mar 19th now at 40%

USA now at 72%

HHS Region 3: 12/26/2021 – 4/2/2022

HHS Region 3: 3/27/2022 – 4/2/2022 NOWCAST

Region 3 - Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia

WHO label	Lineage #	US Class	%Total	95%PI
Omicron	BA.2	VOC	67.7%	61.6-73.3%
	B.1.1.529	VOC	32.3%	26.7-38.4%
Delta	B.1.617.2	VOC	0.0%	0.0-0.0%
Other	Other*		0.0%	0.0-0.0%

* Enumerated lineages are US VOC and lineages circulating above 1% nationally in at least one week period. "Other" represents the aggregation of lineages which are circulating <1% nationally during all weeks displayed.
** These data include Nowcast estimates, which are modeled projections that may differ from weighted estimates generated at later dates
\# AY.1-AY.133 and their sublineages are aggregated with B.1.617.2. BA.1 and BA.3 are aggregated with B.1.1.529. For regional data, BA.1 is also aggregated with B.1.1.529, as it currently cannot be reliably called in each region.
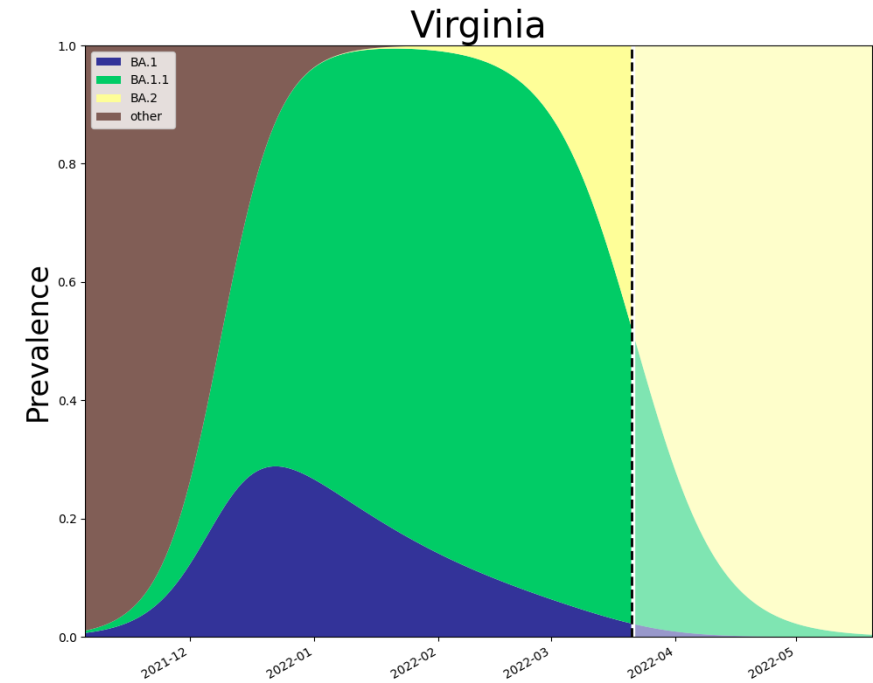
[CDC Variant Tracking](#)

SARS-CoV2 Omicron and Sub-Variants

As detected in whole Genomes in public repositories

VoC Polynomial Fit Projections
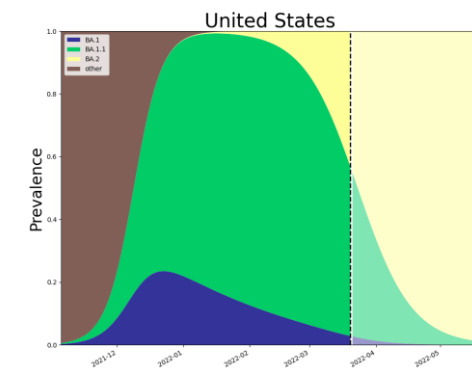
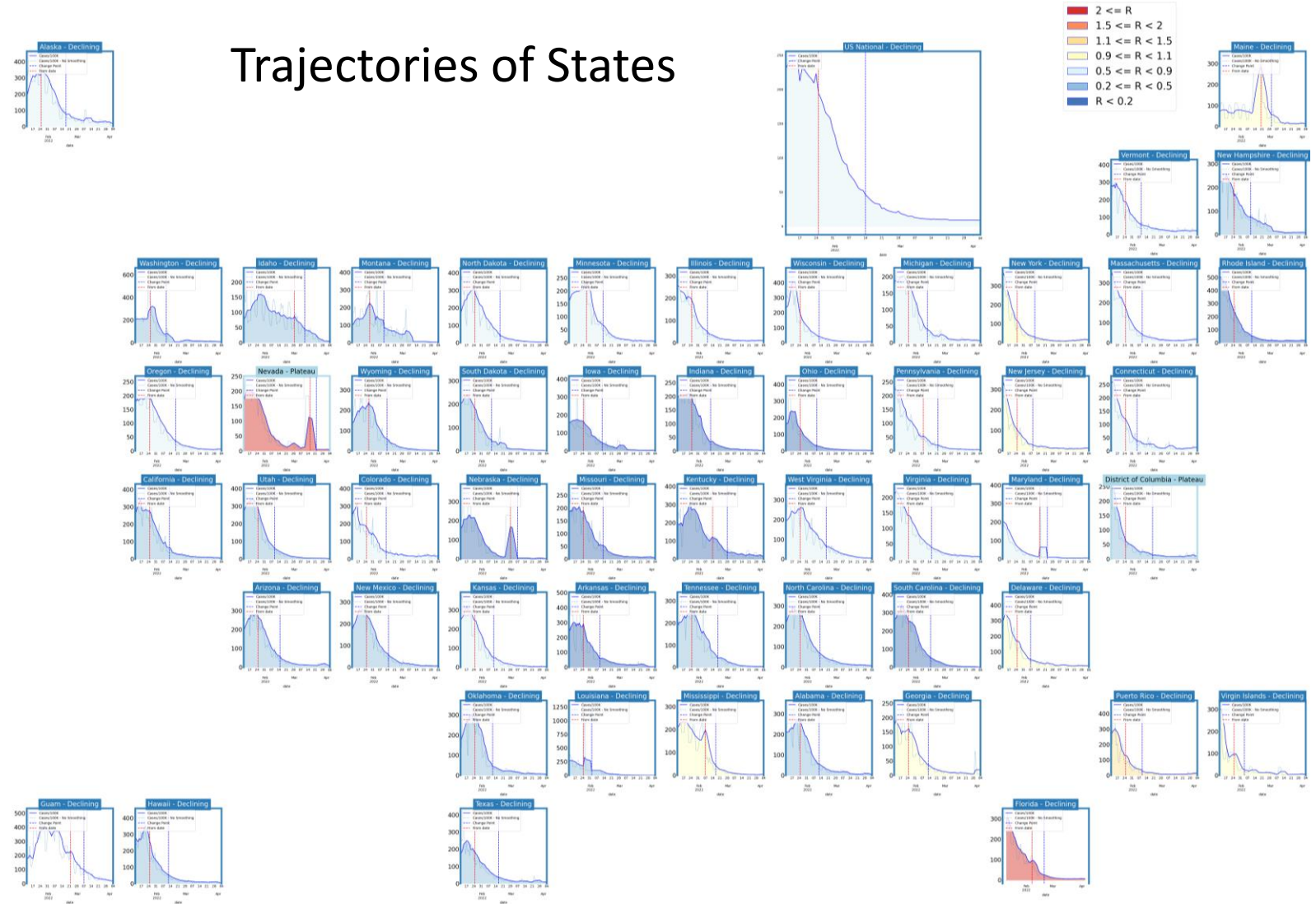Note: Data lags force projections to start in past. Everything from dotted line forward is a projection.

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United States Overall

- Nation completely declining
- Most are sustained declines

Trajectories of States

Status	# States
Declining	53 (54)
Plateau	1 (0)
Slow Growth	0 (0)
In Surge	0 (0)

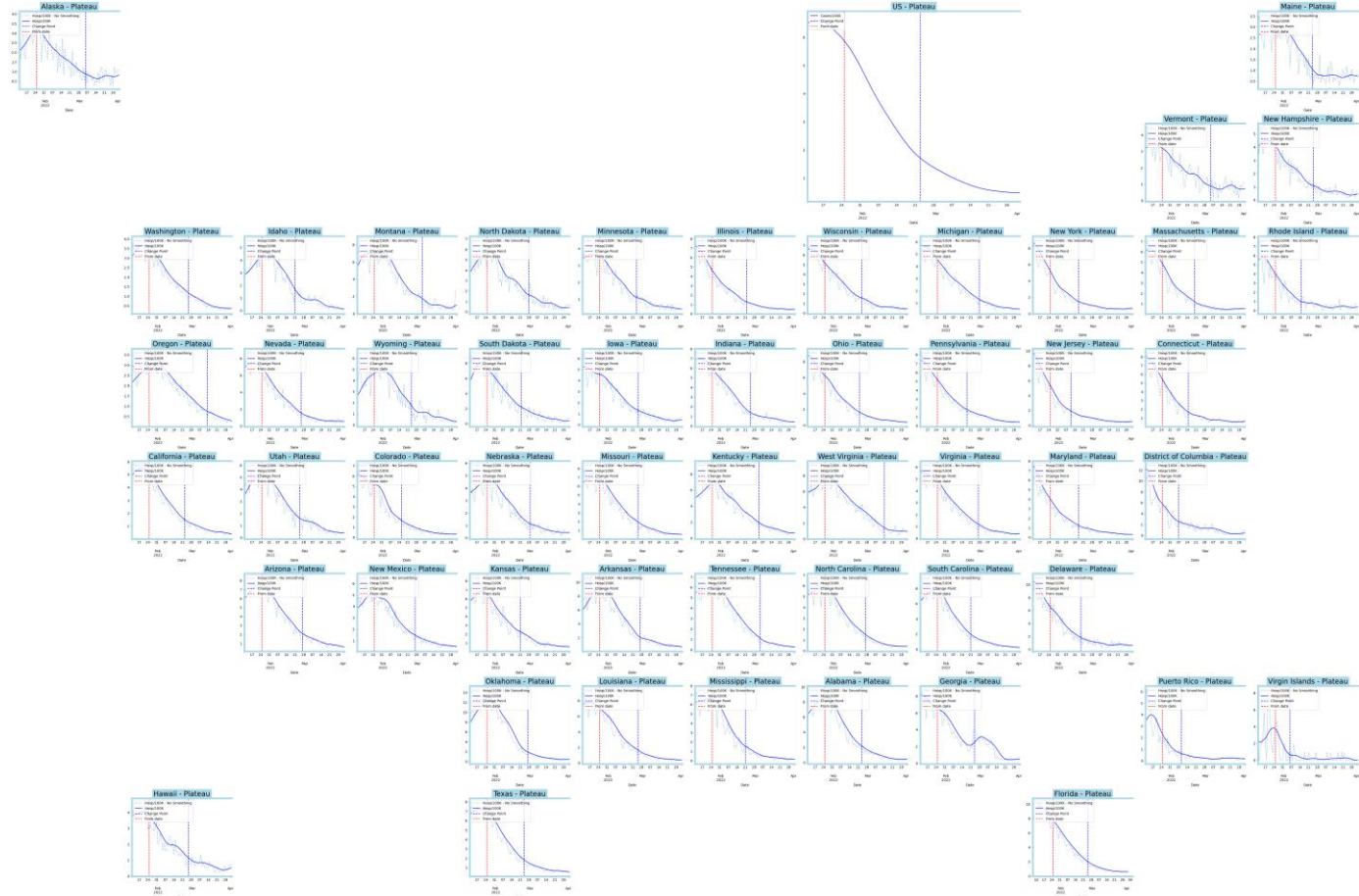UNIVERSITY of VIRGINIA

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United States Hospitalizations

- Hospital admissions are lagging case rates, and are declining

Trajectories of States

| Status	# States (prev week)
Declining	0 (1)
Plateau	53 (52)
Slow Growth	0 (0)
In Surge	0 (0)

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Virginia and Her Neighbors

- Case rates are much lower and dipping into the moderate range
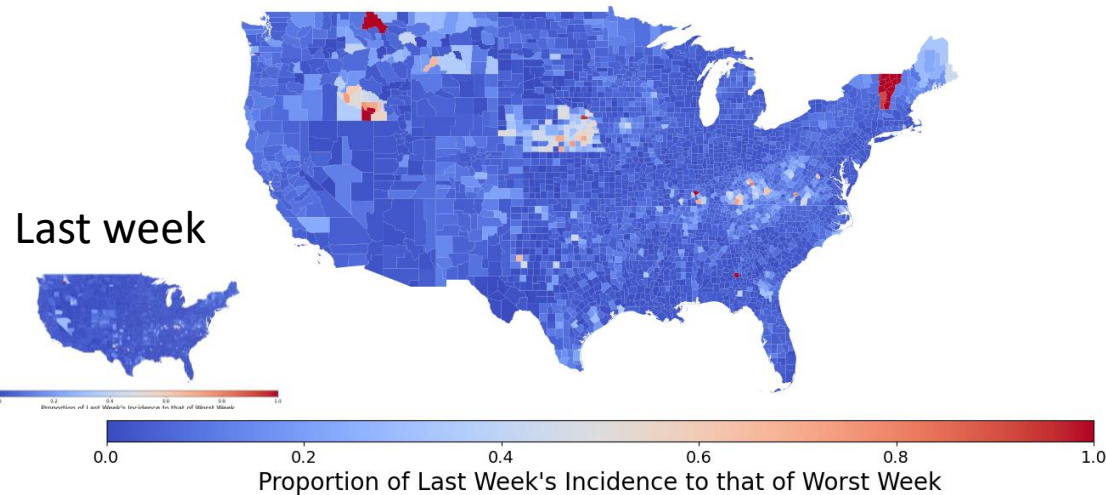
- Most now below 10/100K
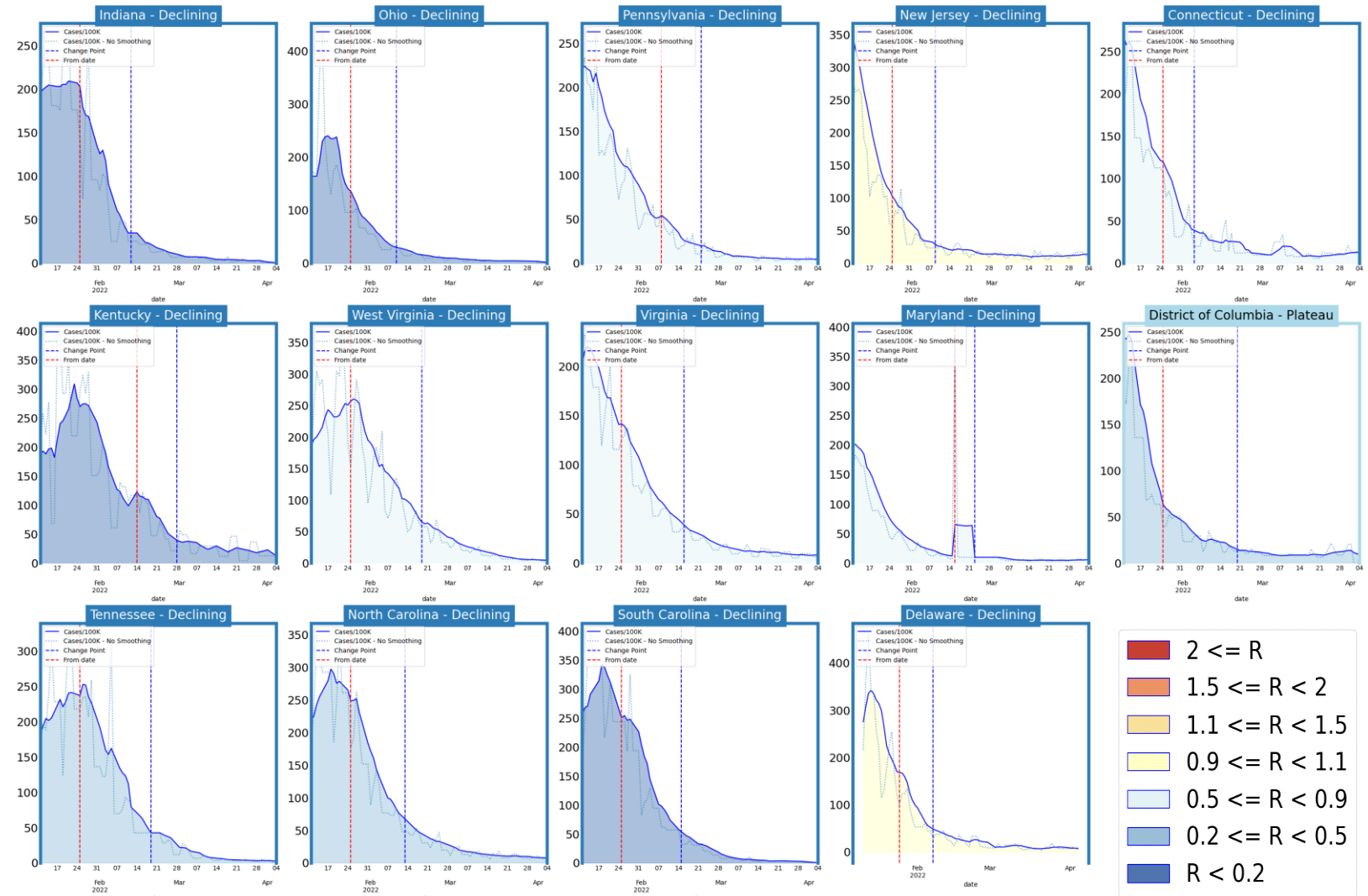
Other Countries

- UK, Ireland, and France show increases in hospitalizations
- After period of rebound most European countries are now declining
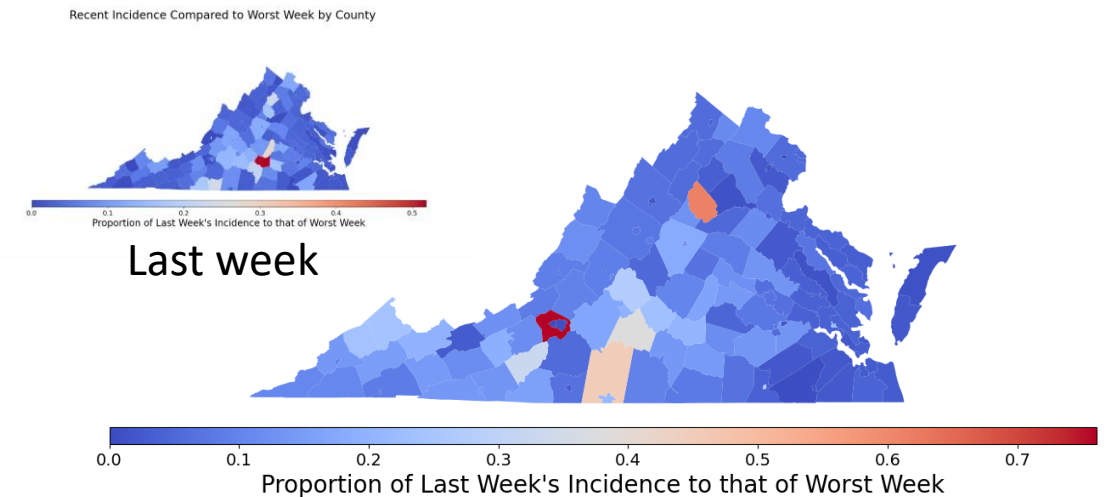

[Our World in Data](...)
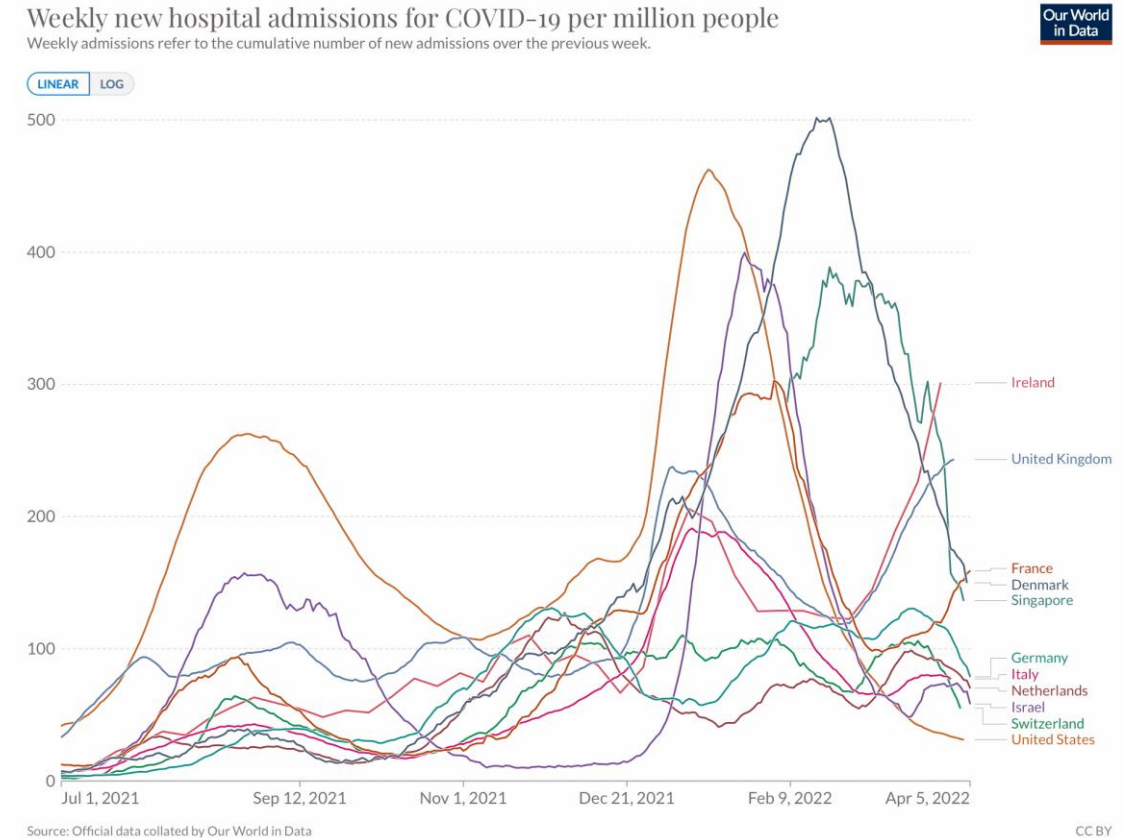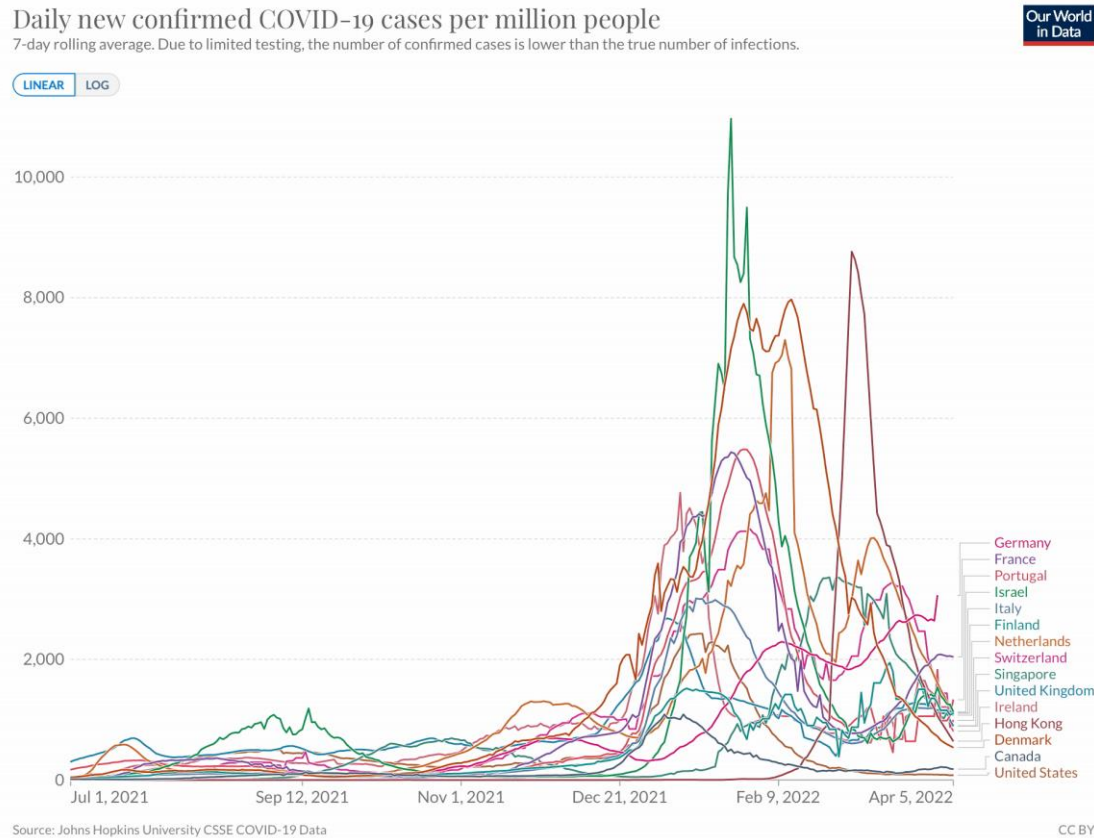
County-level comparison to previous highest peak

- Most counties in VA have had the highest case rate of the pandemic in the last week
- Nationally the number of counties at their highest rate has expanded considerably

Recent Incidence Compared to Worst Week by County

Last week

Proportion of Last Week's Incidence to that of Worst Week

Recent Incidence Compared to Worst Week by County

Last week

Proportion of Last Week's Incidence to that of Worst Week

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County-level comparison to last Summer

- Most counties in VA have had the highest case rate of the pandemic in the last week
- Nationally the number of counties at their highest rate has expanded considerably

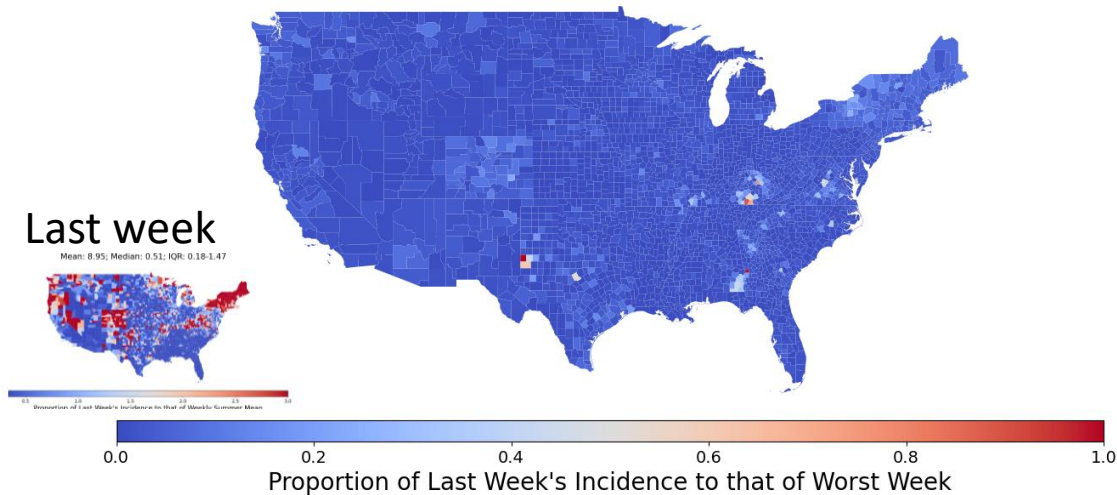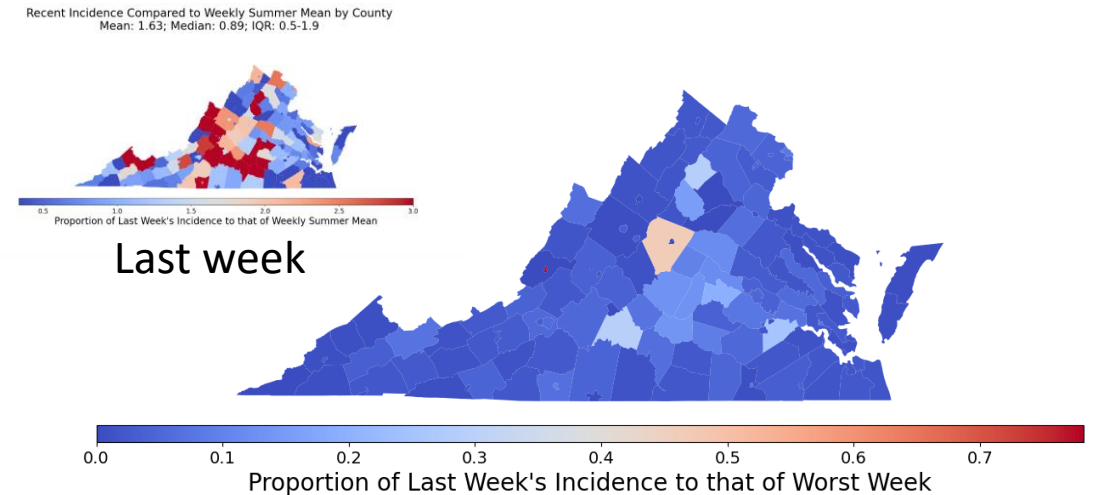Recent Incidence Compared to Worst Week by County

Last week

Proportion of Last Week's Incidence to that of Worst Week

Recent Incidence Compared to Worst Week by County

Last week

Proportion of Last Week's Incidence to that of Worst Week

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Additional Analyses

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COVID-19 Scenario Modeling Hub – Round 13

Collaboration of multiple academic teams to provide national and state-by-state level projections for 4 aligned scenarios

- Round 13 results getting finalized
  - Scenarios: New Variant in Summer and waning compared (yes/no new variant vs. 4 month or 10 month waning)

- Prelim results shared internally

- Only national consortium tracking Omicron wave well

- Rounds 4-12 now available
Round 4 Results were published
May 5th, 2021 in MMWR

https://covid19scenariomodelinghub.org/viz.html