Network Systems
Science & Advanced
Computing

Biocomplexity Institute
& Initiative

University of Virginia

Foresight and Analysis of Infectious Disease Threats to Virginia's Public Health

April 13th, 2023

(data current to April 6th – April 12th)

Biocomplexity Institute Technical report: TR BI-2023-52

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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 current and emerging Infectious Disease threats to the Commonwealth of Virginia using modeling and analytics

- **Approach:**
  - Provide analyses and summaries of current infectious disease threats
  - Survey existing forecasts and trends in these threats
  - Analyze and summarize the current situation and trends of these threats in the broader context of the US and world.
  - Provide broader overview of other emerging threats

Key Takeaways

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

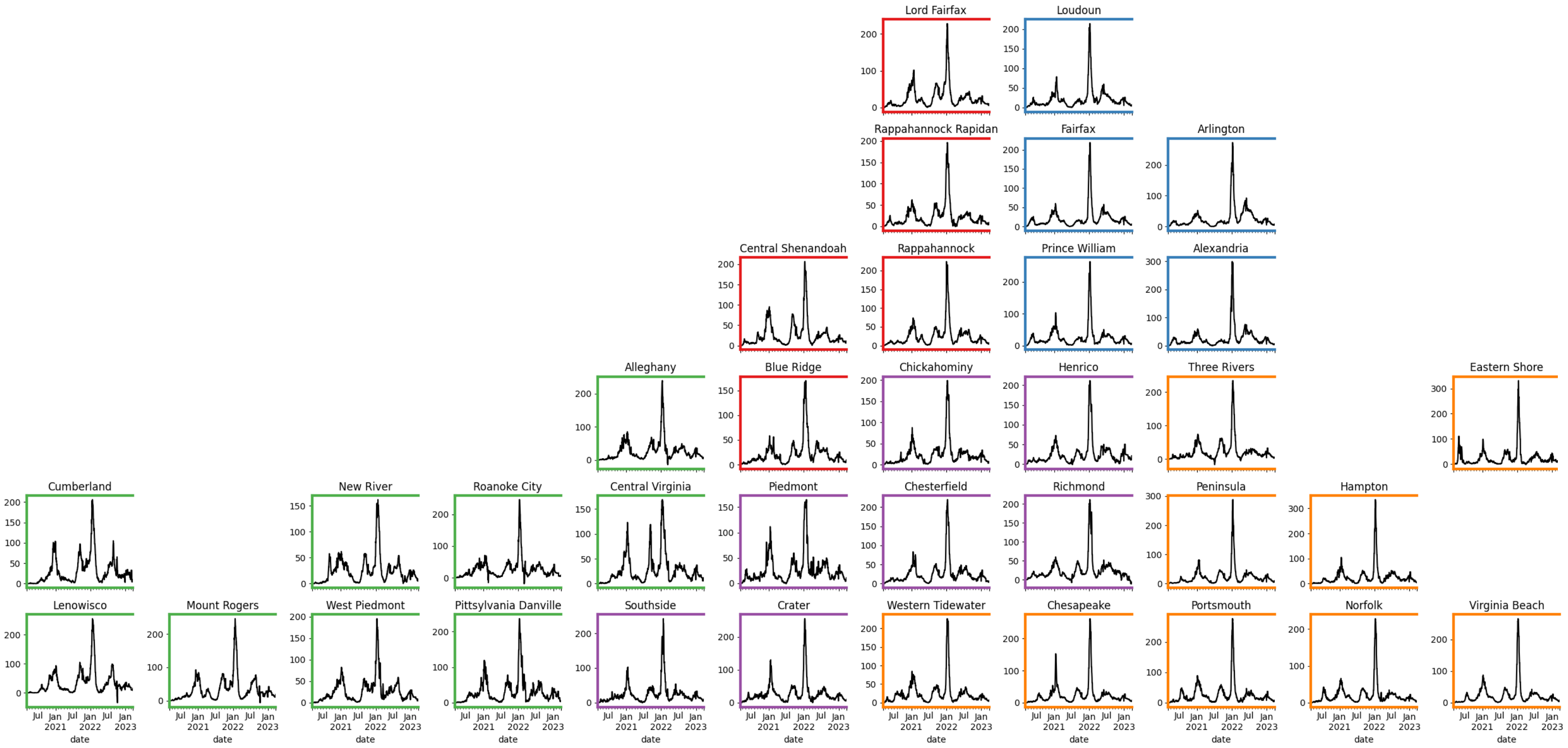
- Case rates and hospitalizations from COVID-19 continue declines but rate has slowed and have seemingly entered a plateau
  - Hospital occupancy down to levels last seen in early May of 2022
- Nearly all indicators point to this trend continuing in near term
- Influenza hospitalizations remain very low and ILI activity remains below seasonal threshold

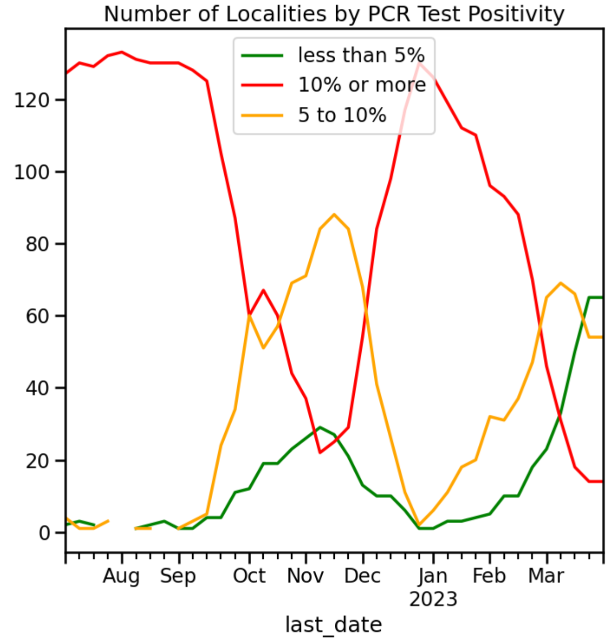
Model Updates

- Projected Trajectories from previous rounds remain on target, no new projections made this round

COVID-19 Surveillance

Case Rates (per 100k) and Test Positivity





County level RT-PCR test positivity

Green: <5.0% (or <20 tests in past 14 days)

Orange: 5.0%-10.0% (or <500 tests and <2000 tests/100k and >10% positivity over 14 days)

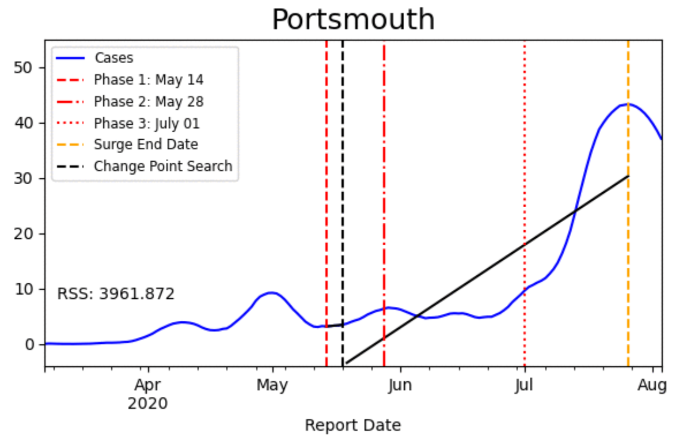
Red: >10.0% (and not "Green" or "Yellow")

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

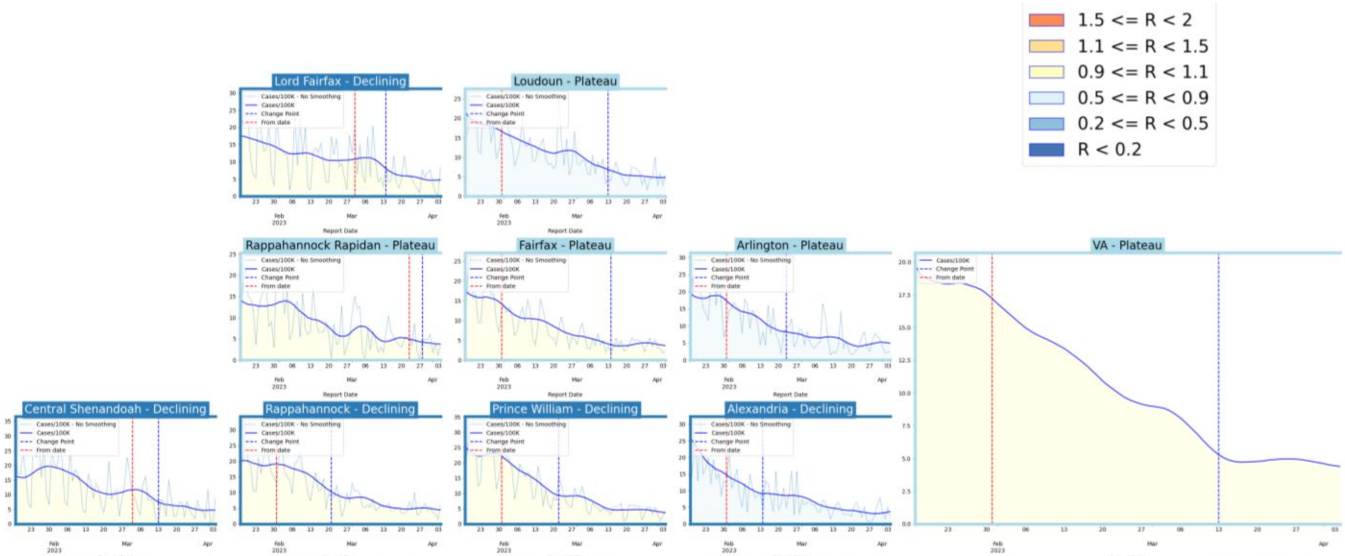


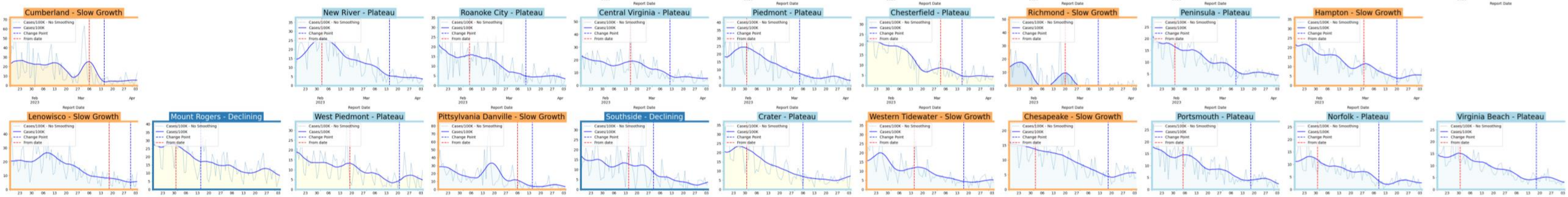
Trajectory	Description	Weekly Case Rate Slope (per 100k)	Weekly Hosp Rate Slope (per 100k)
Declining	Sustained decreases following a recent peak	slope < -0.88/day	slope < -0.07/day
Plateau	Steady level with minimal trend up or down	-0.88/day < slope < 0.42/day	-0.07/day < slope < 0.07/day
Slow Growth	Sustained growth not rapid enough to be considered a Surge	0.42/day < slope < 2.45/day	0.07/day < slope < 0.21/day
In Surge	Currently experiencing sustained rapid and significant growth	2.45/day < slope	0.21/day < slope

District Case Trajectories – last 10 weeks

Status	Number of Districts Current Week	Last Week
Declining	9	(10)
Plateau	18	(18)
Slow Growth	8	(7)
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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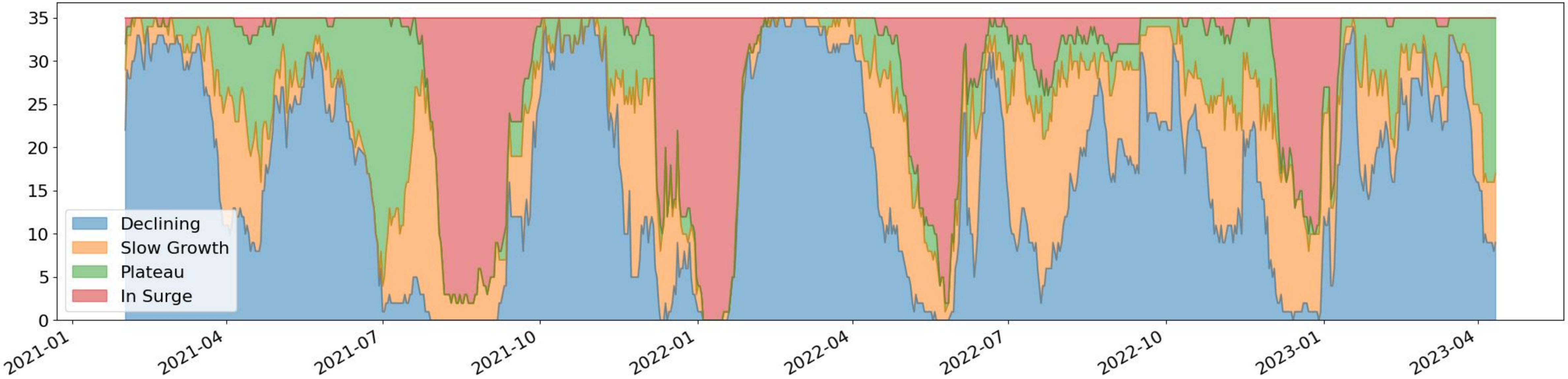
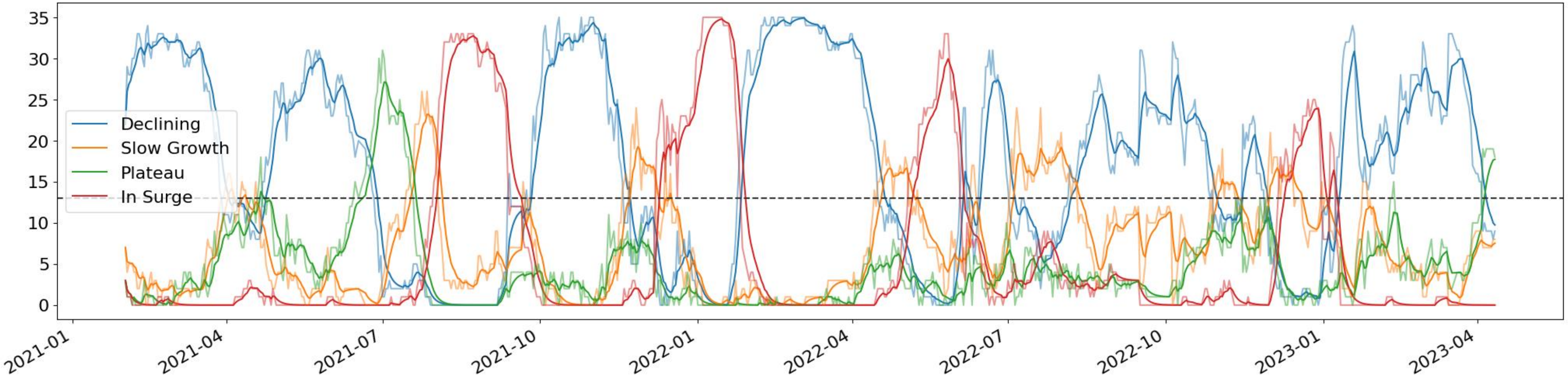
District Case Trajectories – Full History





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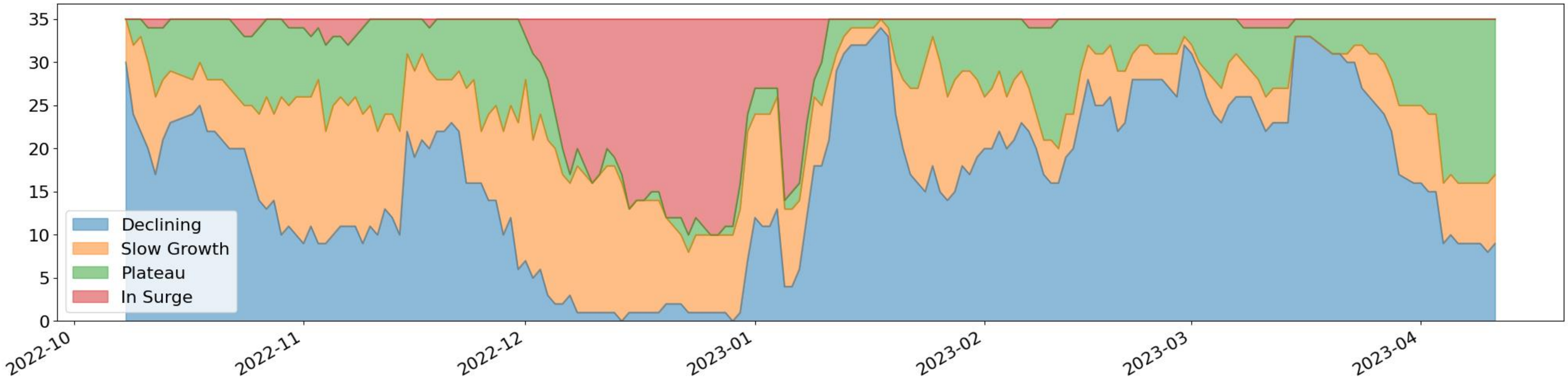
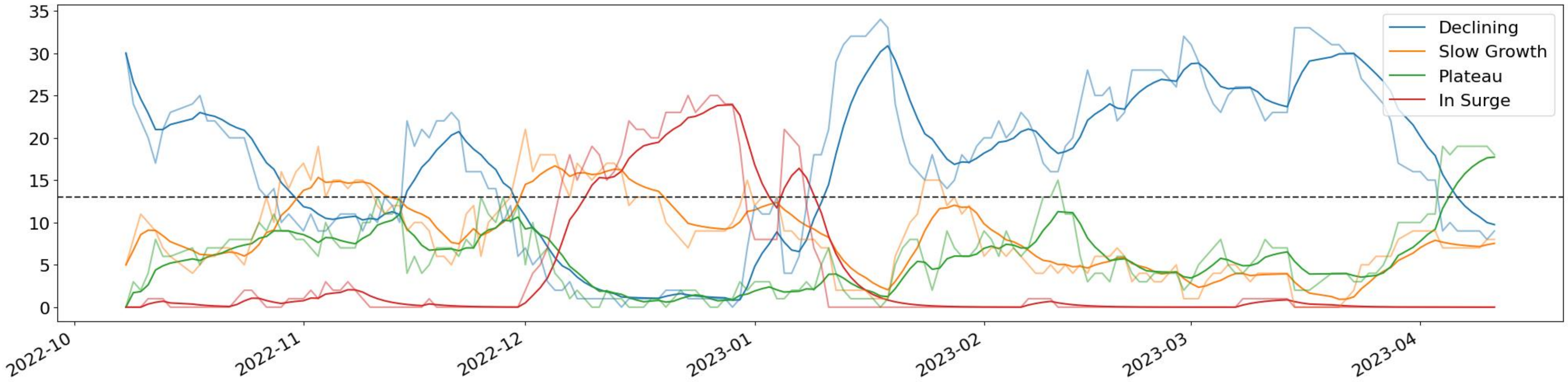
District Case Trajectories – Recent 6 months





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District Hospital Trajectories – last 10 weeks

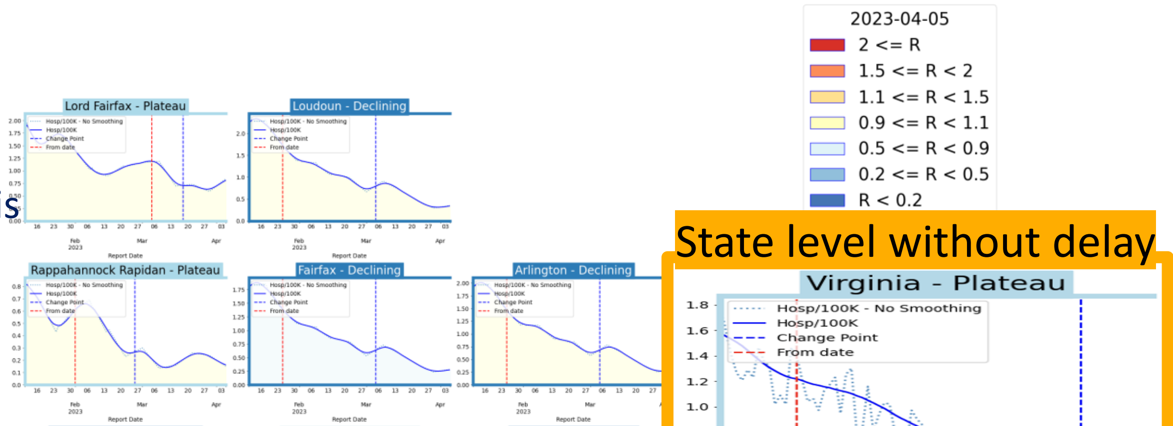
Status	Number of Districts	
	Current Week	Last Week
Declining	9	(9)
Plateau	15	(14)
Slow Growth	1	(2)
In Surge	0	(0)

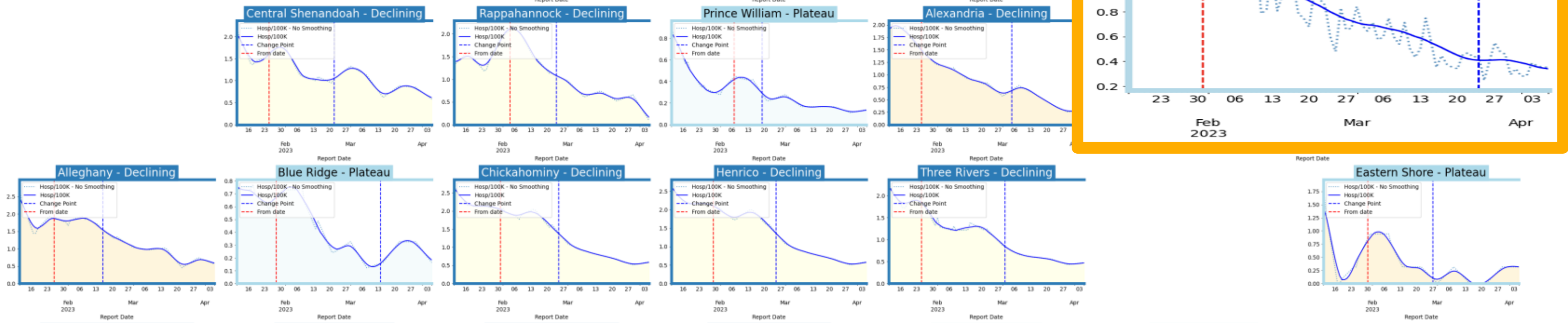
Hospitalization by county is delayed, these data are current as of

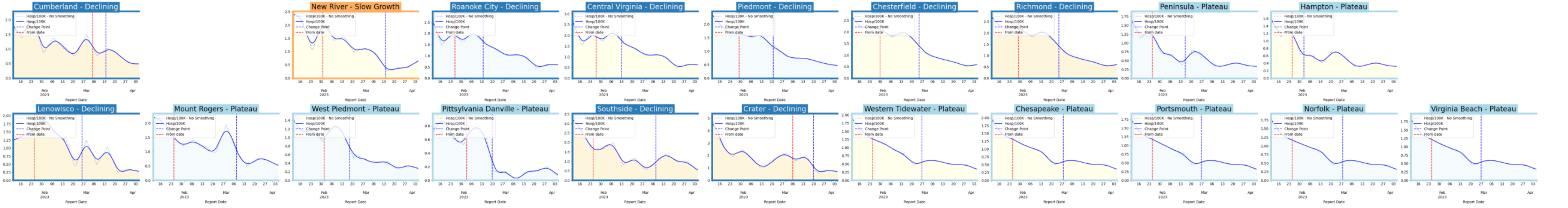
April 5th

Curve shows smoothed hospitalization rate (per 100K) by district

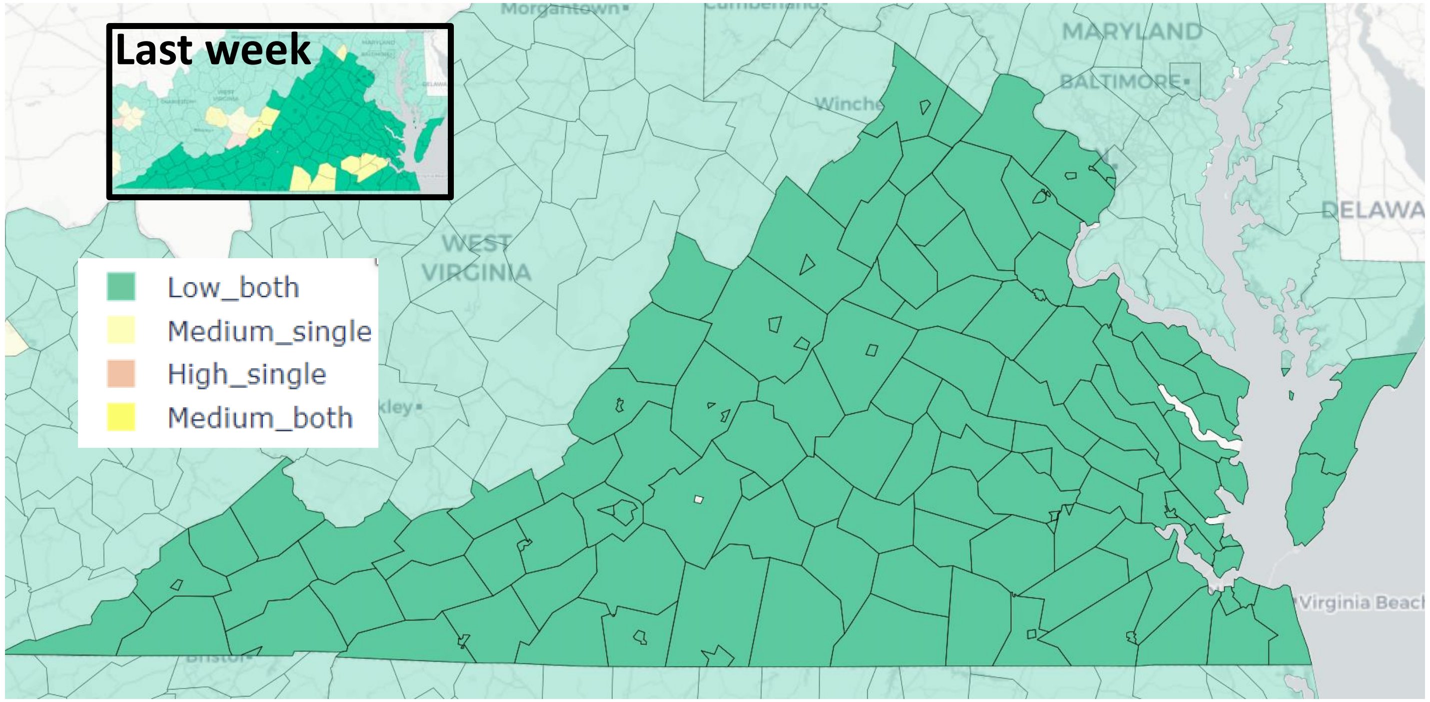
Hosp rate curve colored by R_e number







CDC's COVID-19 Community Levels



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

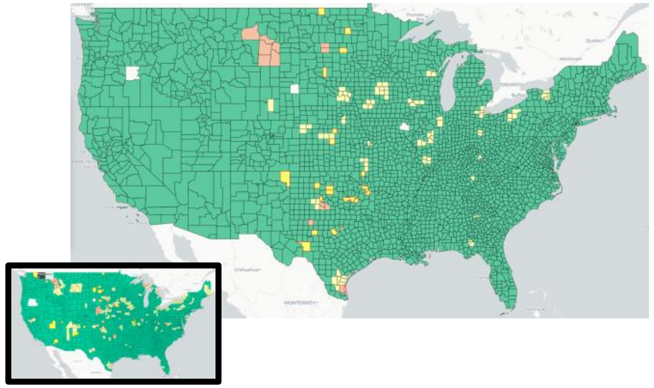
Pale color indicates either beds or occupancy set the level for this county

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

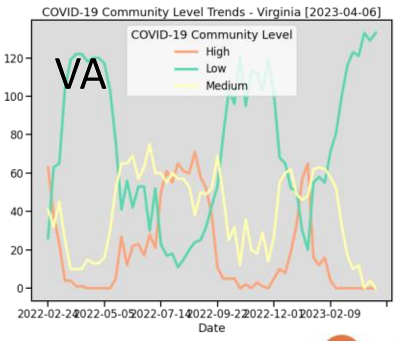
COVID-19 Community Levels – Use the Highest Level that Applies to Your Community

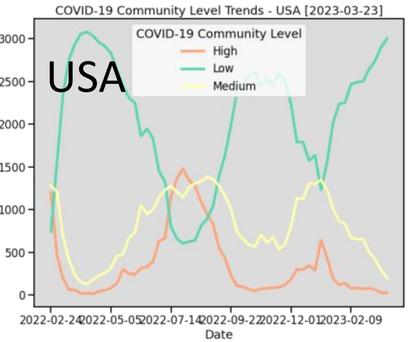
New COVID-19 Cases Per 100,000 people in the past 7 days	Indicators	Low	Medium	High
Fewer than 200	New COVID-19 admissions per 100,000 population (7-day total)	<10.0	10.0-19.9	≥20.0
	Percent of staffed inpatient beds occupied by COVID-19 patients (7-day average)	<10.0%	10.0-14.9%	≥15.0%
200 or more	New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



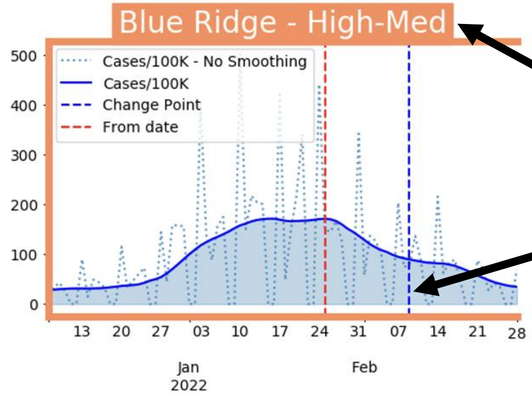


Data from: [CDC Data Tracker Portal]()

District Trajectories with Community Levels

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

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

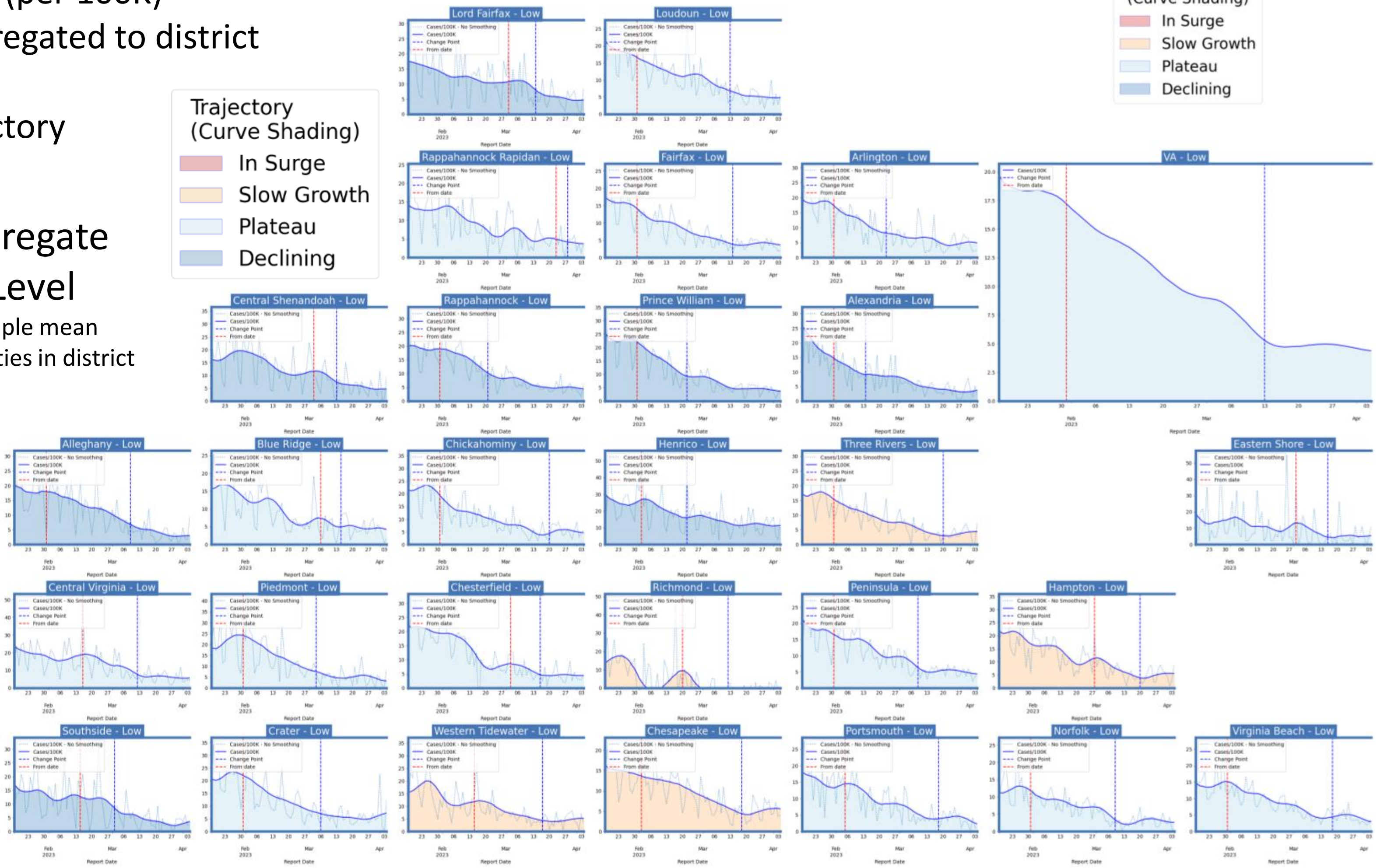


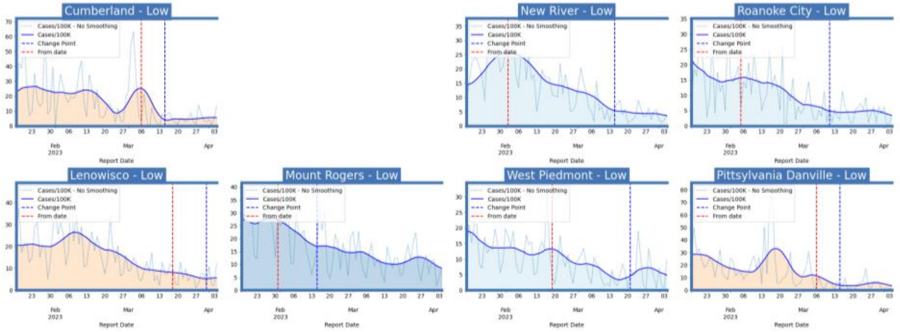
District's Aggregate Community Level

Aggregate level a simple mean of all levels for counties in district

Case rate Trajectory

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





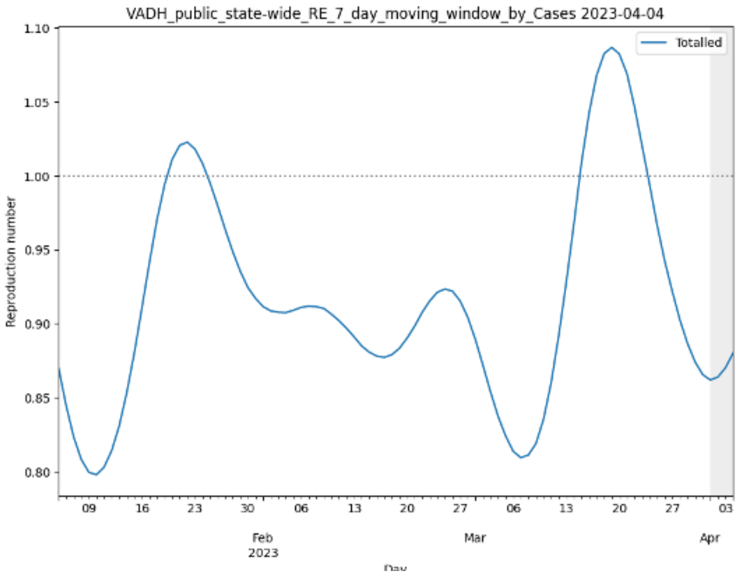
Trajectory
(Curve Shading)
- In Surge
- Slow Growth
- Plateau
- Declining

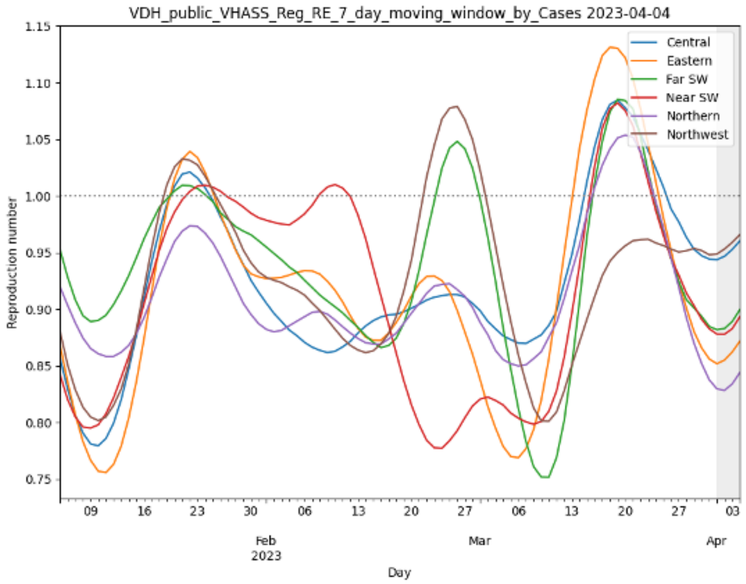
COVID-19 Growth Metrics

Estimating Daily Reproductive Number –
VDH report dates

April 4th Estimates

Region	Date Confirmed R_e	Date Confirmed Diff Last Week
State-wide	0.894	-0.133
Central	0.972	-0.022
Eastern	0.878	-0.188
Far SW	0.904	-0.158
Near SW	0.905	-0.146
Northern	0.872	-0.152
Northwest	0.948	0.020





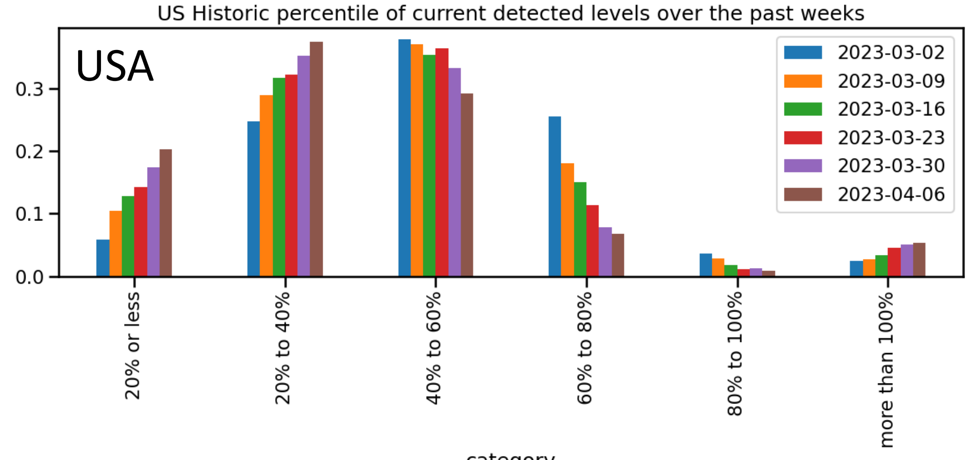
Methodology

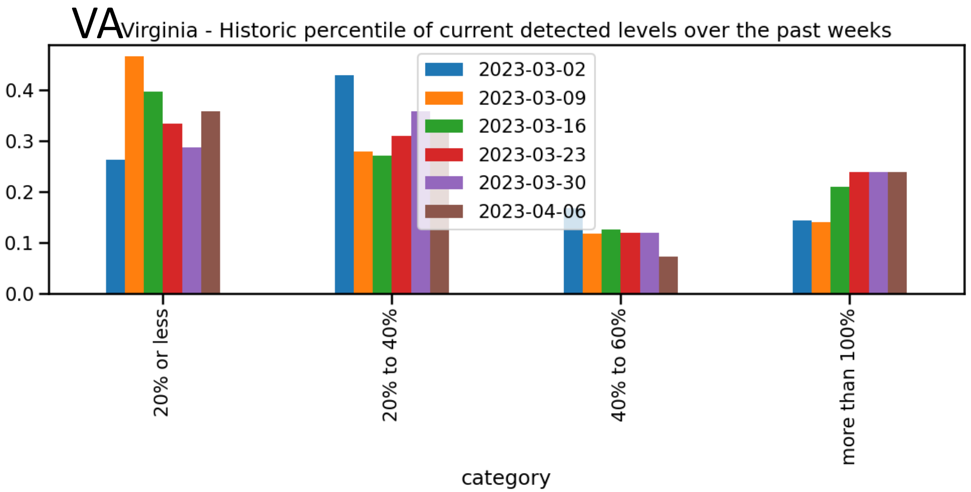
- Wallinga-Teunis method (EpiEstim[1]) for cases by **confirmation date**
- Serial interval: updated to discrete distribution from observations (mean=4.3, Flaxman et al, Nature 2020)
- Using Confirmation date since due to increasingly unstable estimates from onset date due to backfill

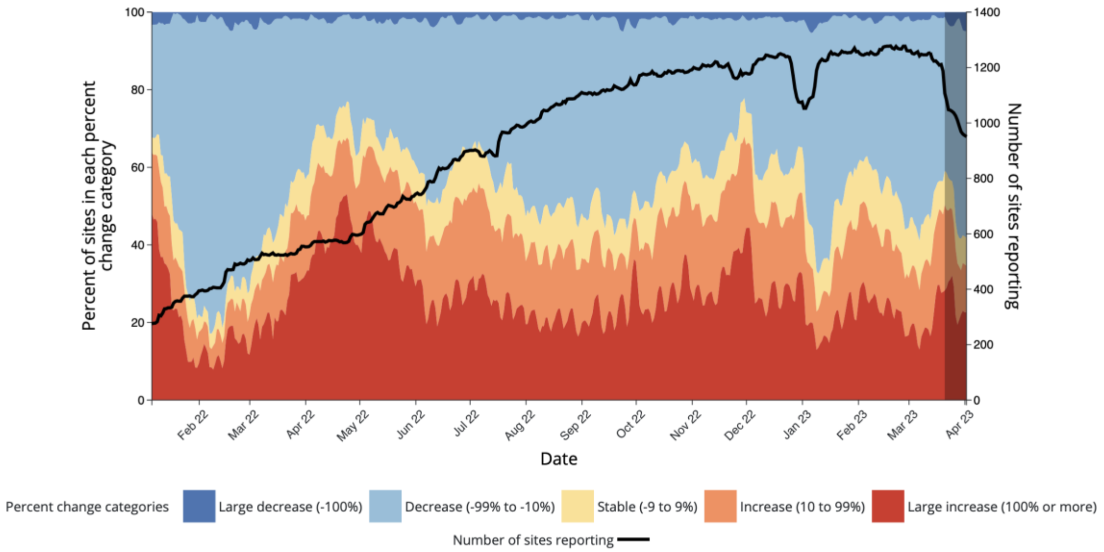
1. Anne Cori, Neil M. Ferguson, Christophe Fraser, Simon Cauchemez. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Volume 178, Issue 9, 1 November 2013, Pages 1505–1512, https://doi.org/10.1093/aje/kwt133

Wastewater Monitoring

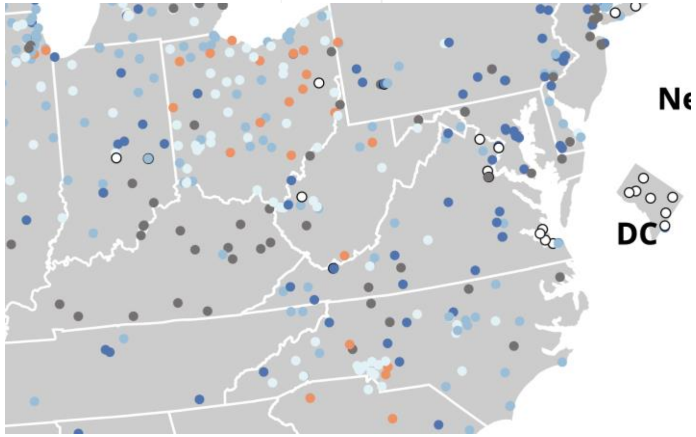
Wastewater provides a coarse estimate of COVID-19 levels in communities and can be a good indicator of activity levels







*The darker bar on the right side of the figure highlights the most recent 2 weeks, which may be subject to reporting delays. The actual number of sites reporting during those 2 weeks will likely increase as historical data are added.



Data Source: [CDC Data Tracker]()

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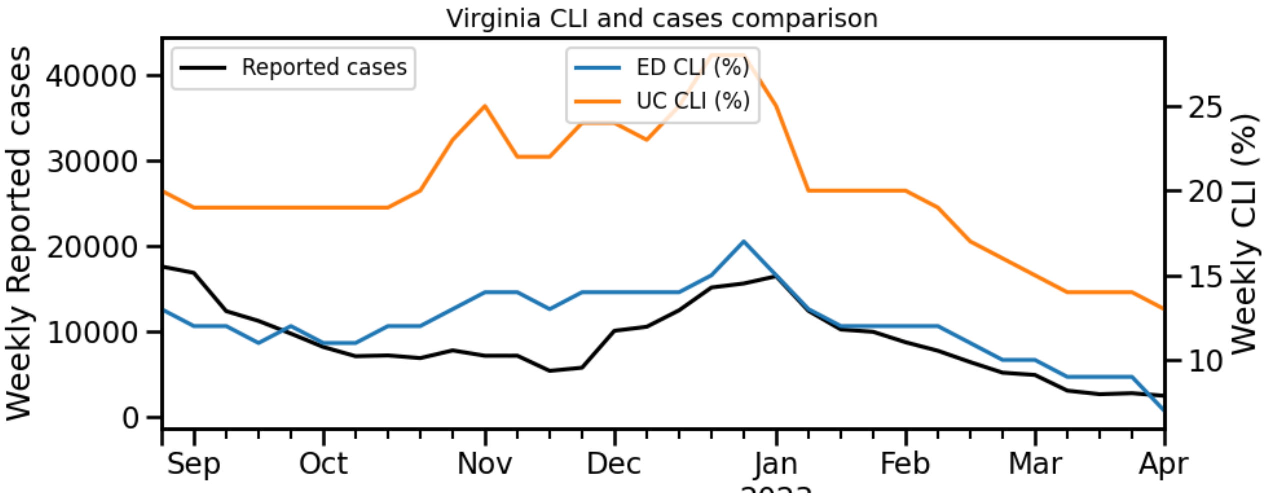
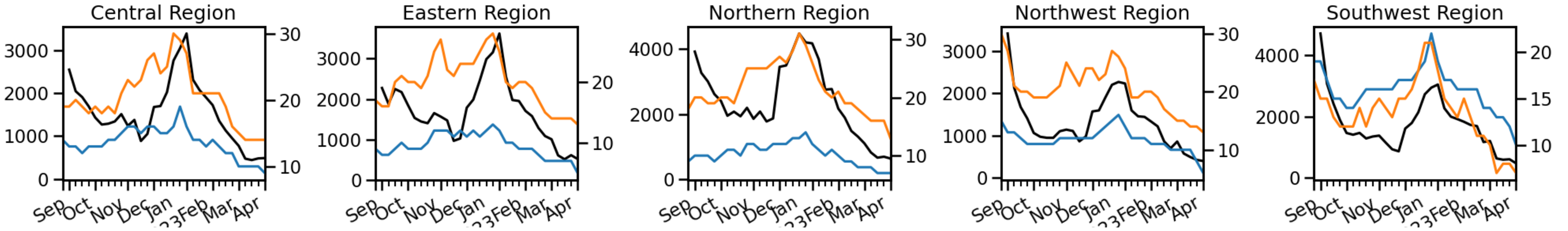
COVID-like Illness Activity

COVID-like Illness (CLI) gives a measure of COVID transmission in the community

- Emergency Dept (ED) based CLI is more correlated with case reporting
- Urgent Care (UC) is a leading indicator but may be influenced by testing for other URIs
- **Levels continue to decline into lowest levels in past 7 months**





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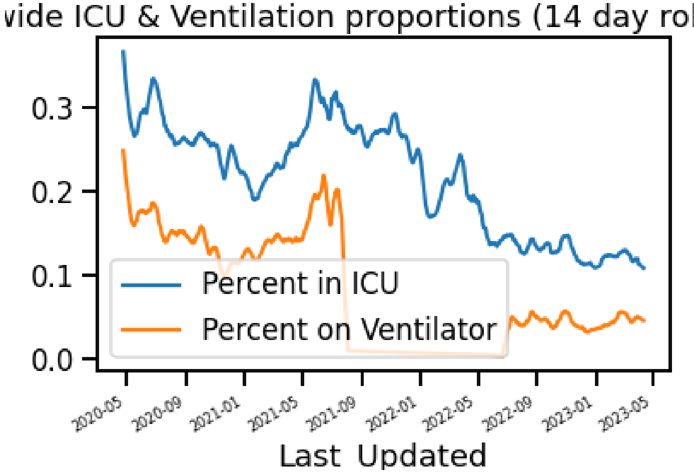
COVID-19 Severity Metrics

Hospitalizations and Severe Outcomes

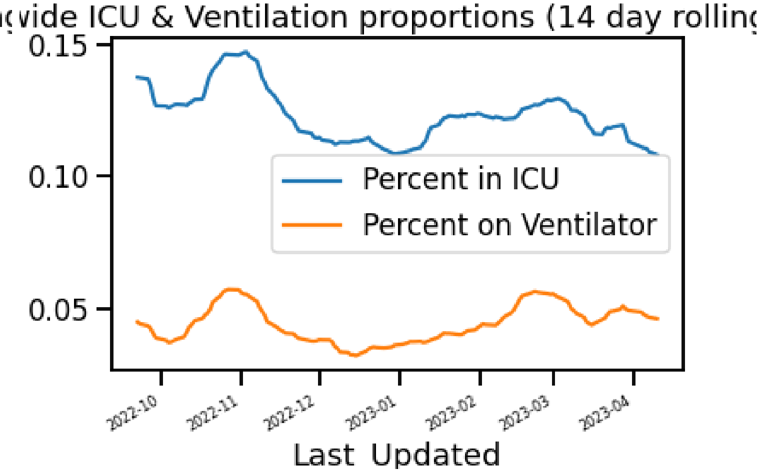
Proportion of most severe outcomes decreasing among those who are hospitalized

- ICU has declined from ~20% of hospitalized to 10-15% since initial Omicron wave
- Levels remain near all time lows, though have entered an oscillating plateau
- Regional trends are similar to state levels

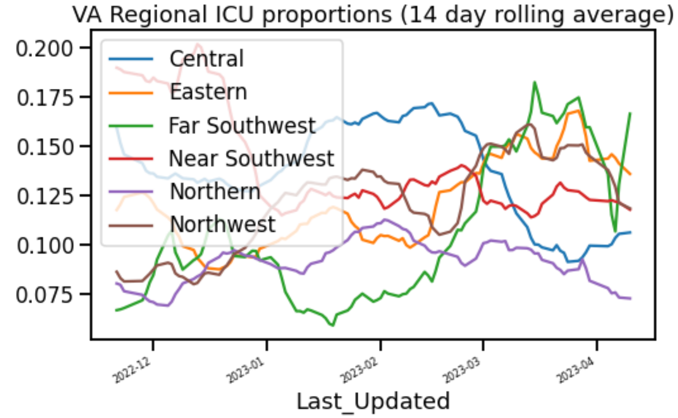
Virginia-wide – full pandemic



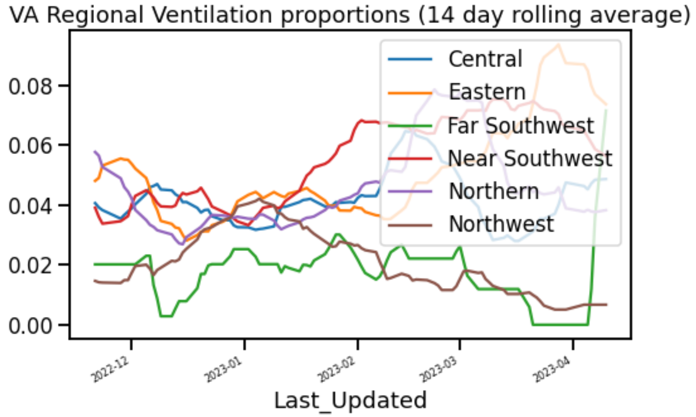
Virginia-wide – recent



Virginia Regional ICU percent



Virginia Regional Ventilation %



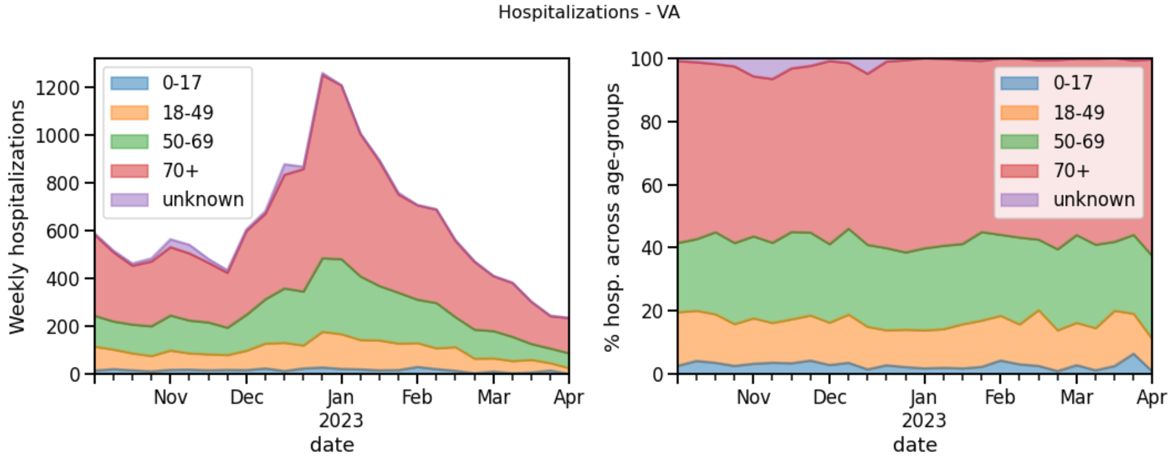
Hospitalizations in VA by Age

Age distribution in hospitals relatively stable

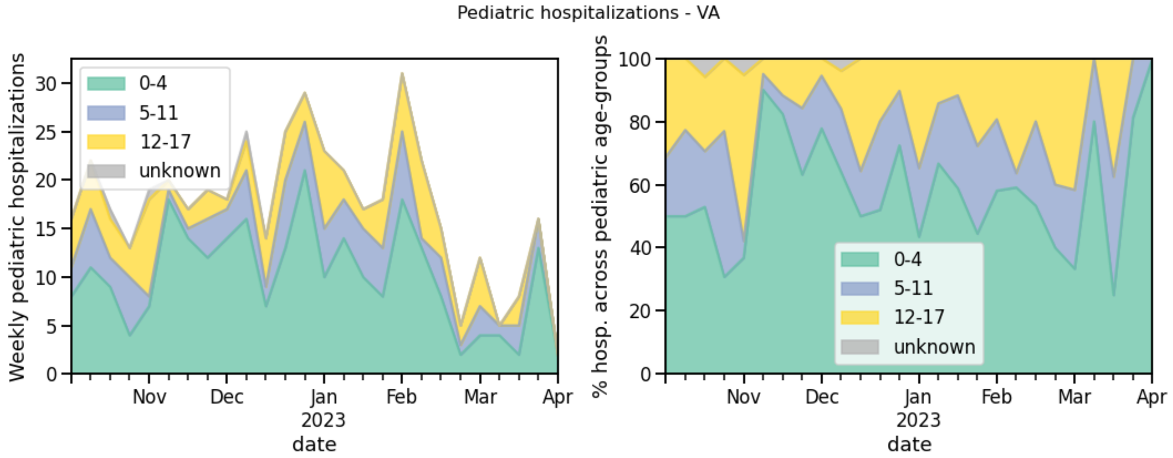
- Uptick in hospitalizations mostly fueled by 70+ age group
- Pediatric hospitalizations level off after uptick last week

Note: These data are lagged and based on HHS hospital reporting

Virginia Hospitalizations by Age (all ages)



Pediatric Hospitalizations by Age (0-17yo)



Data Source: Delphi and HHS

COVID-19 Spatial Epidemiology

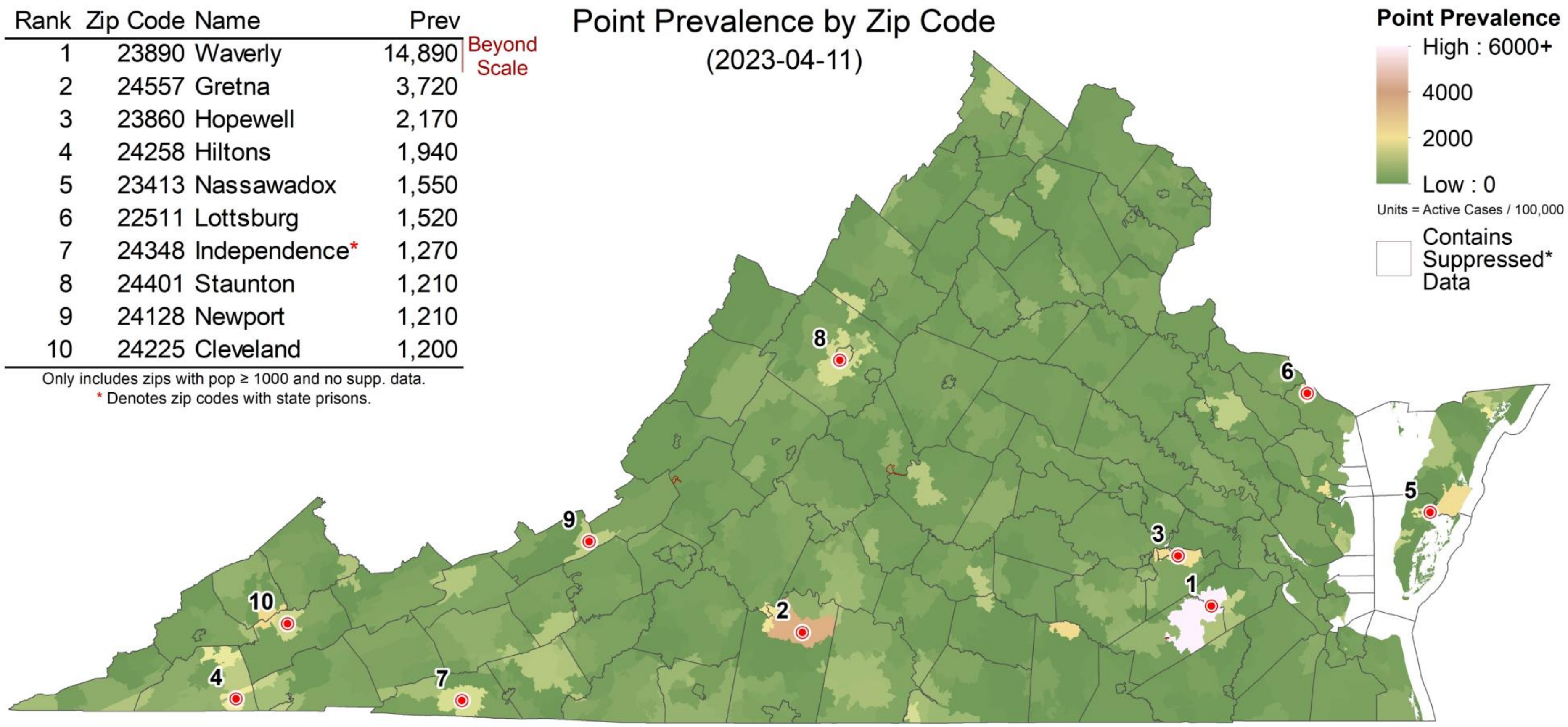
Zip code level weekly Case Rate (per 100K)

Case Rates in the last week by zip code

- Statewide point prevalence levels remain low.
- Waverly is alone in reporting unusually high rates, likely reporting artifact.
- Independence, VA is the only locale with a prison in this week’s top 10.
- High values are sporadic and spread across the Commonwealth.
- Some counts are low and suppressed to protect anonymity. They are shown with a red outline.

Rank	Zip Code	Name	Prev
1	23890	Waverly	14,890 (Beyond Scale)
2	24557	Gretna	3,720
3	23860	Hopewell	2,170
4	24258	Hiltons	1,940
5	23413	Nassawadox	1,550
6	22511	Lottsburg	1,520
7	24348	Independence*	1,270
8	24401	Staunton	1,210
9	24128	Newport	1,210
10	24225	Cleveland	1,200

Only includes zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.

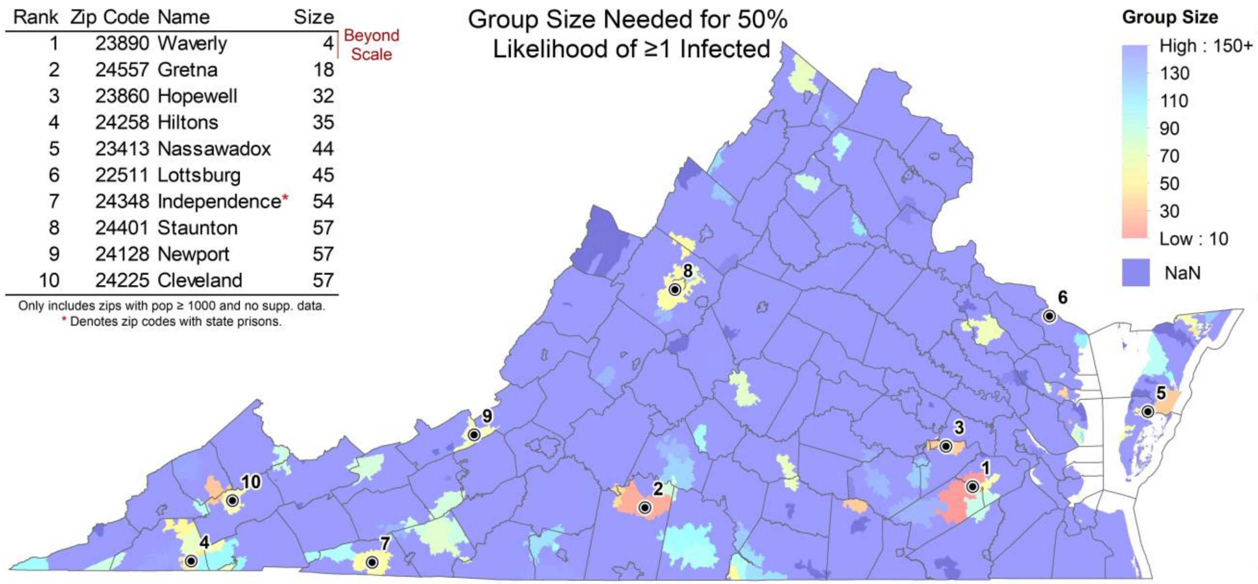


Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-04-11.

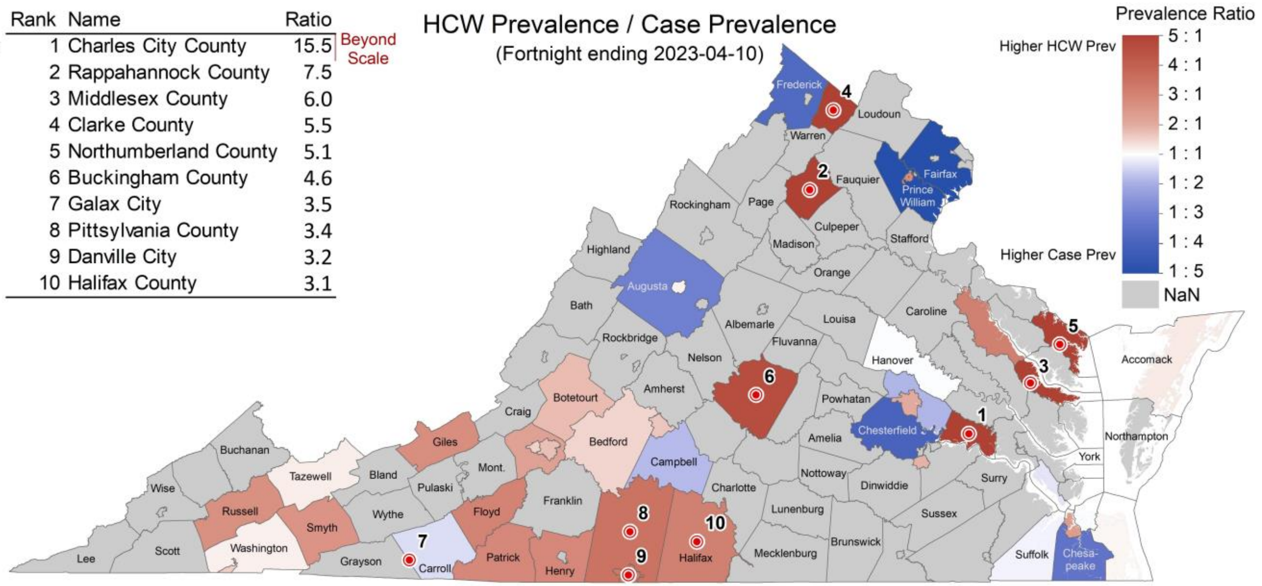
Risk of Exposure by Group Size and HCW prevalence

Case Prevalence in the last week by zip code used to calculate risk of encountering someone infected in a gathering of randomly selected people

- **Group Size**: Assumes **8 undetected infections** per confirmed case (ascertainment rate from recent seroprevalence survey) and shows minimum size of a group with a 50% chance an individual is infected by zip code (e.g., in a group of 4 in Waverly, there is a 50% chance someone will be infected).
- **HCW ratio**: Case rate among health care workers (HCW) in the last fortnight using patient facing health care workers as the numerator / population’s case prevalence. Pittsylvania and Halifax have significant HCW cases.



Based on Spatial Empirical Bayes smoothed point prevalence, with an 8:1 ascertainment ratio, for week ending 2023-04-11.



Note: This assumes that the ascertainment rate of healthcare workers is double that of the public.

Current Hot-Spots

Case rates that are significantly different from neighboring areas or model projections

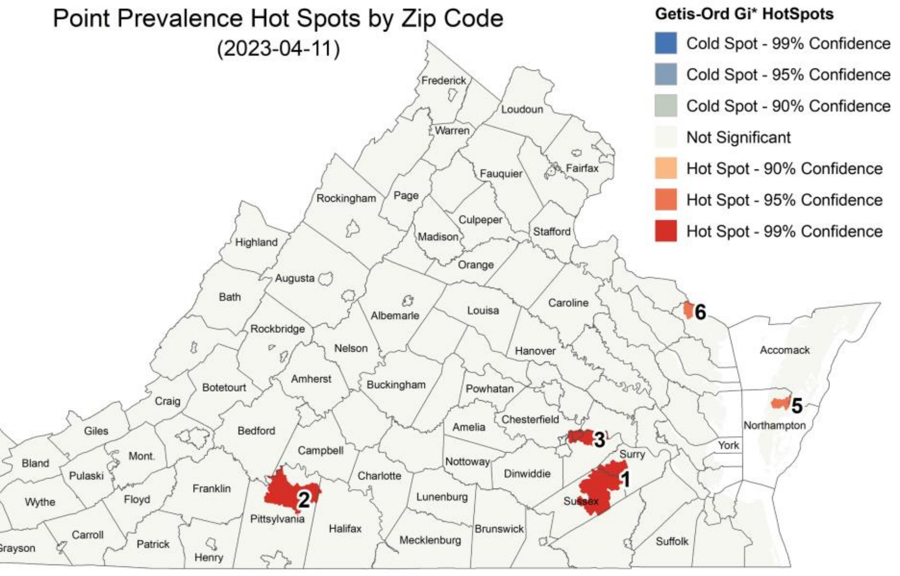
- **Spatial**: Getis-Ord Gi* based hot spots compare clusters of zip codes with weekly case prevalence higher than nearby zip codes to identify larger areas with statistically significant deviations
- **Temporal**: The weekly case rate (per 100K) projected last month compared to those observed by county, which highlights temporal fluctuations that differ from the model's projections.
- Spatial hotspots were sporadic. Note manual adjustment of Waverly due to extreme values. The models slightly underpredicted the Cumberland Plateau, Pittsylvania / Danville, and Crater Health Districts.

Spatial Hotspots

Spot	Zip Code	Name	Conf.
1	23890	Waverly	99%
2	24557	Gretna	99%
3	23860	Hopewell	99%
4	24258	Hiltons	99%
5	23413	Nassawadox	95%
6	22511	Lottsburg	95%

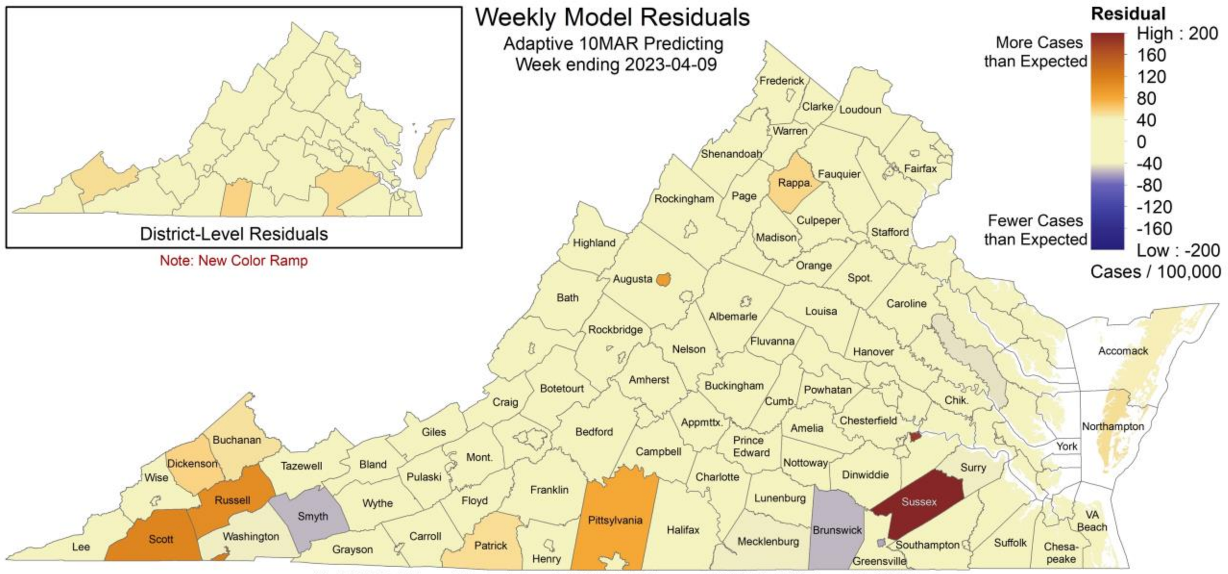
Only zips with pop ≥ 1000 and no supp. data.
* Denotes zip codes with state prisons.

Note: The prevalence for Waverly, VA was manually censored prior to Getis-Ord calculations as the extreme value confounded the analysis.



Based on Global Empirical Bayes smoothed point prevalence for week ending 2023-04-11.

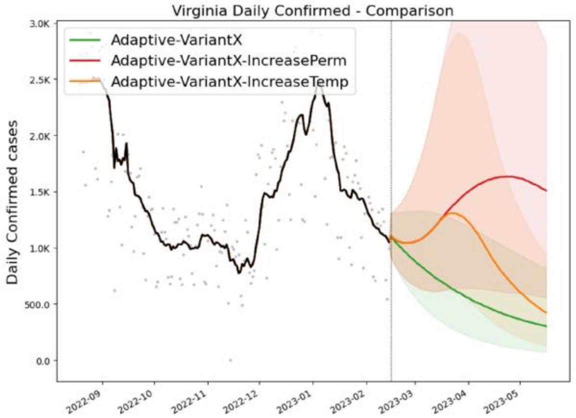
Clustered Temporal Hotspots

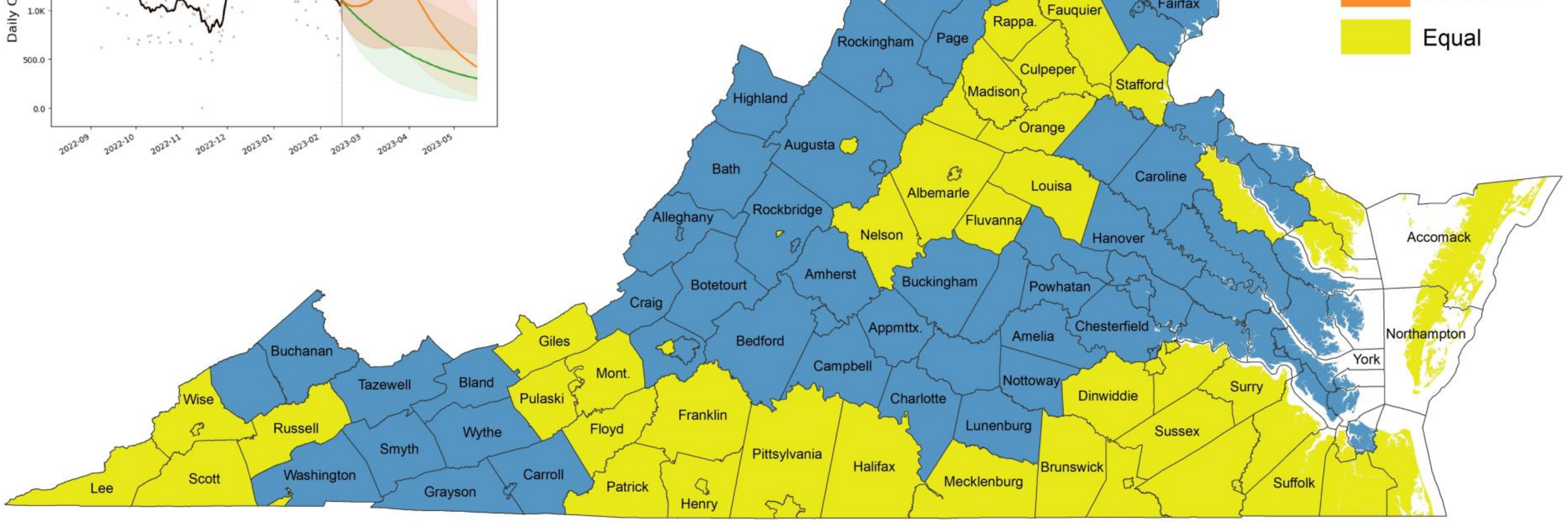


Health District Level Moran's I = -0.051086, Z-Score = -0.36376, P-Value = 0.716037
No Residual Autocorrelation Detected

Scenario Trajectory Tracking

Which scenario from a six weeks ago did projection for each county track closest?





- Six-week projections separate the scenarios more clearly and reveals larger overall patterns.
- Most counties tracked the Adaptive (current course) scenario from late February.
- Not even one tracked the Increased Transmission scenarios better than the Adaptive.

COVID-19 Broader Context

United States Hospitalizations

<table>
<tr><th rowspan="2">Status</th><th colspan="2">Number of States</th></tr>
<tr><th>Current Week</th><th>Last Week</th></tr>
<tr><td>Declining</td><td>18</td><td>(13)</td></tr>
<tr><td>Plateau</td><td>34</td><td>(33)</td></tr>
<tr><td>Slow Growth</td><td>0</td><td>(6)</td></tr>
<tr><td>In Surge</td><td>1</td><td>(1)</td></tr>
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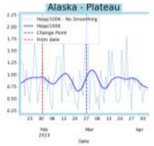
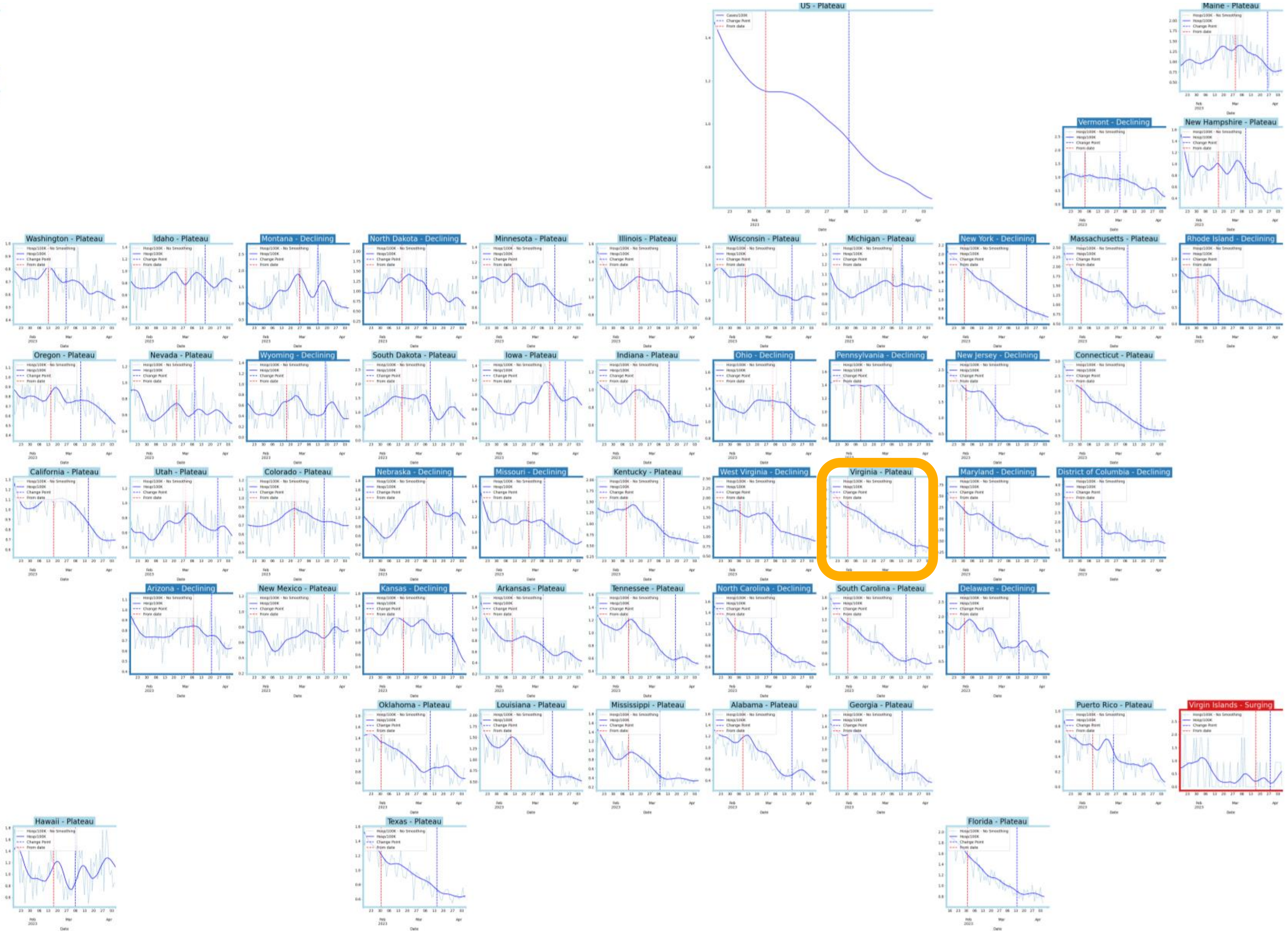
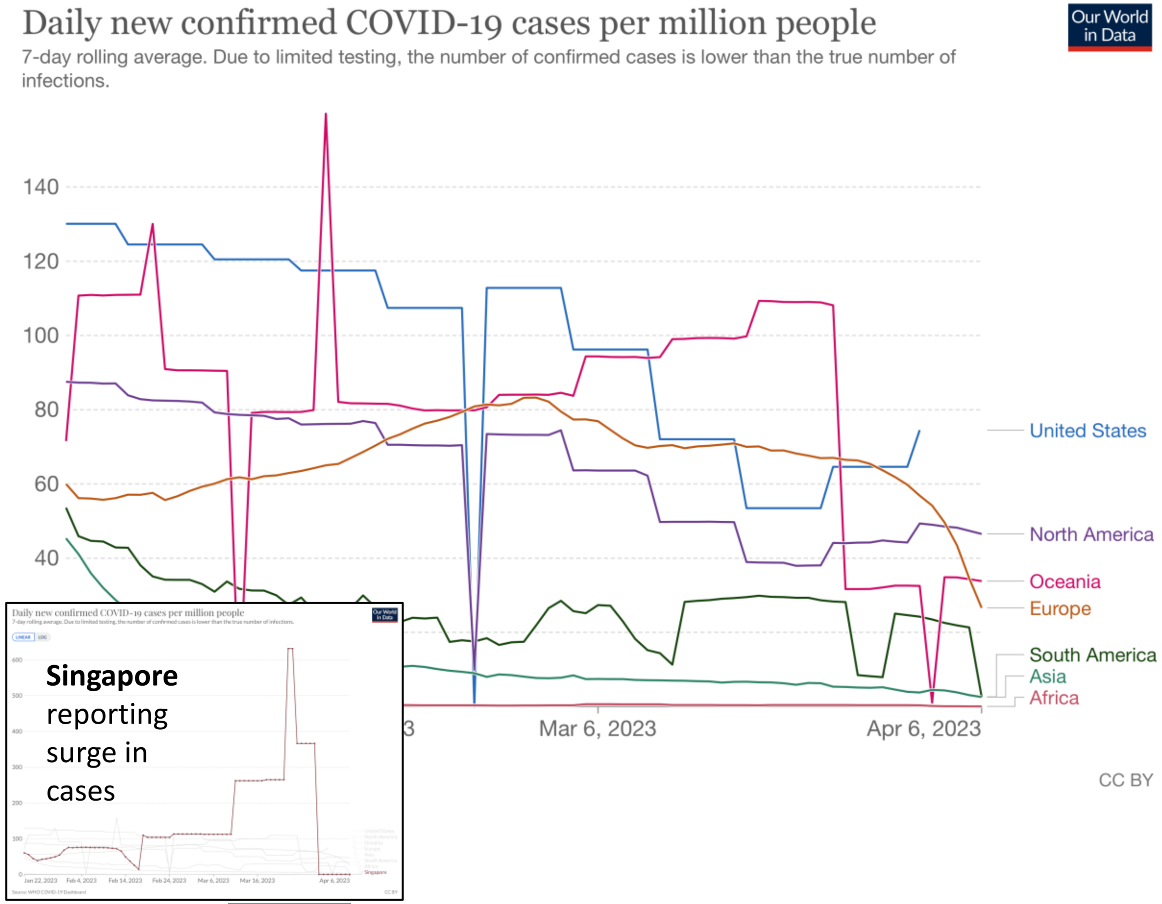


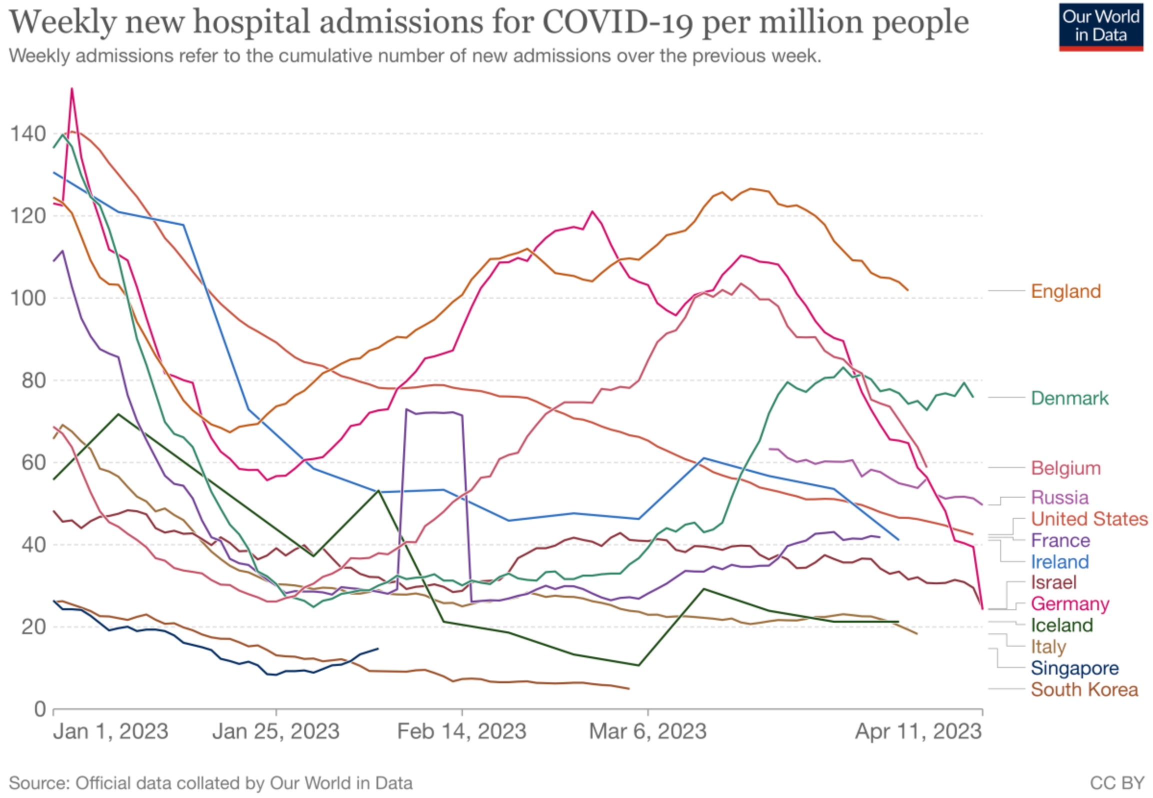


Around the World – Various trajectories

Confirmed cases



Hospitalizations



Our World in Data [Our World in Data](#)

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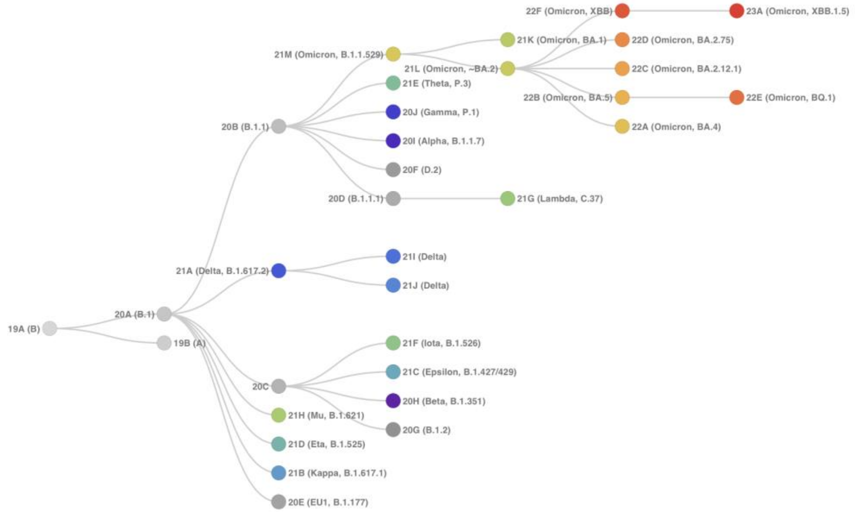
COVID-19 Genomic Update

SARS-CoV2 Variants of Concern

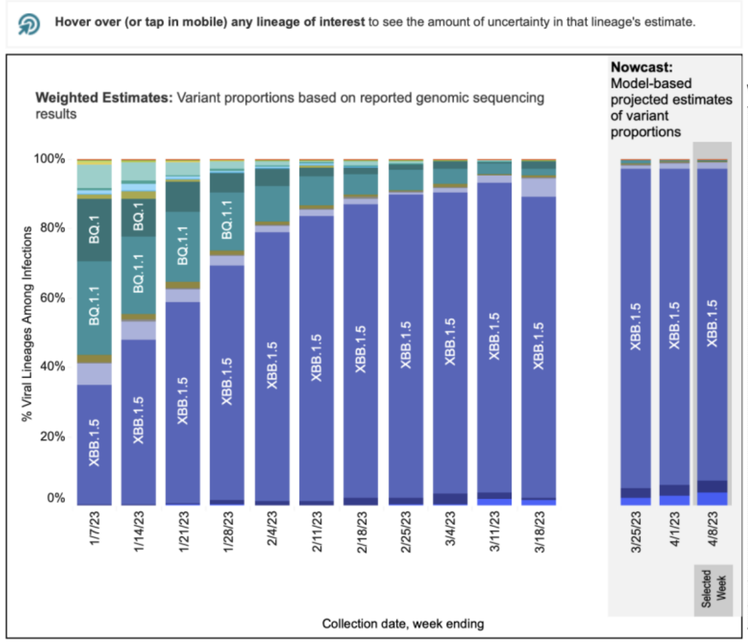


https://clades.nextstrain.org

Emerging variants have potential to continue to alter the future trajectories of pandemic and have implications for future control

- **Variants have been observed to:** increase transmissibility, increase severity (more hospitalizations and/or deaths), and limit immunity provided by prior infection and vaccinations

Weighted and Nowcast Estimates in HHS Region 3 for Weeks of 1/1/2023 – 4/8/2023



Nowcast Estimates in HHS Region 3 for 4/2/2023 – 4/8/2023

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

WHO label	Lineage #	US Class	%Total	95%PI
Omicron	XBB.1.5	VOC	90.1%	87.3-92.3%
	XBB.1.9.1	VOC	3.7%	2.3-5.8%
	XBB.1.5.1	VOC	3.4%	2.3-5.0%
	XBB	VOC	2.2%	1.2-3.8%
	BQ.1.1	VOC	0.4%	0.3-0.5%
	CH.1.1	VOC	0.2%	0.1-0.3%
	BQ.1	VOC	0.1%	0.0-0.1%
	BA.2	VOC	0.0%	0.0-0.1%
	BN.1	VOC	0.0%	0.0-0.0%
	BA.5	VOC	0.0%	0.0-0.0%
	BA.2.75	VOC	0.0%	0.0-0.0%
	BF.7	VOC	0.0%	0.0-0.0%
	BA.5.2.6	VOC	0.0%	0.0-0.0%
	BA.2.75.2	VOC	0.0%	0.0-0.0%
	BF.11	VOC	0.0%	0.0-0.0%
	BA.1.1	VOC	0.0%	0.0-0.0%
	B.1.1.529	VOC	0.0%	0.0-0.0%
	BA.4.6	VOC	0.0%	0.0-0.0%
	BA.4	VOC	0.0%	0.0-0.0%
Delta	B.1.617.2	VBM	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.

BA.1, BA.3 and their sublineages (except BA.1.1 and its sublineages) are aggregated with B.1.1.529. Except BA.2.12.1, BA.2.75, XBB and their sublineages, BA.2 sublineages are aggregated with BA.2. Except BA.2.75.2, CH.1.1 and BN.1, BA.2.75 sublineages are aggregated with BA.2.75. Except BA.4.6, sublineages of BA.4 are aggregated to BA.4. Except BF.7, BF.11, BA.5.2.6, BQ.1 and BQ.1.1, sublineages of BA.5 are aggregated to BA.5. Except XBB.1.9.1, XBB.1.5 and its sublineages, sublineages of XBB are aggregated to XBB. Except XBB.1.5.1, sublineages of XBB.1.5 are aggregated to XBB.1.5. For all the other lineages listed, their sublineages are aggregated to the listed parental lineages respectively. Previously, XBB.1.9.1 was aggregated to XBB. Lineages BA.2.75.2, XBB, XBB.1.5, XBB.1.5.1, XBB.1.9.1, BN.1, BA.4.6, BF.7, BF.11, BA.5.2.6 and BQ.1.1 contain the spike substitution R346T.

Omicron Updates*

- XBB.1.5 proportions have fallen to 90%
- XBB.1.5.1 steady at 3%
- XBB.1.9 now at 3.7% up from 1% last week
- All other XBB strains (including XBB.1.16.1) increasing to 2.2%
- BQ.1.1, CH.1.1, and BQ.1 are all below 1% but remain in the population

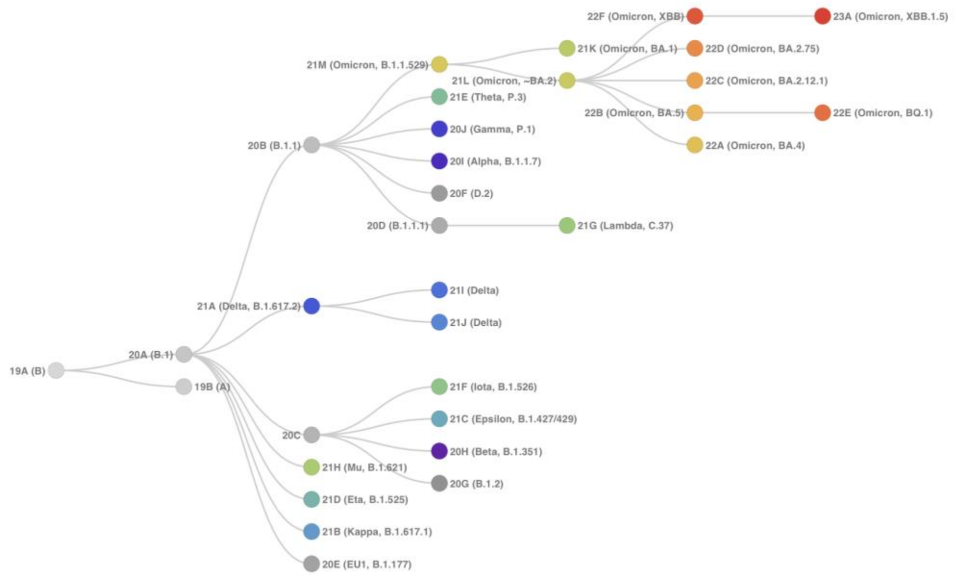
*percentages are CDC NowCast Estimates

CDC Variant Tracking

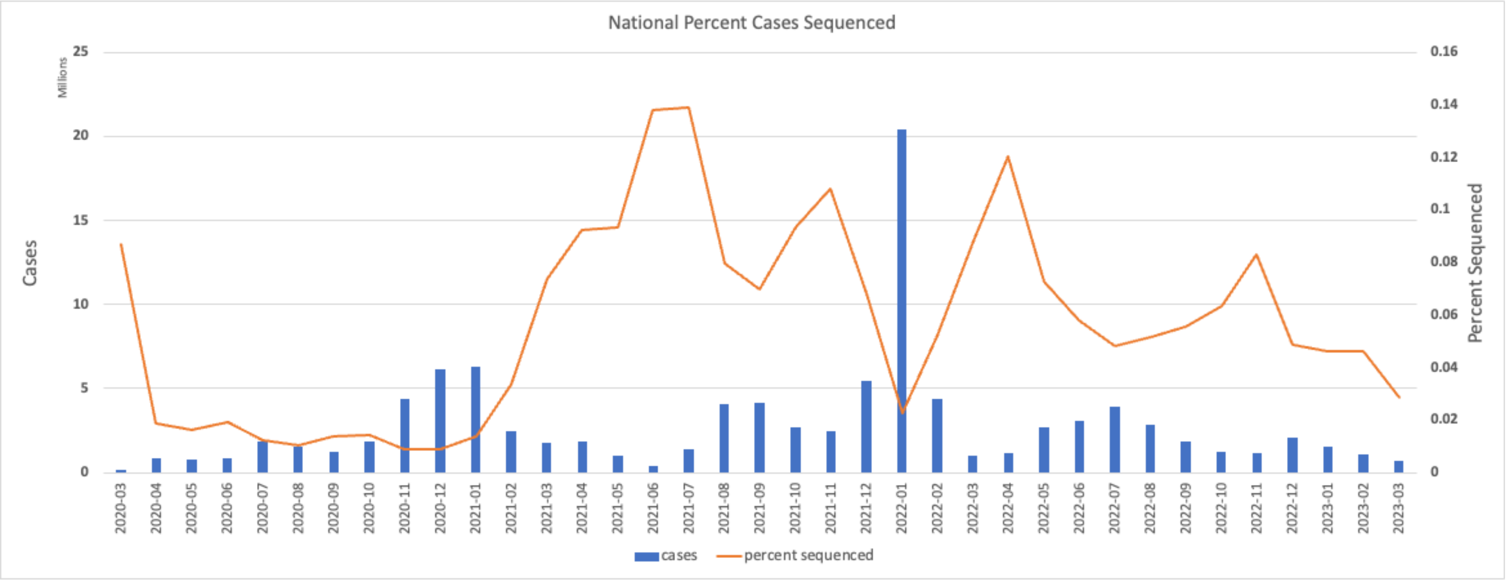
SARS-CoV2 Sequencing

Emerging variants have potential to continue to alter the future trajectories of pandemic and have implications for future control

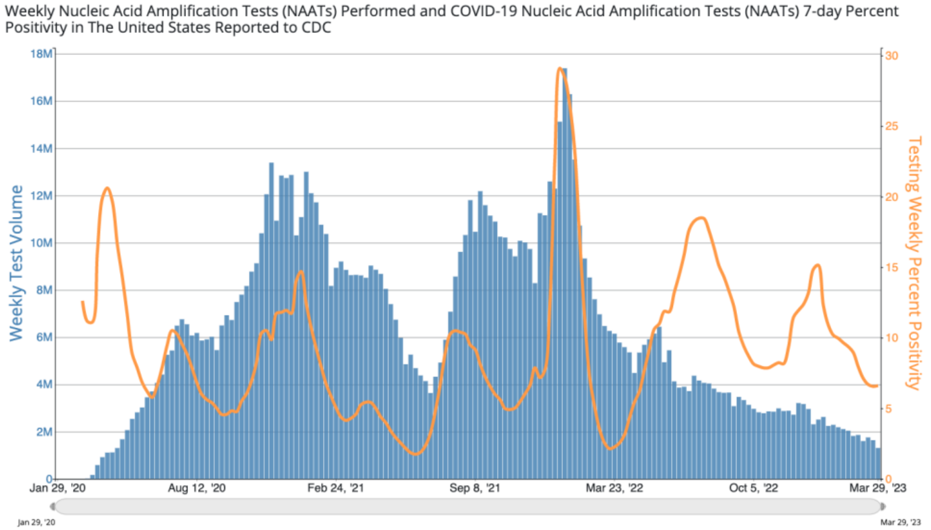
- Current proportion of cases being sequenced is on a downward trend nationally.
- Leveraging additional resources such as wastewater sequencing and adopting into existing infrastructure will be an important supplement



https://clades.nextstrain.org



United States



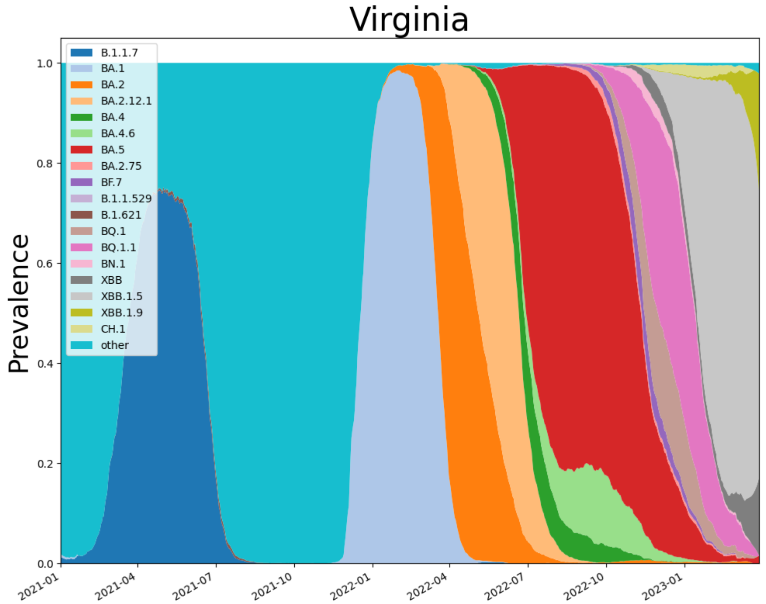
https://cov-spectrum.org/explore/United%20States/AllSamples/Past6M/sequencing-coverage

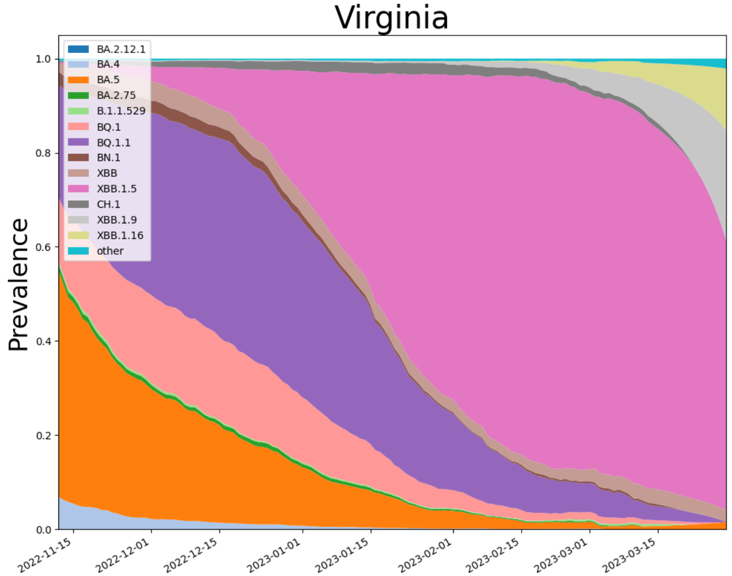
https://covid.cdc.gov/covid-data-tracker/#trends_7daytestresultsreported_7daytestingpositive_00

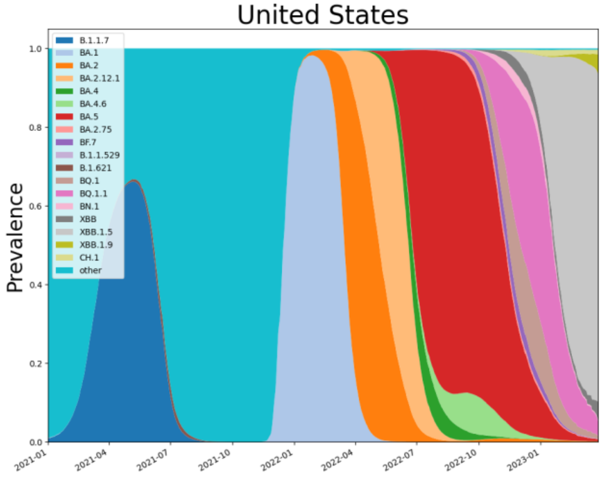
SARS-CoV2 Omicron Sub-Variants

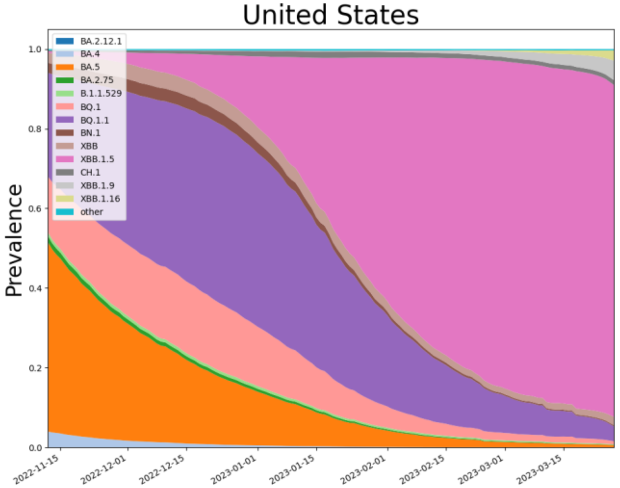
covSPECTRUM
Enabled by data from GISAID

As detected in whole Genomes in public repositories

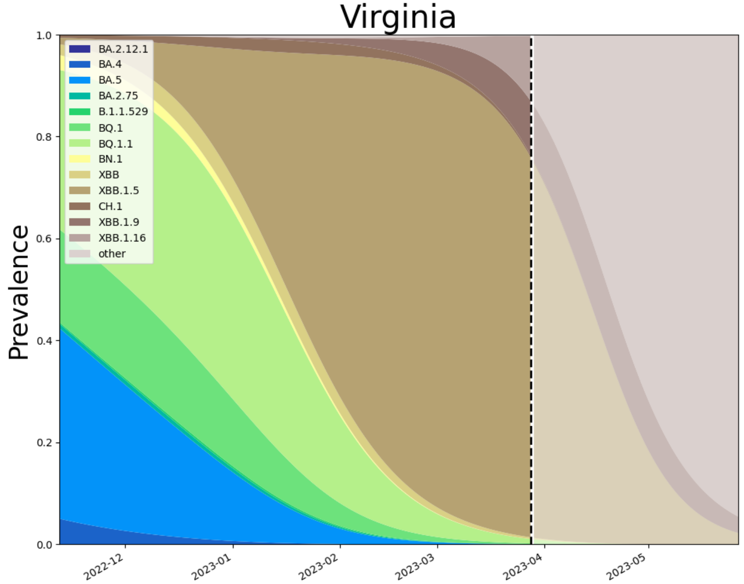


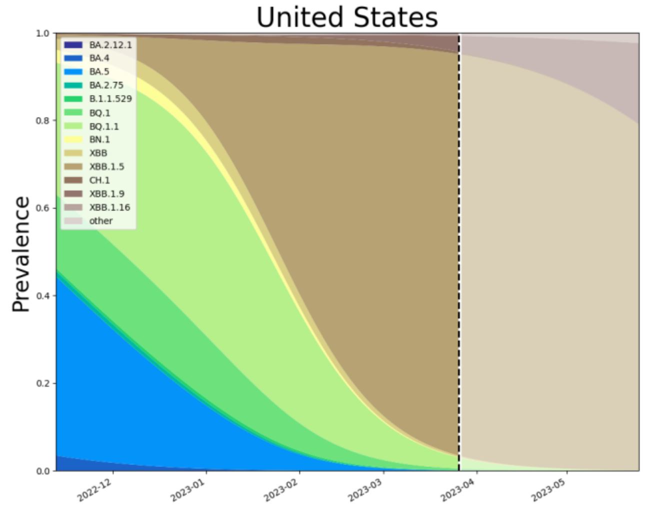






VoC Polynomial Fit Projections





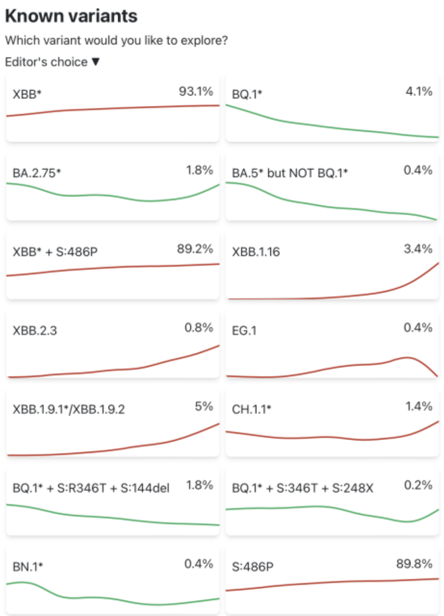
Note: Everything from dotted line forward is a projection.

SARS-CoV2 Omicron Sub-Variants

COV-spectrum

"Editor's choice"

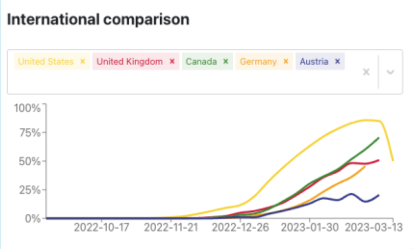
Variants to watch

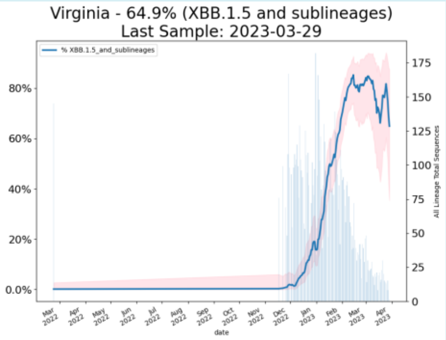


covSPECTRUM

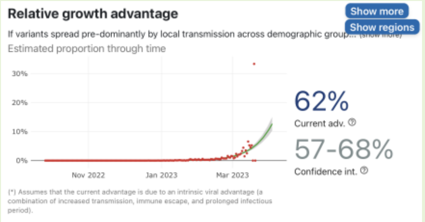
Enabled by data from GISAID

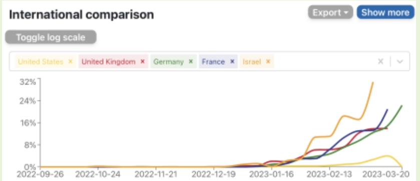
XBB.1.5

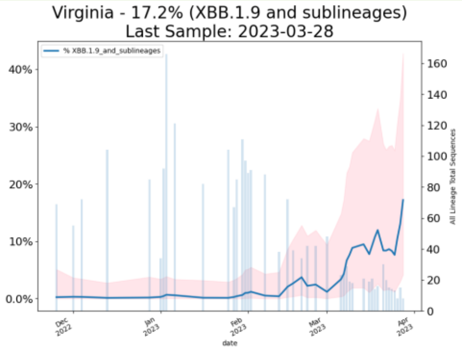




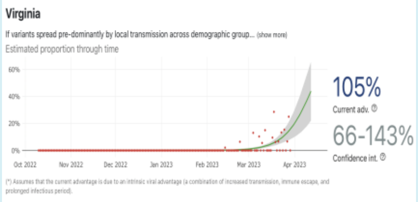
XBB.1.9*

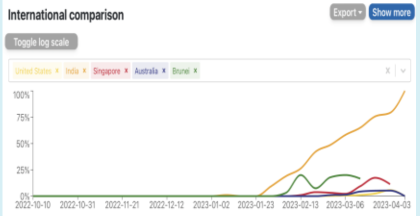


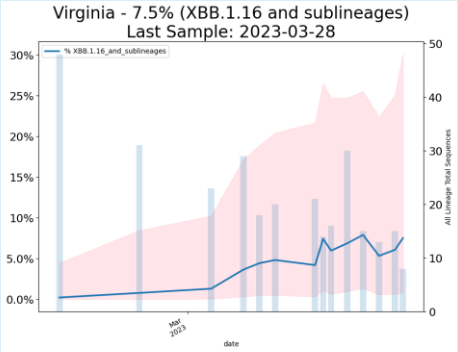




XBB.1.16*







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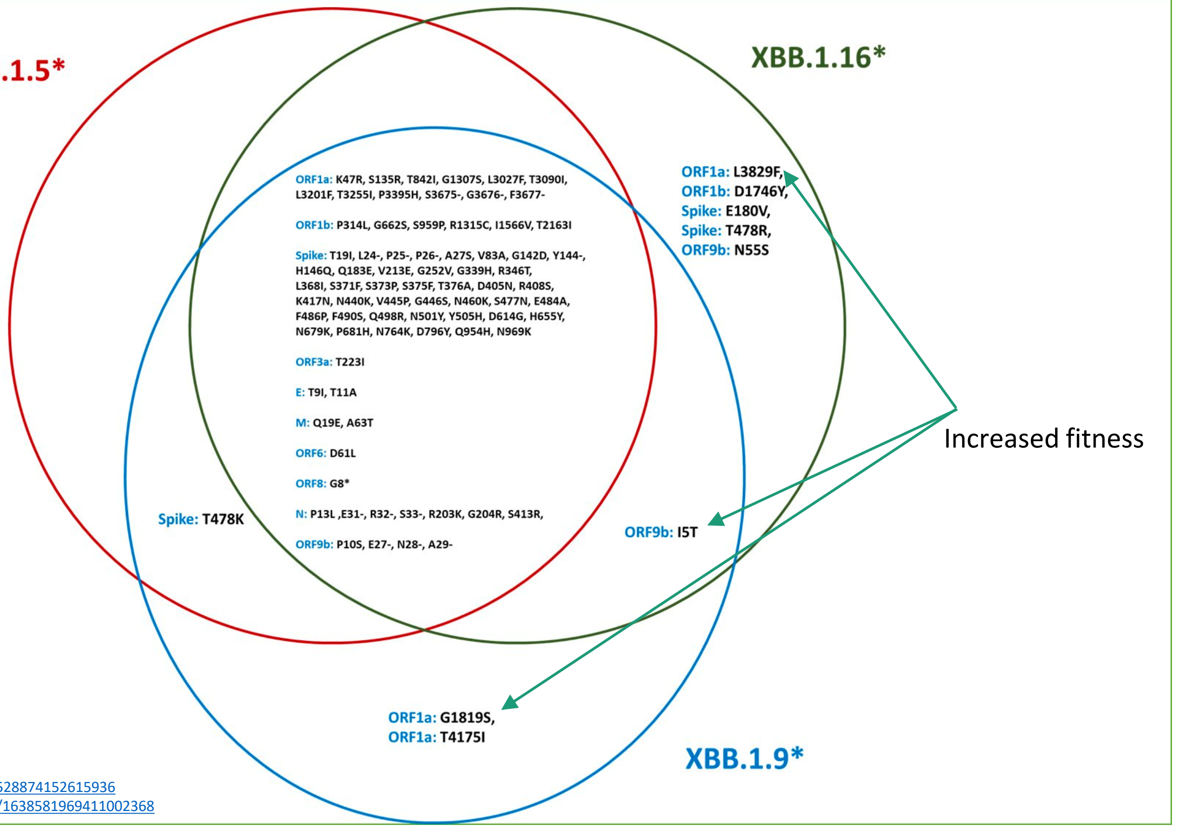
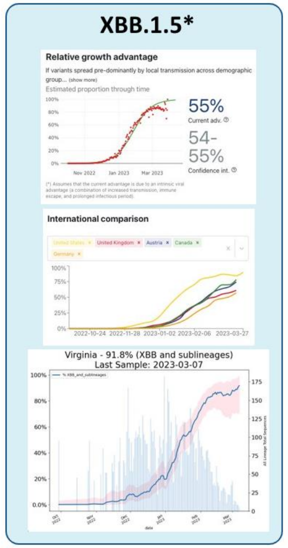
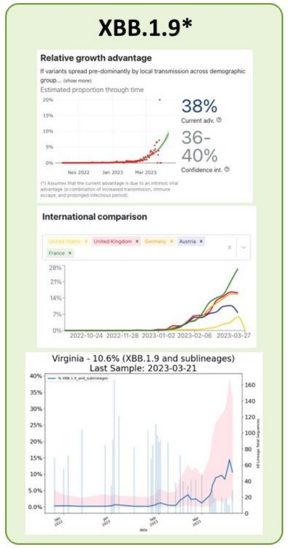
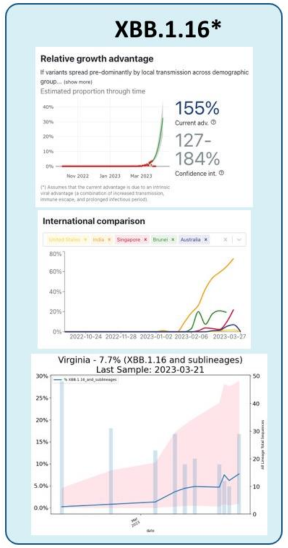
SARS-CoV2 Omicron Sub-Variants



https://twitter.com/RajlabN/status/1638528874152615936
https://twitter.com/SolidEvidence/status/1638581969411002368







covSPECTRUM

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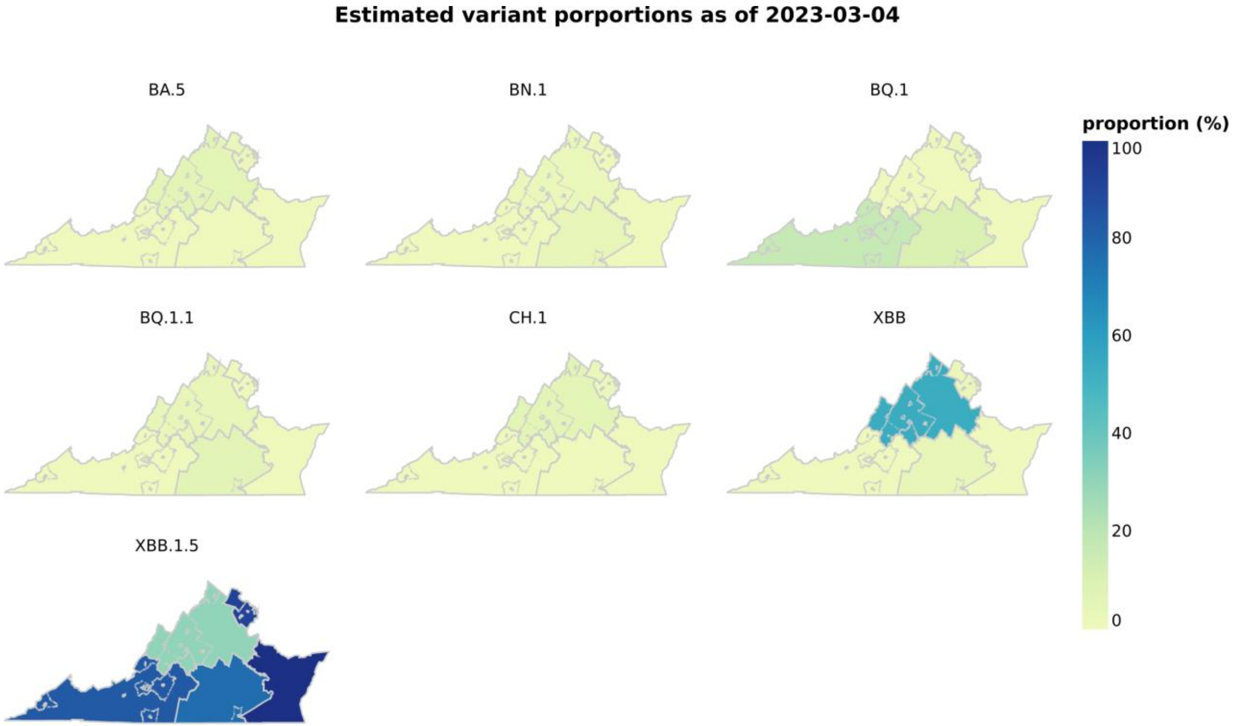
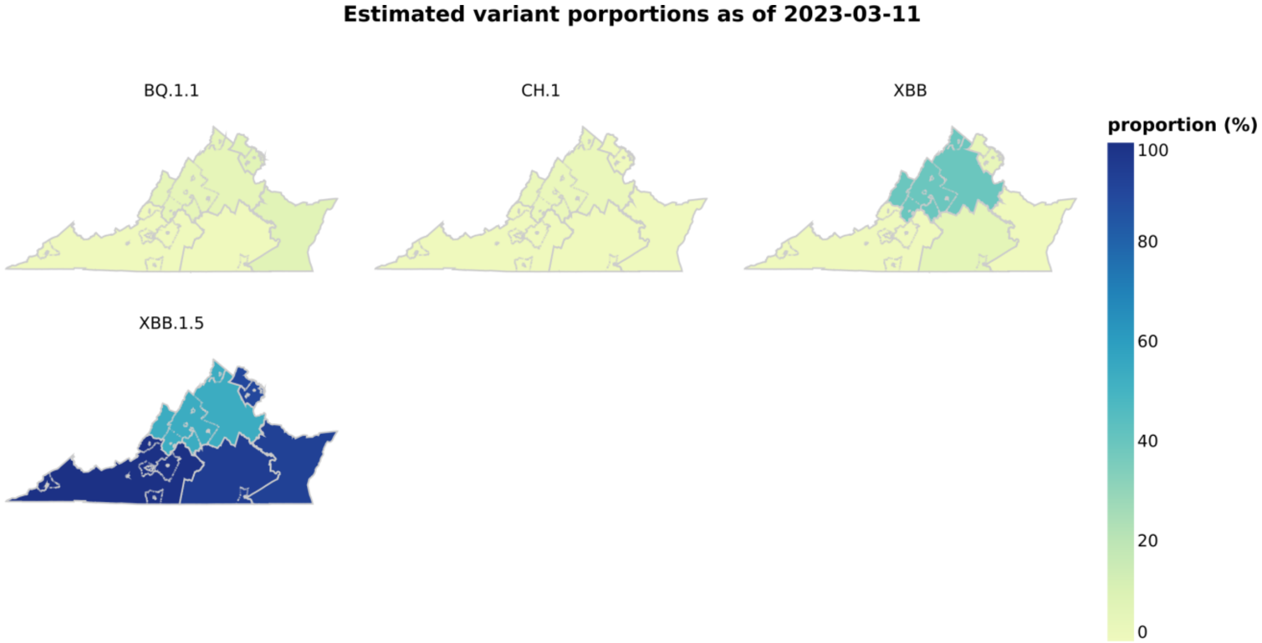
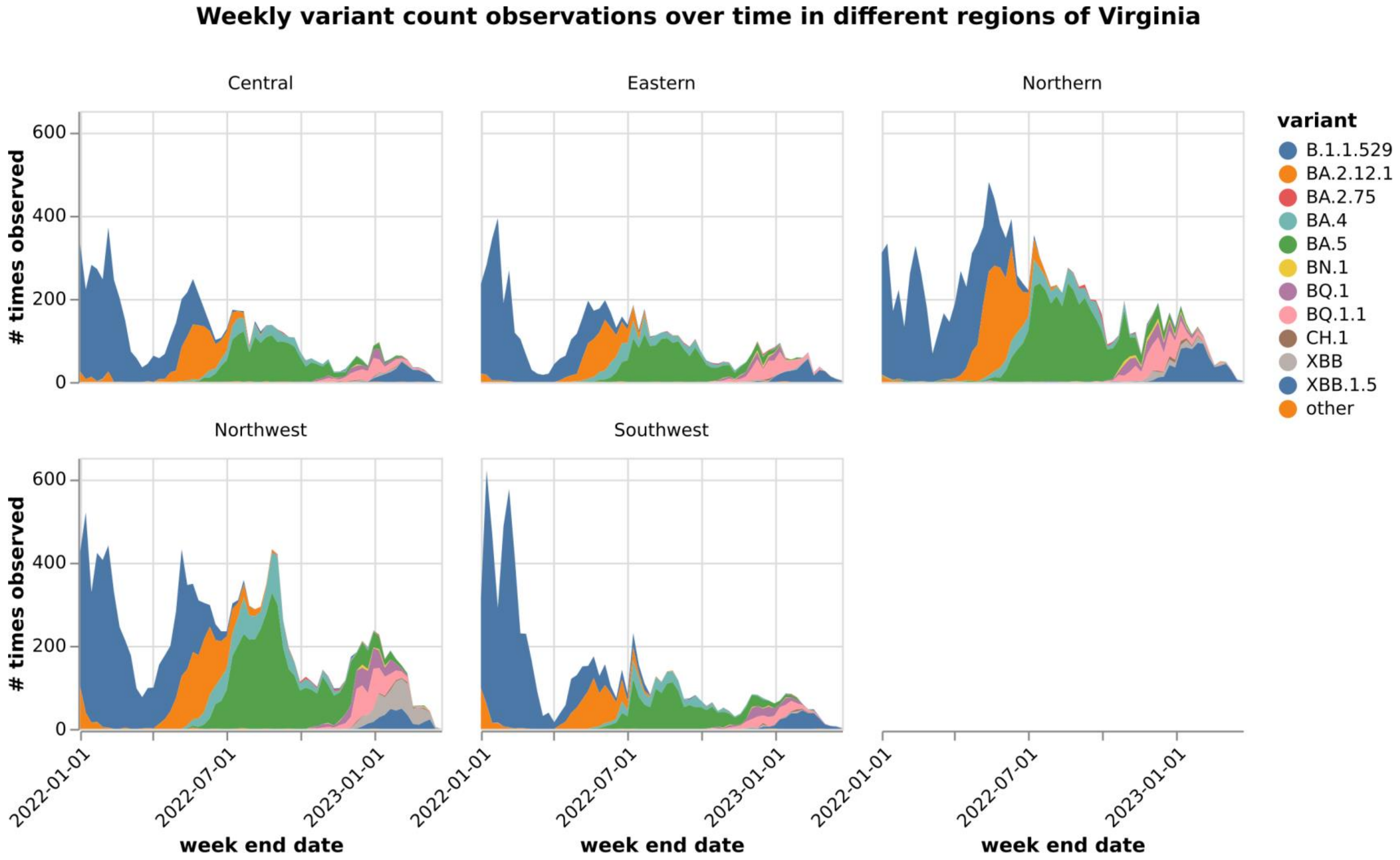
SARS-CoV2 Omicron Sub-Variants





SARS-CoV2 Omicron Sub-Variants



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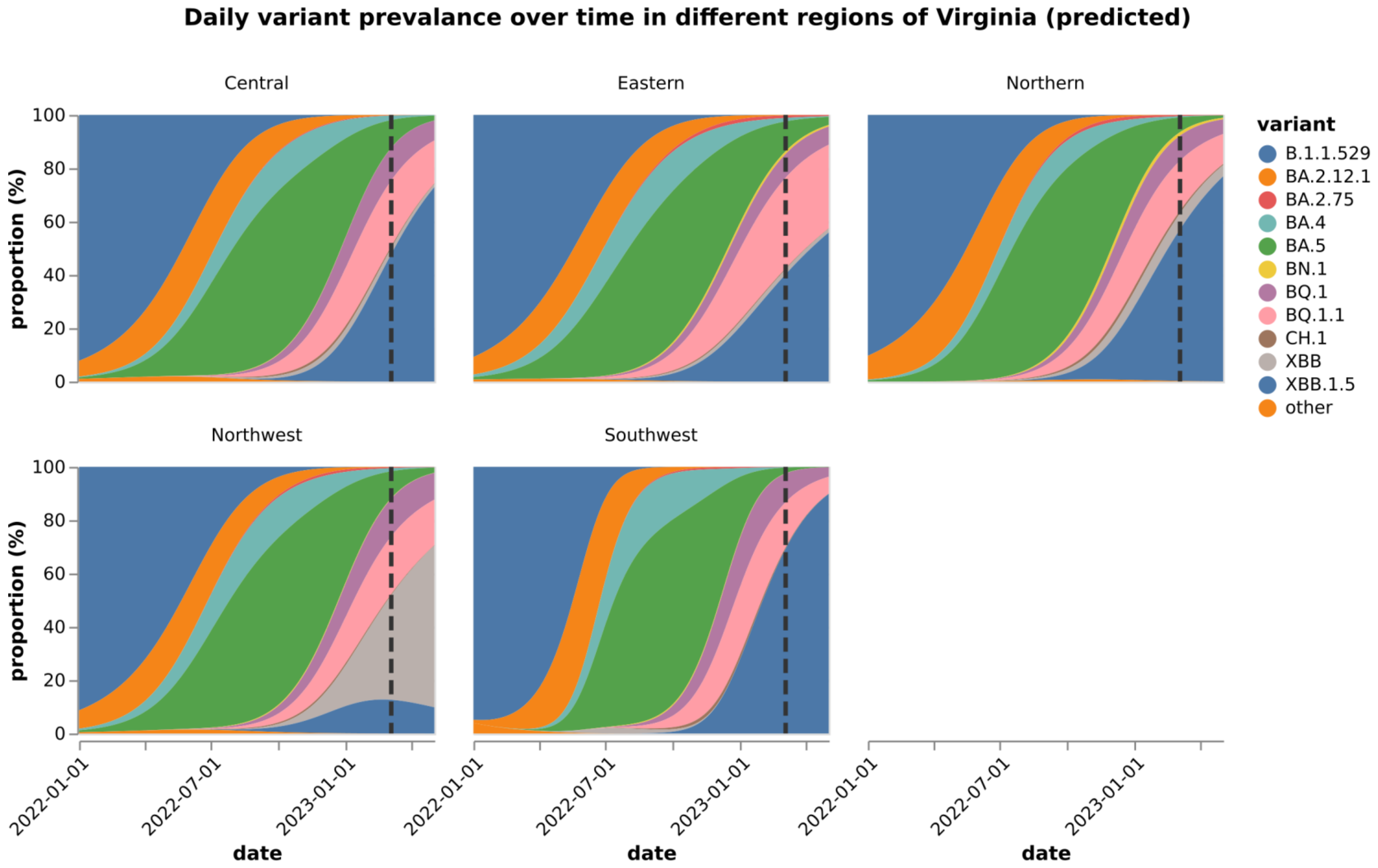
SARS-CoV2 Omicron Sub-Variants



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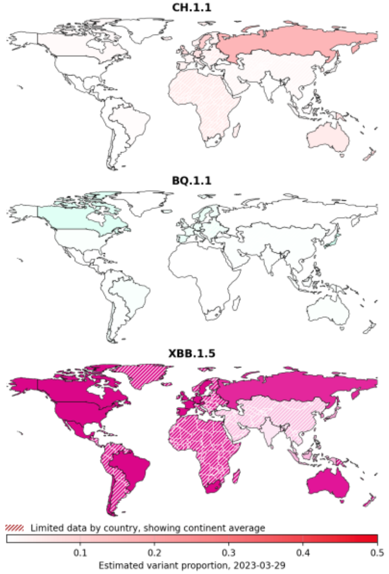
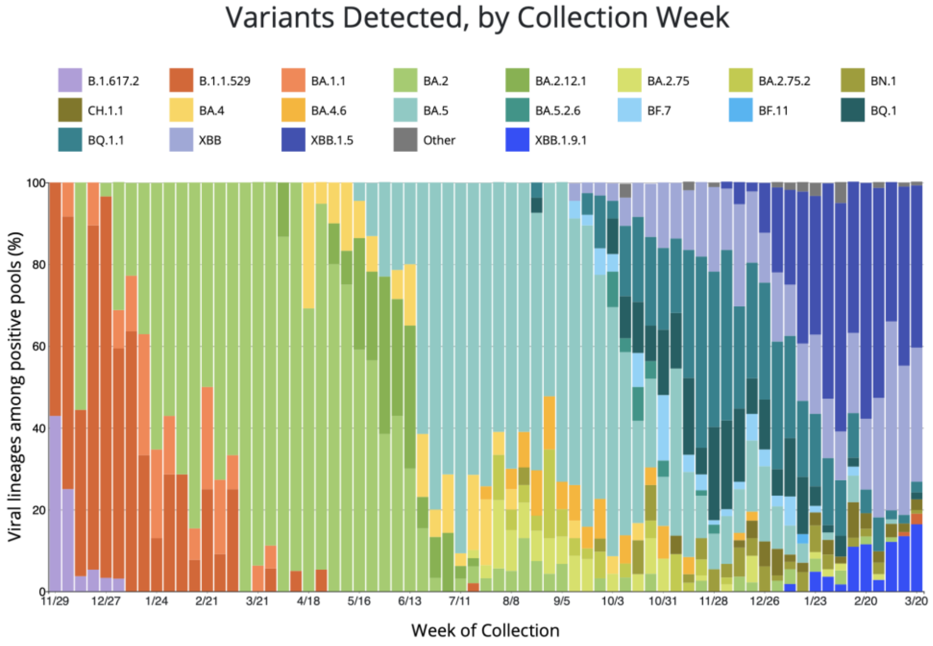
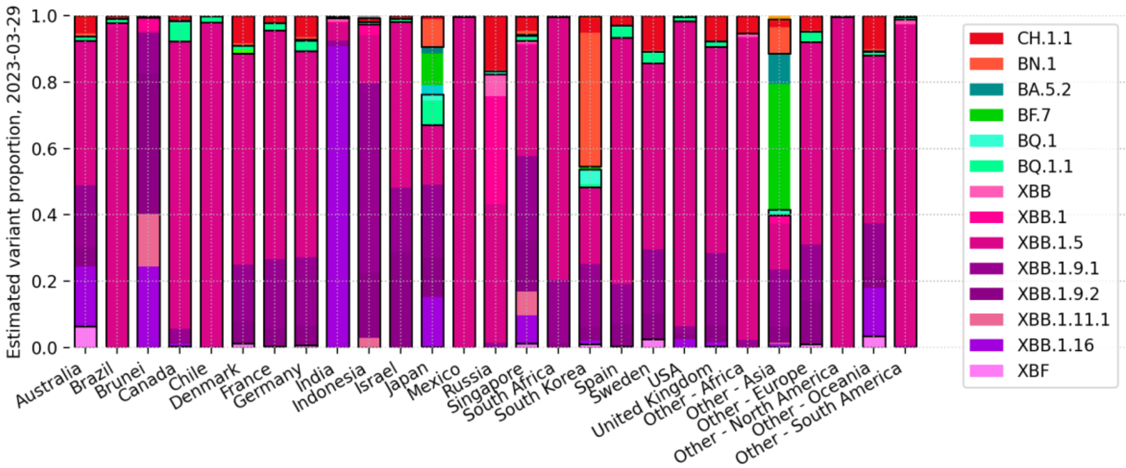
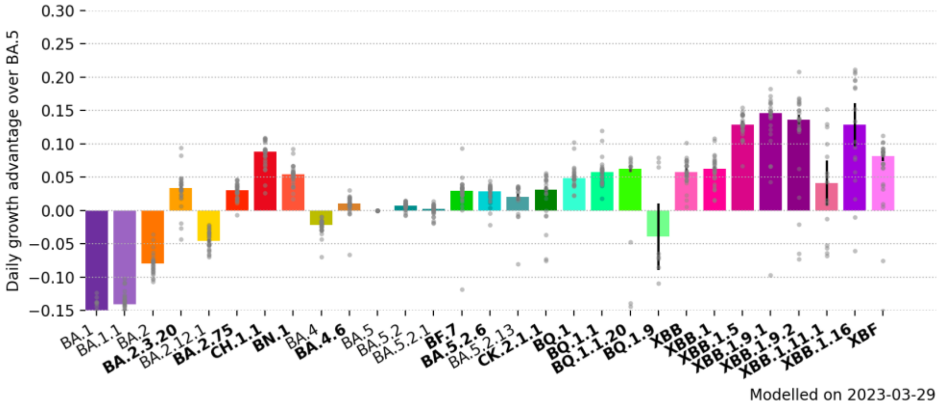
Global SARS-CoV2 Variant Status









https://covid.cdc.gov/covid-data-tracker/#traveler-genomic-surveillance
https://github.com/gerstung-lab/SARS-CoV-2-International (03/29/23)

Pandemic Pubs (April 05th, 2023)

1. Canadian national survey indicates that female sex, pre-existing comorbidities, more severe initial SARS-CoV-2 infection symptoms, obesity, identifying as a person with a disability, and being infected earlier in the COVID-19 pandemic were all associated with an increased risk of reporting longer-term symptoms, while having received more vaccine doses prior to infection was associated with a reduced risk of longer-term symptoms.

Figure 2: Percent of adults (aged 18+) self-reporting longer-term symptoms after a positive COVID-19 test or suspected infection by sociodemographics, Canada, January 2020 to August 2022

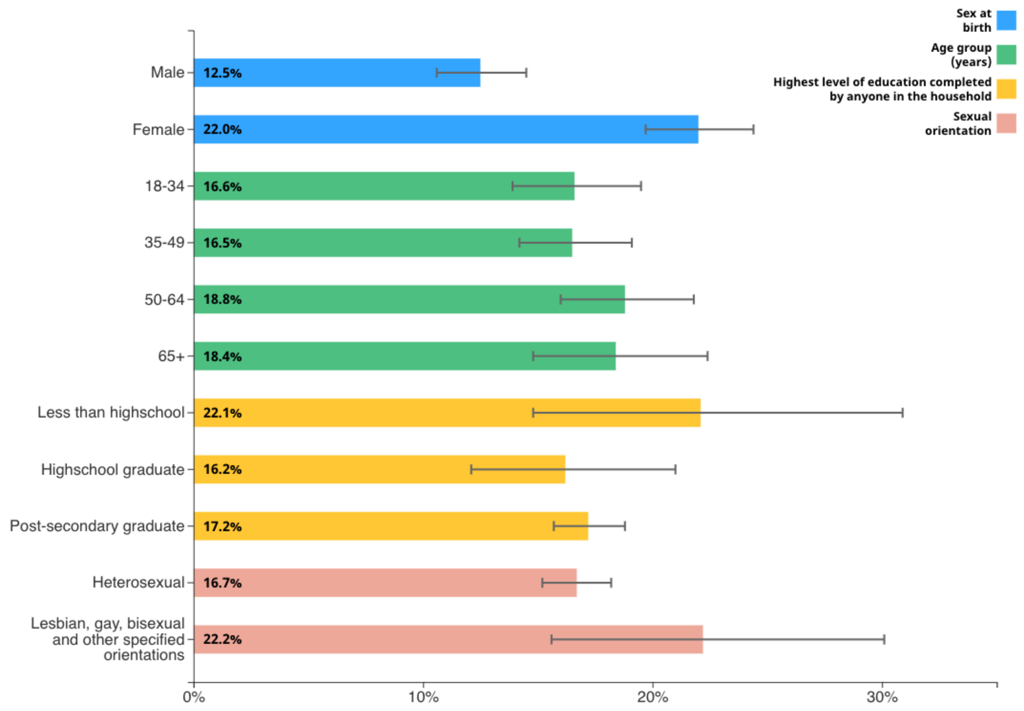


Figure 7: Percent of adults (aged 18+) self-reporting longer-term symptoms after a positive COVID-19 test or suspected infection by time period of infection, Canada, January 2020 to August 2022

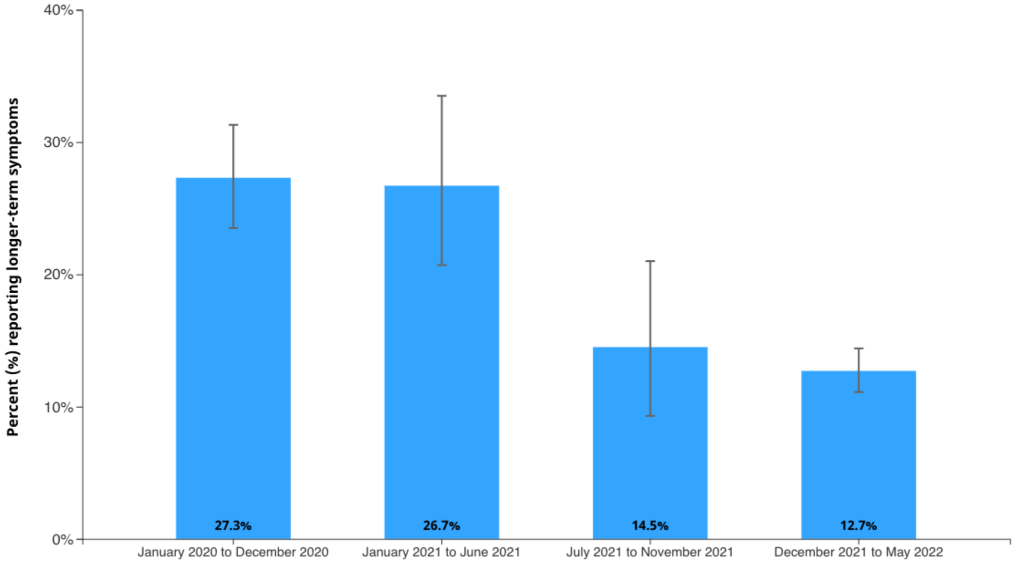
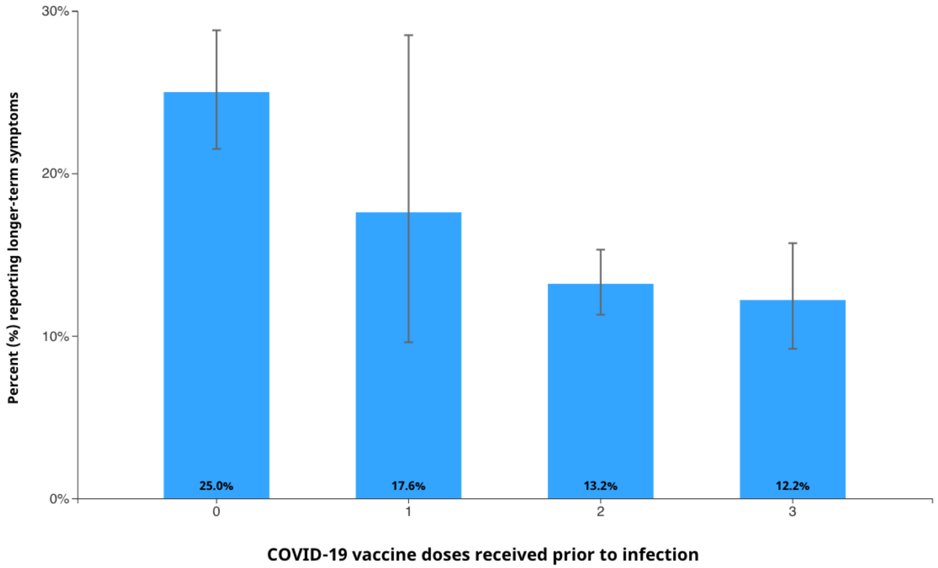


Figure 8: Percent of adults (aged 18+) self-reporting longer-term symptoms after a positive COVID-19 test or suspected infection by number of COVID-19 vaccine doses received prior to infection, Canada, January 2020 to August 2022

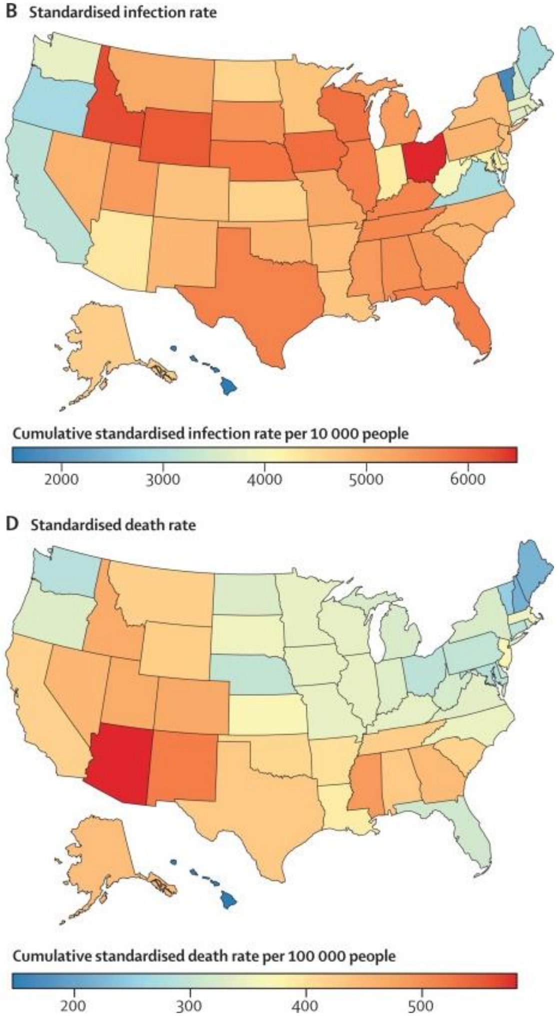


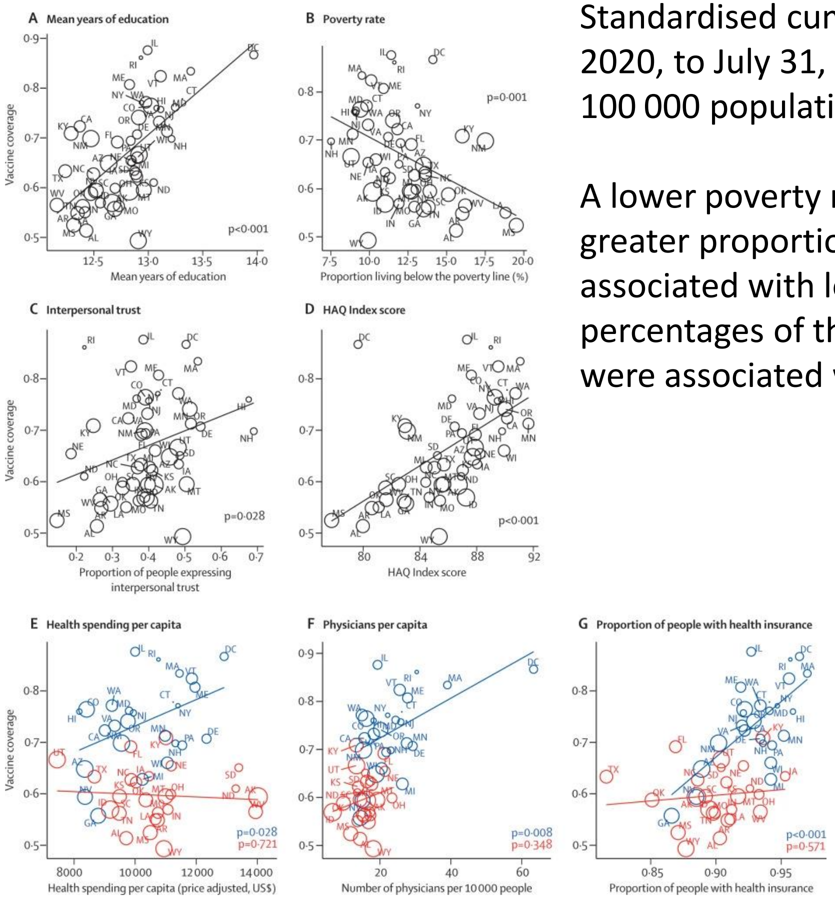
The Public Health Agency of Canada partnered with Statistics Canada to conduct the 2nd Canadian COVID-19 Antibody and Health Survey (CCAHS-2). The survey aimed to identify population subgroups disproportionately affected by longer-term symptoms and the risk and protective factors associated with experiencing longer-term symptoms. Respondents completed an electronic questionnaire between April 1, 2022 and August 31, 2022. Longer-term symptoms are defined as self-reported persistent, recurring, or new symptoms 3 or more months after a confirmed (via PCR or RAT) or suspected SARS-CoV-2 infection.

https://health-infobase.canada.ca/covid-19/post-covid-condition/spring-2023-report.html

Pandemic Pubs (March 30th , 2023)

1. A comprehensive assessment of factors associated with standardized infection, hospitalization, and death rates were performed, including healthcare, social, and political factors that vary by state. Virginia's standardized death rate was lower than the national average. Many other outcomes and factors were assessed. [Lancet]





Standardised cumulative COVID-19 death rates for the period from Jan 1, 2020, to July 31, 2022 varied across the USA (national rate 372 deaths per 100 000 population [95% uncertainty interval [UI] 364–379]),

A lower poverty rate, higher mean number of years of education, and a greater proportion of people expressing interpersonal trust were statistically associated with lower infection and death rates, and states where larger percentages of the population identify as Black (non-Hispanic) or Hispanic were associated with higher cumulative death rates.

Access to quality health care (measured by the IHME's Healthcare Access and Quality Index) was associated with fewer total COVID-19 deaths and SARS-CoV-2 infections, but higher public health spending and more public health personnel per capita were not, at the state level. The political affiliation of the state governor was not associated with lower SARS-CoV-2 infection or COVID-19 death rates, but worse COVID-19 outcomes were associated with the proportion of a state's voters who voted for the 2020 Republican presidential candidate. State governments' uses of protective mandates were associated with lower infection rates, as were mask use, lower mobility, and higher vaccination rate, while **vaccination rates were associated with lower death rates**. State GDP and student reading test scores were not associated with state COVD-19 policy responses, infection rates, or death rates.

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(23)00461-0/fulltext#

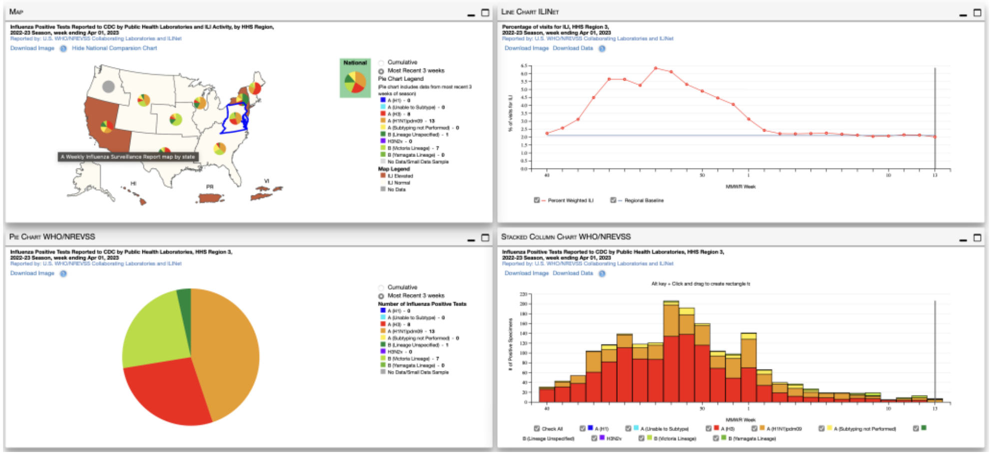
Influenza Update

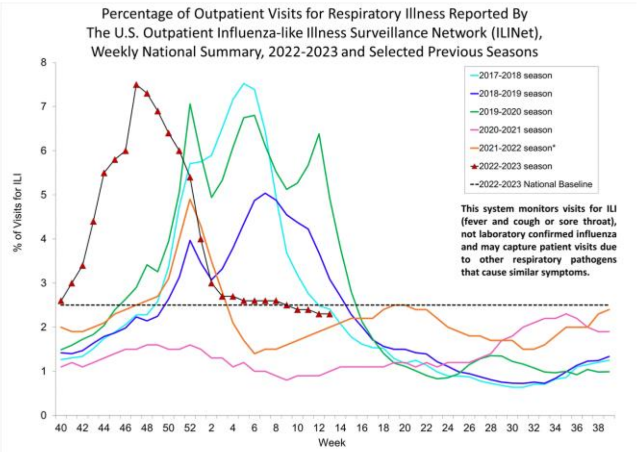
Current Influenza Situation – ILI Activity

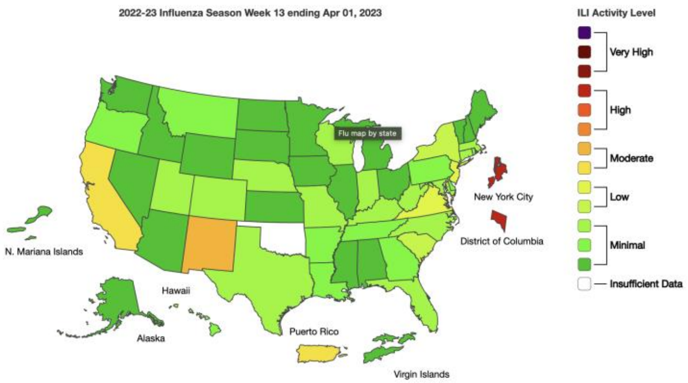
Influenza Activity remains below threshold

- Virginia remains at a ”Low” level as is most of the nation
- National ILI activity has also consistently declined since a peak in late November, and remains below threshold
- Most regions and the nation are now below the seasonal threshold for ILI activity, though a couple regions have ticked above threshold in recent weeks

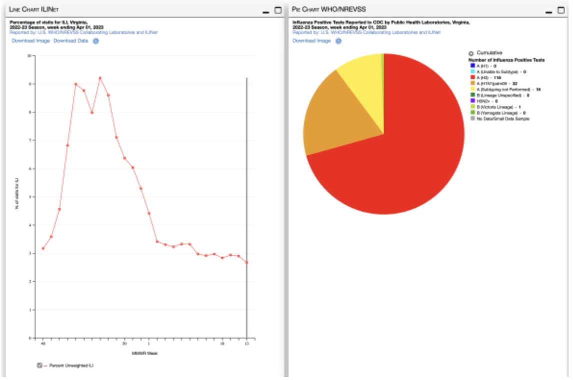
Region 3







Virginia



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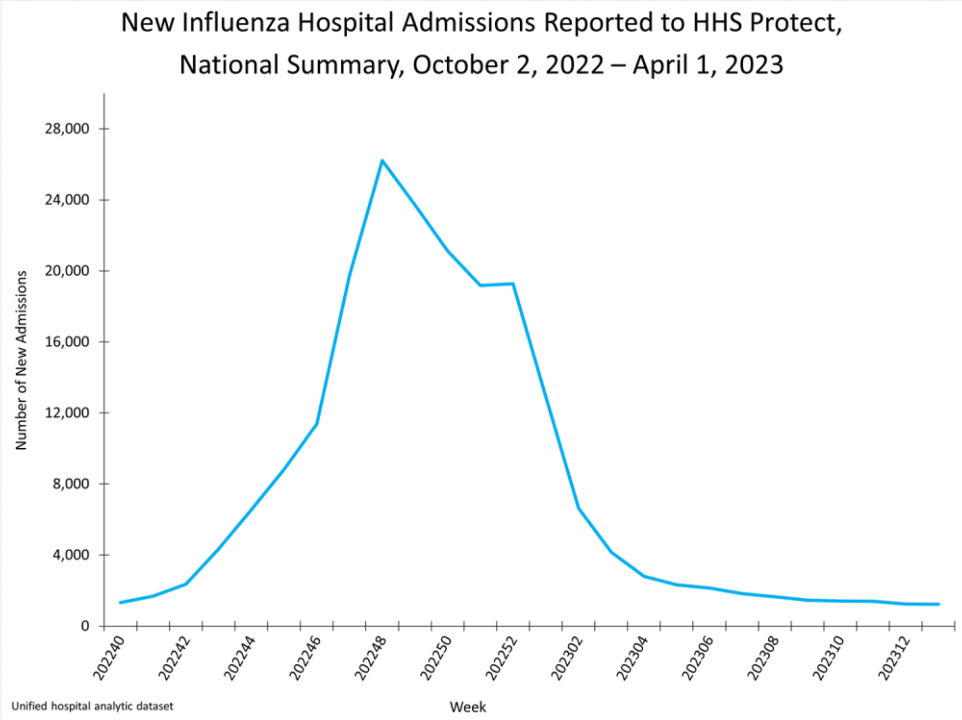
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

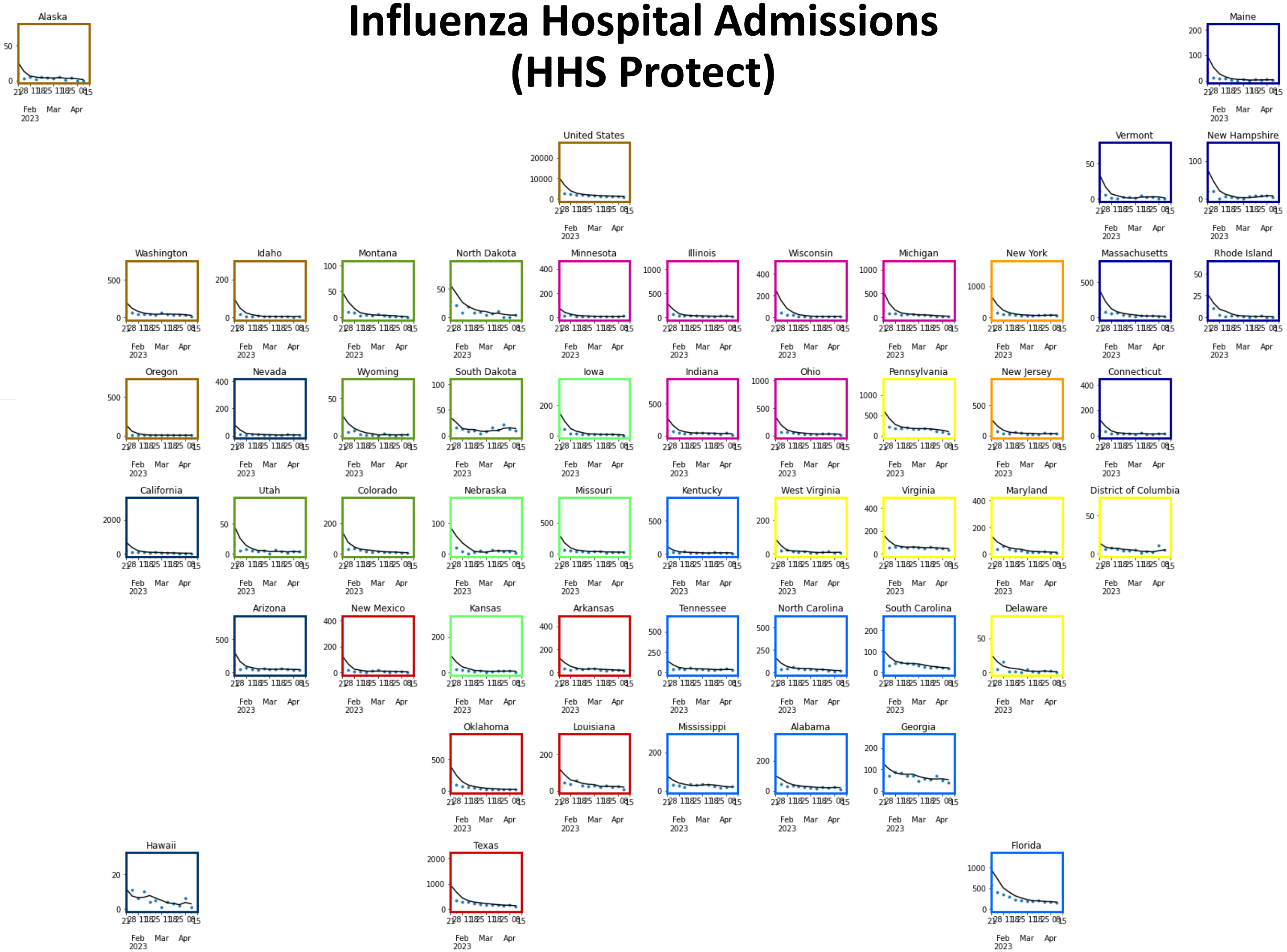
Current Influenza Situation - Hospitalizations

Influenza A hospitalizations continue decline

- National level of influenza hospitalizations have dropped to pre-season levels



Influenza Hospital Admissions (HHS Protect)



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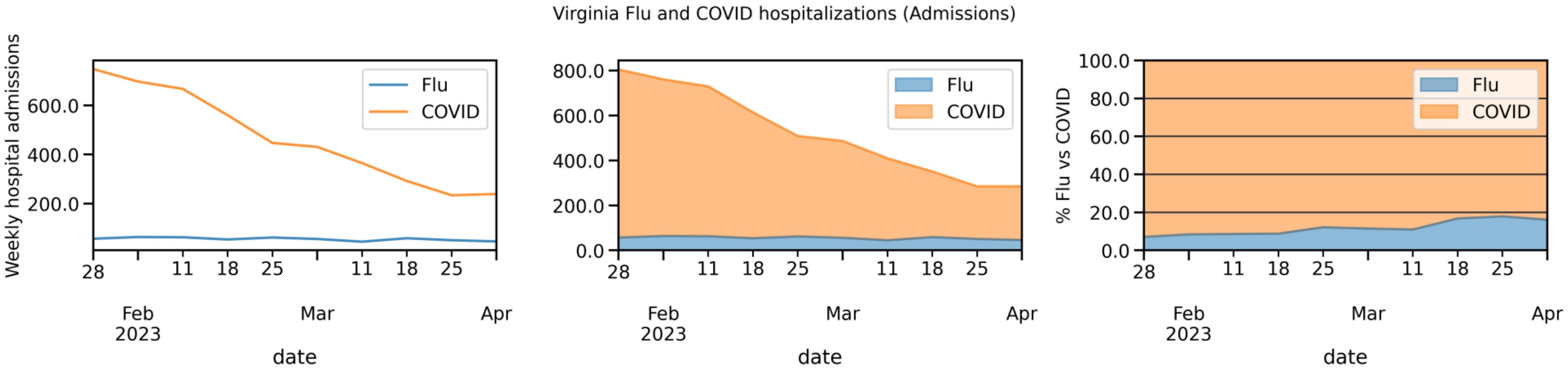
FLUVIEW
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

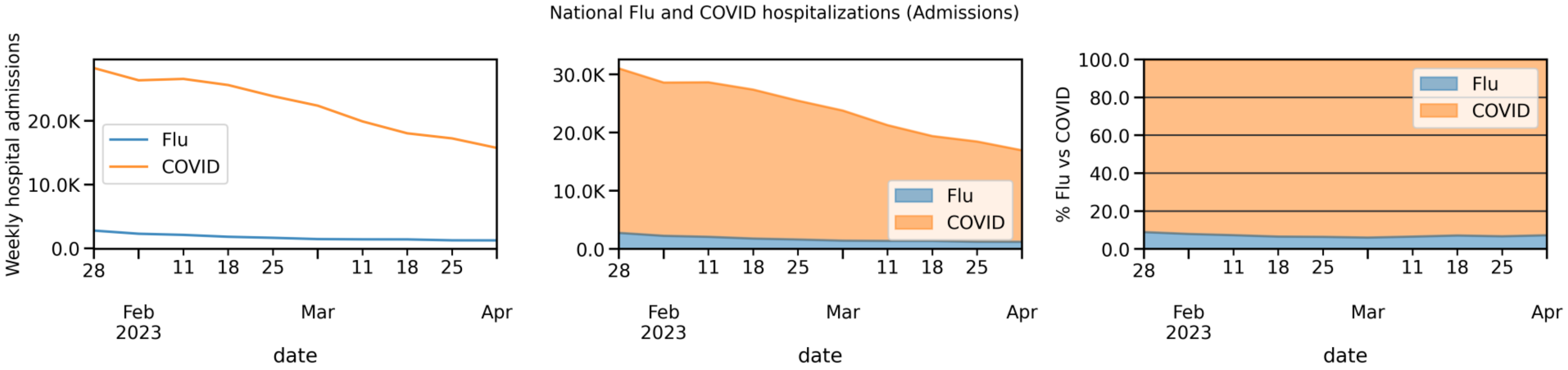
Current Combined Hospitalizations (COVID-19 & Influenza)

COVID-19 and Influenza Weekly Hospitalizations (HHS Protect)

Virginia



USA

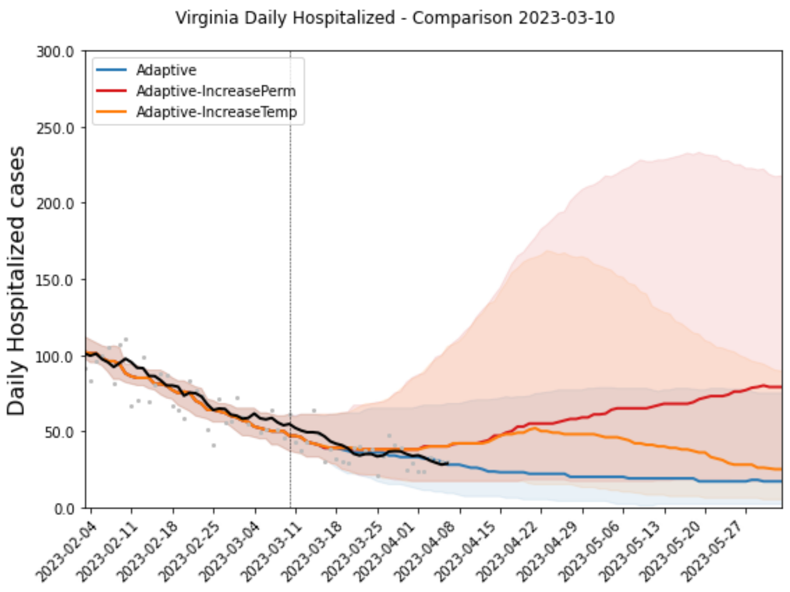


Model Results

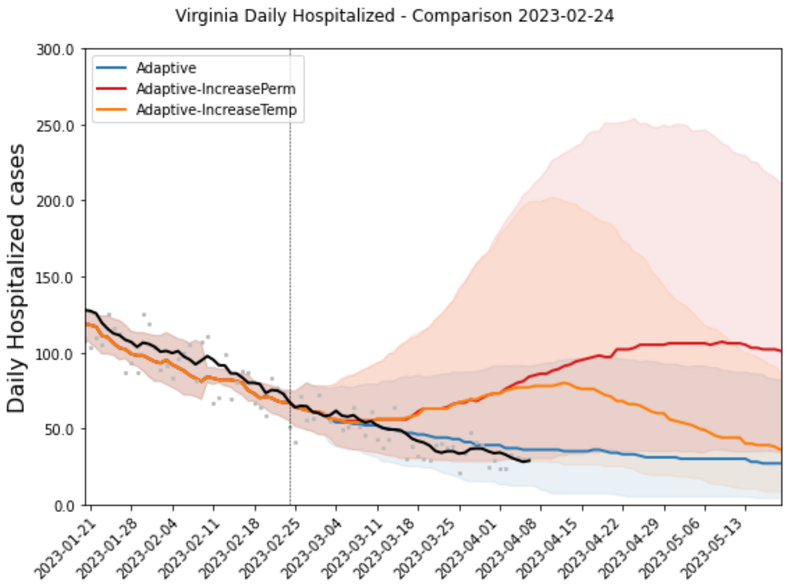
Previous projections comparison - Hospitalizations

- Previous projections have tracked observed hospitalizations well
- Past 8 weeks have stayed steady and indicate no increases in transmissions

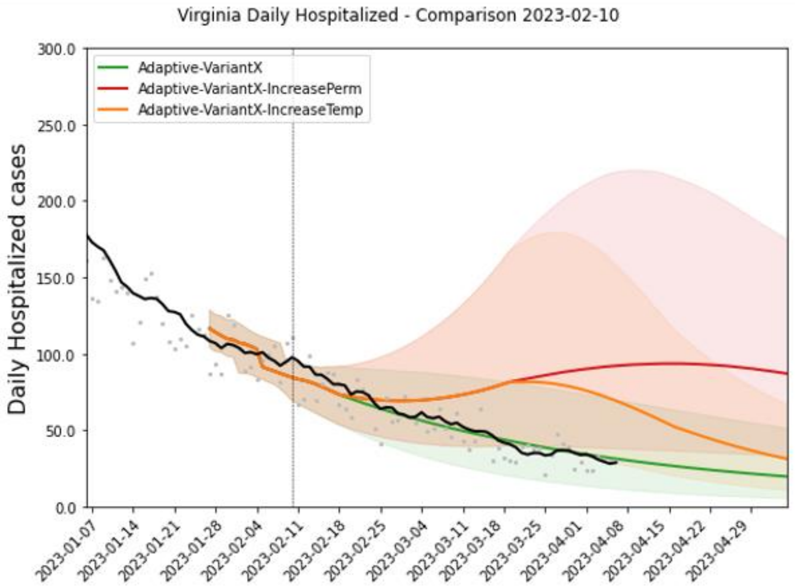
Previous round – 4 weeks ago



Previous round – 6 weeks ago



Previous round – 8 weeks ago



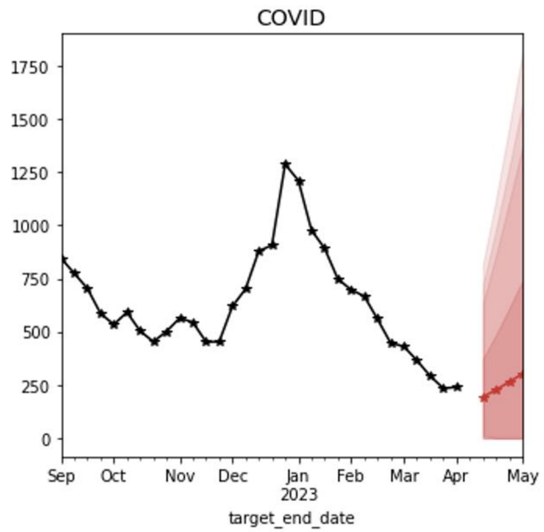
National Modeling Hub Updates

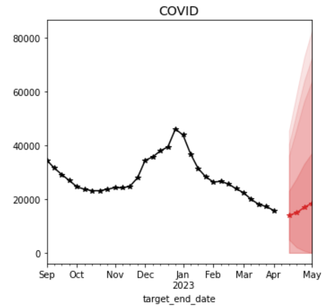
Current COVID-19 Hospitalization Forecast

Statistical models for submitting to CDC FluSight forecasting challenge

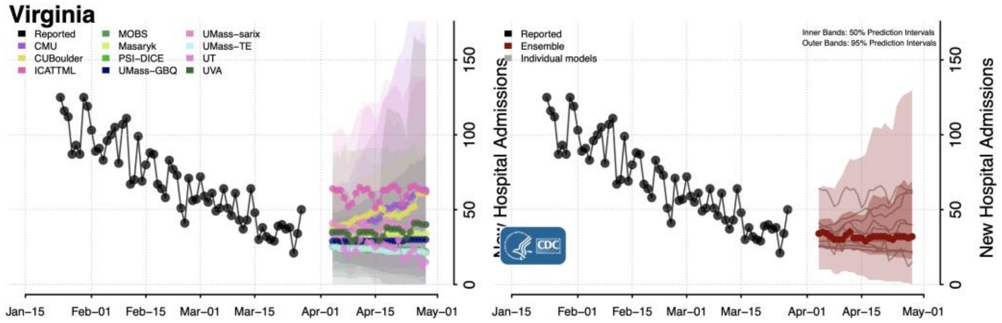
- Uses a variety of statistical and ML approaches to forecast weekly hospital admissions for the next 4 weeks for all states in the US

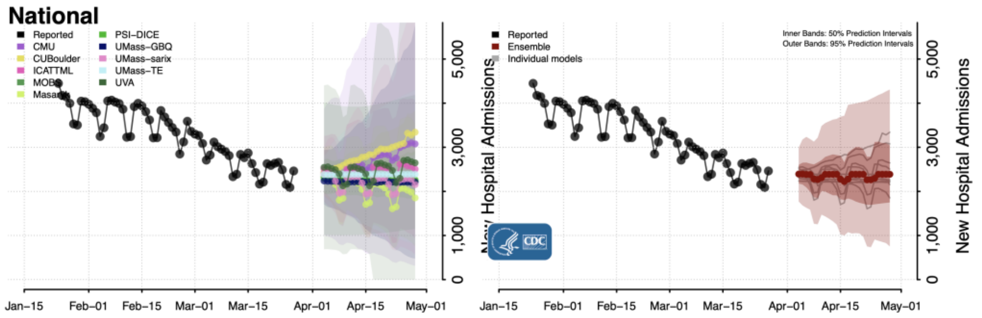
Hospital Admissions for COVID-19 and Forecast for next 4 weeks (UVA ensemble)





Hospital Admissions for COVID-19 and Forecast for next 4 weeks (CDC COVID Ensemble)





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[CDC COVID Forecast]

Combined ILI and COVID-19 Hospitalizations

Ensemble methodology that combines the Adaptive with machine learning and statistical models such as:

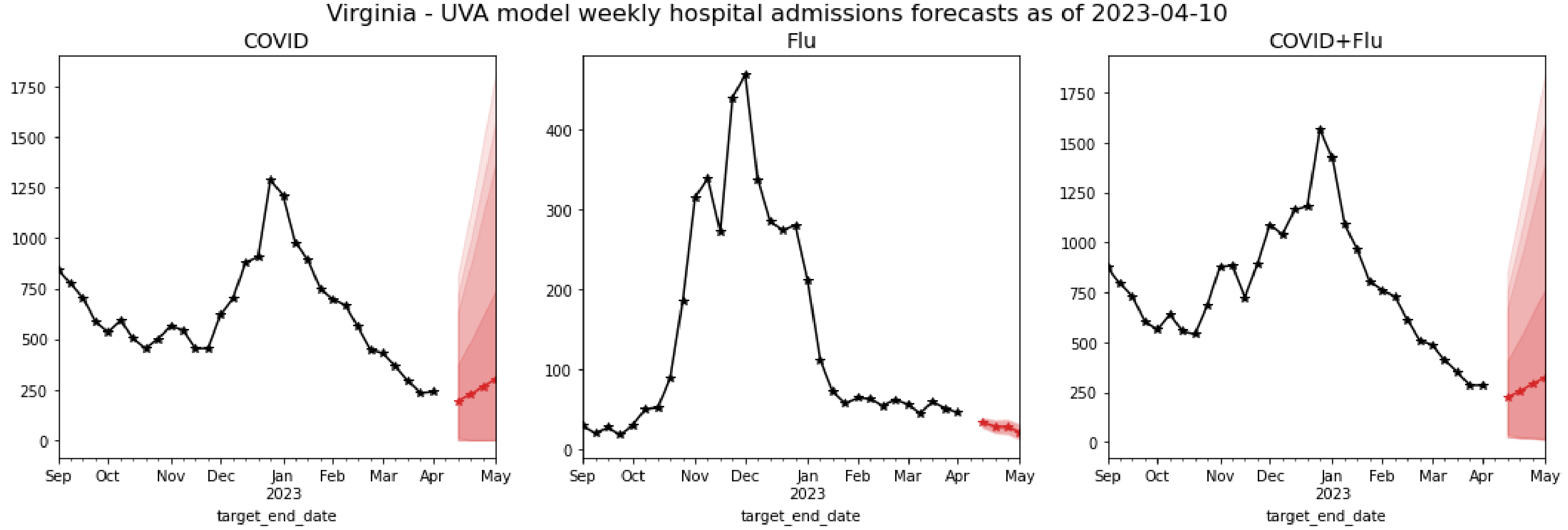
- Autoregressive (AR, ARIMA) , Neural networks (LSTM), Kalman filtering (EnKF), G-model (phase), Holt-Winters

Weekly forecasts of hospitalizations done at state level.

Models chosen because of their track record in disease forecasting and to increase diversity and robustness.

Both are regularly submitted to CDC Forecast Hubs

Weekly Hospitalizations
Short-term COVID-19 and Influenza Forecasts



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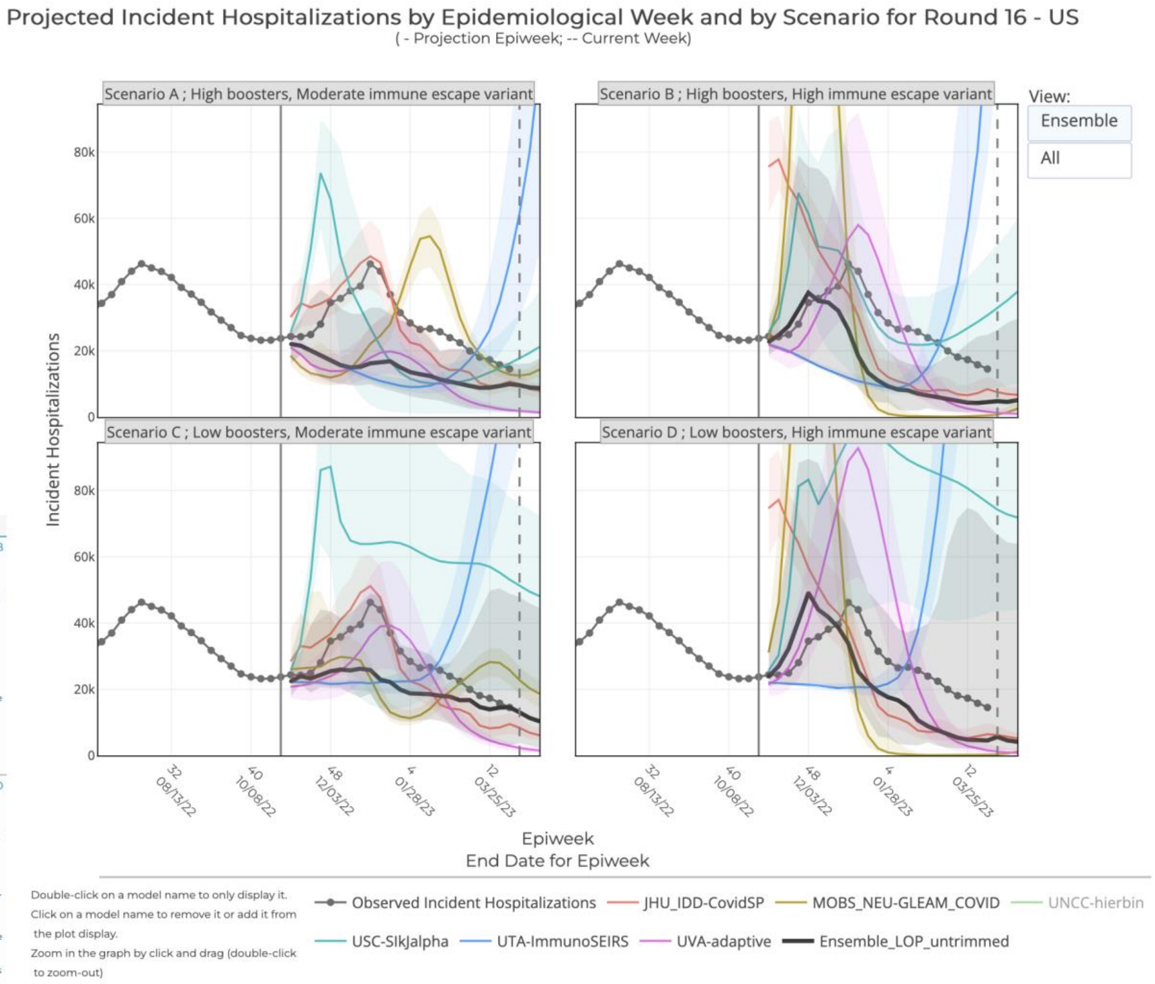
Scenario Modeling Hub – COVID-19 (Round 16)

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

- Round 16 results published
- Moderate escape scenarios tracking best
- Round 17 is underway, prelim results in coming weeks

https://covid19scenariomodelinghub.org/viz.html



	"Level 5" Variants	"Level 6/7" Variants
Accelerating uptake levels of reformulated boosters	Scenario A "Level 5" Variants - Variants have a 25% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 5 variants at the start of the projection period - No change in severity given symptomatic infection Accelerating uptake levels of reformulated boosters, with coverage plateauing at 90% of flu vaccination levels by February 1st, 2023 - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2022 plateau	Scenario B "Level 6/7" Variants - Variants have a 50% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 6 and 7 variants at the start of the projection period - No change in severity given symptomatic infection Accelerating uptake levels of reformulated boosters, with coverage plateauing at 90% of flu vaccination levels by February 1st, 2023 - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Teams should assume increasing uptake through October and November as necessary to reach the projected February 1st, 2022 plateau
Current uptake levels of reformulated boosters	Scenario C "Level 5" Variants - Variants have a 25% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 5 variants at the start of the projection period - No change in severity given symptomatic infection Current uptake levels of reformulated boosters, with coverage plateauing at booster 1 levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Based on current rates, plateau date is flexible as long as it occurs before the end of the simulation (Teams can adjust rates up if needed to achieve adequate coverage by target date)	Scenario D "Level 6/7" Variants - Variants have a 50% immune escape from BA.5.2 - Seeding based on combined observed prevalence of Level 6 and 7 variants at the start of the projection period - No change in severity given symptomatic infection Current uptake levels of reformulated boosters, with coverage plateauing at booster 1 levels by the end of the simulation - Teams are free to use available data and information from current and previous rollouts as tehy see fit to define rates - Based on current rates, plateau date is flexible as long as it occurs before the end of the simulation (Teams can adjust rates up if needed to achieve adequate coverage by target date)

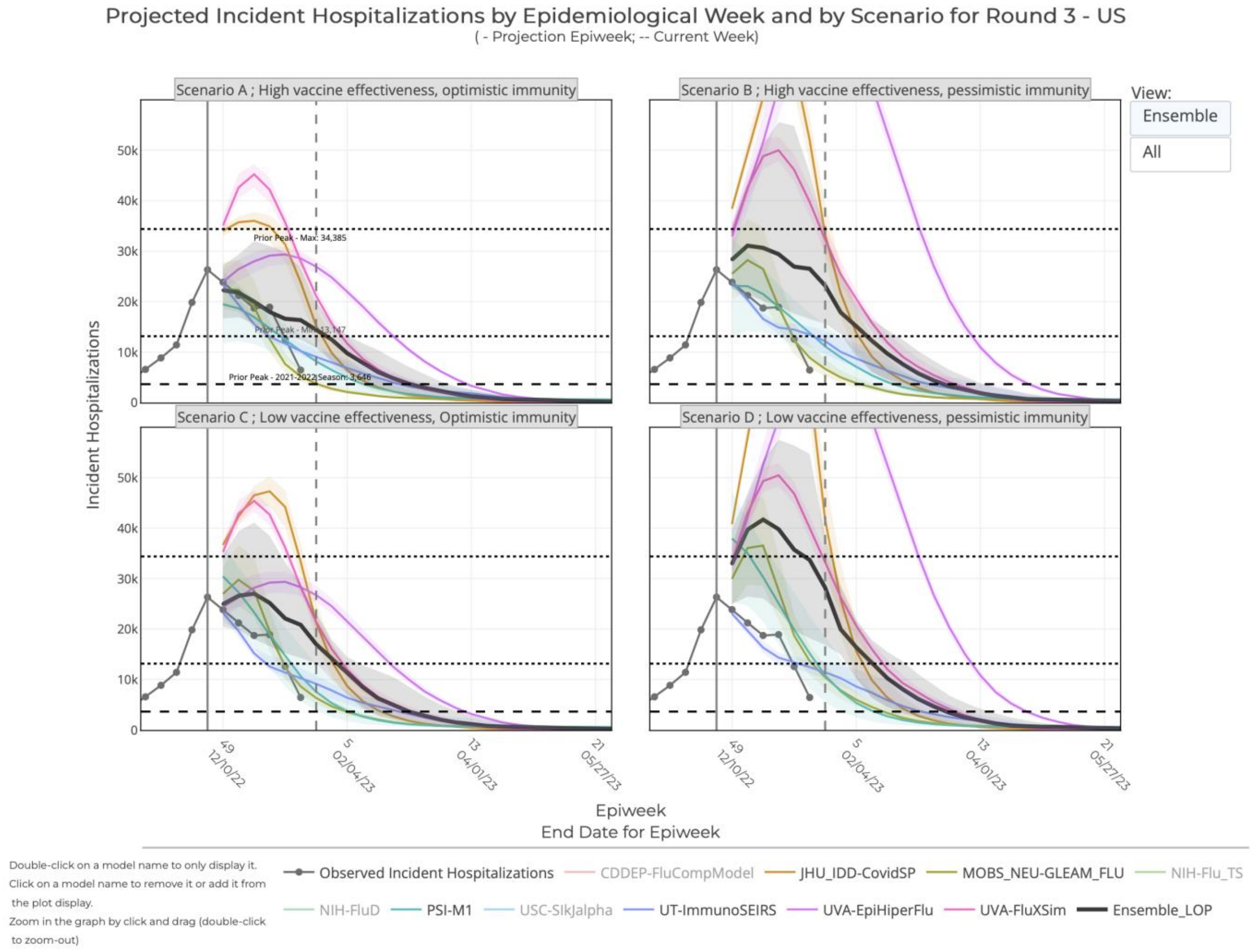
Scenario Modeling Hub – Influenza (Round 3)

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

- All rounds so far have explored the combination of a prior immunity axis and a vaccine effectiveness axis
- Round 2 and 3 are identical in design (Round 3 cutoff December 3rd)

	Optimistic flu prior immunity	Pessimistic flu prior immunity
High Vaccine Effectiveness	Scenario A Optimistic flu prior immunity - No impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - Same amount of prior immunity as in a typical, pre-COVID19 pandemic prior season. High Vaccine Effectiveness - VE = 50% against medically attended influenza illnesses and hospitalizations (comparable to 2015-16 season).	Scenario B Pessimistic flu prior immunity - Substantial impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - 50% lower immunity than a typical, pre-COVID19 pandemic season. High Vaccine Effectiveness - VE = 50% against medically attended influenza illnesses and hospitalizations (comparable to 2015-16 season).
Low Vaccine Effectiveness	Scenario C Optimistic flu prior immunity - No impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - Same amount of prior immunity as in a typical, pre-COVID19 pandemic prior season. Low Vaccine Effectiveness - VE = 30% against medically attended influenza illnesses and hospitalizations (comparable to 2018-19 season).	Scenario D Pessimistic flu prior immunity - Substantial impact of missed flu seasons due to the COVID-19 pandemic on prior immunity.* - 50% lower immunity than a typical, pre-COVID19 pandemic season. Low Vaccination Protection - VE = 30% against medically attended influenza illnesses and hospitalizations (comparable to 2018-19 season).

https://fluscenariomodelinghub.org/viz.html



Key Takeaways

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

- Case rates and hospitalizations from COVID-19 continue declines but rate has slowed and have seemingly entered a plateau
  - Hospital occupancy down to levels last seen in early May of 2022
- Nearly all indicators point to this trend continuing in near term
- Influenza hospitalizations remain very low and ILI activity remains below seasonal threshold

Model Updates

- Projected Trajectories from previous rounds remain on target, no new projections made this round

Questions?

Biocomplexity COVID-19 Response Team

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